Course Libraries 2020/21

Courses A – C

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 04/05/2020

1. What is the course?

Course information

Course Title	Advanced Chemical Engineering
Course code	MSACGFTC, MSACGPTC, PDACGFTC, PDACGPTC, PCACGFTC, PCACGPTC
Academic Year	2020/21
Valid entry routes	PgCert, PgDip, MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield
School(s)	School of Water, Energy & Environment
Theme	Energy & Power
Centre	Centre for Climate and Environmental Protection
Course Director	Dr Ali Nabavi
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	No
Is the Degree apprenticeship integrated or non-integrated?	No
Is the Mastership offered as an open and/or closed course?	No

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full-time MSc - one year, part-time MSc - up to three years Full-time PgDip – one year, part-time PgDip – up to two years Full-time PgCert – one year, part-time PgCert – up to two years
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by Centre for Climate and Environmental Protection where the research interests include:

- Energy Markets & Policy, Future Energy System
- Biofuels Processes & Technologies
- Thermodynamics in Bio-process Systems
- Biomass and Energy Conversion Technology
- Process and Energy Systems Design, Simulation and Optimisation
- Downstream process: Product Separation and Product Recovery
- Process Control
- Environmental Protection & Management
- Bioprocess Engineering

Cranfield University interacts with the following institutions and in the following ways:

- Seek support from industry for students to have professional experiences through group project.
- Seek industrial support for sponsoring MSc Thesis projects.
- Associated industrial advisory committee. The industrial advisory committee will meet on a yearly basis to help in steering the course content.
- Develop double degree relationships with European academic institutions.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

The course has recently been approved for accreditation by the Energy Institute.

2. What are the aims of the course?

Cranfield University offers this course in order to provide engineering and applied science graduates with an advanced understanding and practical experience of the methodologies employed in chemical engineering research and chemical process technology.

The general Chemical Engineering route will equip students with diversified skills in advanced engineering, which includes theoretical and practical elements in operation, design, and control of a wide range of

chemical processes. The Biorefining route will equip students with fundamental understanding of chemical engineering and solid skills to address the challenges of the rapidly growing and dynamic bioenergy sector.

The aim of the course is to prepare engineering and applied science graduates to meet the increasing demand in industry, consultancies, and the education and public sectors for engineers, scientists and advisors with expertise in a range of areas including production of chemicals, petrochemicals, biochemicals, conventional energy and bioenergy, food, and materials.

This programme is intended for the following range of students:

- Graduates with engineering or related applied science degrees keen to pursue a career as chemical engineering professionals.
- Graduates currently in employment keen to extend their qualifications or to pursue a career change.
- Applicants are required to have at least a UK 2nd class honours degree or its equivalent.
- Applications from candidates with lesser qualifications but with considerable relevant working experience will be considered.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Advance Chemical Engineering

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Holistically apply advanced theory and practice of chemical production processes.

ILO 2. Combine and compare appropriate techniques and tools for the operation, design, evaluation, simulation, control and optimisation of a range of chemical processes.

Specific ILO for the General route:

ILO 3. Critically evaluate technologies and strategies for the generation and application of heat and power across a number of chemical processes and energy systems scenarios.

Specific ILO for the Biorefining route:

ILO 4. Critically evaluate and assess the current and future biorefining technologies for the sustainable production of bioenergy and biofuels based on the type of biomass used as feedstock and the targeted products.

B. Postgraduate Diploma in Advanced Chemical Engineering

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Integrate knowledge and understanding of business operation, and commercial, marketing and finance aspects in a context relevant to chemical and energy industries.

ILO 6. Integrate knowledge, understanding and skills from the taught modules in a real-life Situation.

ILO7. Effectively work in a small project team to identify project objectives and select appropriate methodologies to address problems faced by industrial clients; collaborating with other team members to communicate findings in a professional manner in written, oral and visual forms.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 9. To communicate their findings successfully via a thesis, written in an approved School style and in an oral presentation.

4. How is the course taught?

The teaching methods include:

- Combination of online and in class structured lectures, tutorial sessions, computer-based workshops, lab-based practices and private study;
- Personal Development Planning is explicitly and implicitly developed during the course, including topics such as communication, time-management, team work, learning strategies and project management;
- Seminars delivered by invited industrial or academic experts in some areas covered by the course;
- Visits to industrial sites;
- Knowledge and understanding are further developed and enhanced through the assignments associated with some of the taught modules, the group project activity, and the final MSc individual research project;
- Timely and informative feedback on the assignments are an essential part of the learning process.

In addition to the teaching methods outlined above, students will be supported in their learning and personal development by:

- A dedicated electronic Blackboard site
- One-day workshop in MATLAB training
- 3-day laboratory training short course for students undertaking MSc research projects which involve experimental work
- Arrangement of attendance of relevant modules offered by other MSc programmes

The taught programme is generally delivered from October to December and from January to February. The eight modules are divided into 5 core modules and 3 applied modules. Each module is allocated two weeks on the timetable and will be delivered flexible during this time, using a combination of online and face to face interactions. The five core modules will be assessed by either an exam or an assignment. The applied modules build on and apply the material taught in the core modules and utilise more interactive teaching methods, such as workshops and practicals. The applied modules are assessed by assignment submitted at the end of the two weeks.

The group project/ is taken between February and May. Each group will typically include 3-6 students and two academic supervisors will be assigned to each group.

Group Project teams are expected to hold a minimum of 5 team meetings during the project which must be minuted and all participants must sign off the minutes. The academic supervisor will attend at least two of these meetings to record attendance, to assess individual contribution, and to provide guidance as appropriate. Students undertaking the group project are required to participate in these 5 meetings. Additionally, it is expected that students will meet and work on the project outside of the formal weekly meetings. A (student) project co-ordinator will be responsible to ensure that these meetings are used to good effect, and that appropriate minutes are taken and findings reported to the academic supervisor. Part-time (and full-time) students are encouraged to use tele-conferencing, video-conferencing and web-conferencing facilities to participate in the group project review meeting i.e. they are not always required to attend in person. This will afford students with the experience of working within a disperse project team. However, all students will be required to attend in person the initial and final project review meetings. Facilities for telephone and web-conferencing already exist in several of the available meeting rooms in

Building 52 and are routinely used for research project meetings as well as MSc group project meetings within the School. Facilities for video-conferencing also exist in Building 83.

Part time students have the option of completing a Dissertation as an alternative to the Group Project. Students opting for the Part-Time Dissertation will be assigned a supervisor by the Course Director and will agree with the supervisor an appropriate topic of study. This may be related to a workplace/industrial activity that is relevant to the student's work environment. The Dissertation will include a comprehensive literature review of classical and contemporary related material and also a discussion and properly argued conclusions. Where appropriate the Dissertation will acknowledge the work and contribution of others. The Dissertation module will be assessed in a similar way to the group project by presentation and formal report.

The individual research project is typically pursued between May and September. Each student is allocated an academic supervisor who will guide and assess the students work. Again, it is expected that a formal weekly review meeting will occur at which the student will provide a brief presentation on the work performed to date and record minutes and arising actions.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
GENERAL ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Computational Fluid Dynamics for Industrial Processes	10
Separation and Purification Design	10
Sustainability and Environmental Assessment	10
GENERAL ROUTE - ELECTIVE MODULES:	
2 modules chosen from:	
Thermal Systems Operation and Design	10
Process Design Simulation	10
Pilot Plant Operations	10
TOTAL:	60

Description	Credits
BIOREFINING ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Biofuels and Biorefining	10
Sustainability and Environmental Assessment	10
Computation Fluid Dynamics for Industrial Processes	10
BIOREFINING ROUTE - ELECTIVE MODULES:	
2 modules chosen from:	

Energy from Biomass and Waste: Thermochemical Processes	10
Process Design Simulation	10
Bioprocess Engineering	10
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	**Credits**
GENERAL ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Separation and Purification Design	10
Computational Fluid Dynamics for Industrial Processes	10
Sustainability and Environmental Assessment	10
Management for Technology	10
Thermal Systems Operation and Design	10
Process Design and Simulation	10
Pilot Plant Operations	10
Full-time students:	
Group Project	40
GENERAL ROUTE - ELECTIVE MODULES:	
Part-time student to choose one:	(40)
Group Project	40
Dissertation	40
TOTAL:	120

Description	**Credits**
BIOREFINING ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Energy from Biomass and Waste: Thermochemical Processes	10
Sustainability and Environmental Assessment	10
Process Design and Simulation	10
Bioprocess Engineering	10
Biofuels and Biorefining	10
Management for Technology	10
Computational Fluid Dynamics for Industrial Processes	10
Full-time students:	
Group Project	40
BIOREFINING ROUTE - ELECTIVE MODULES:	
Part-time student to choose one:	(40)
Group Project	40
Dissertation	40
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
GENERAL ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Separation and Purification Design	10
Sustainability and Environmental Assessment	10
Thermal Systems Operation and Design	10
Process Design and Simulation	10
Pilot Plant Operations	10
Management for Technology	10
Computational Fluid Dynamics for Industrial Processes	10
Individual Thesis project	80
Full-time students:	
Group Project	40
GENERAL ROUTE - ELECTIVE MODULES:	
Part-time student to choose one:	(40)
Group Project	40
Dissertation	40
TOTAL:	200

Description	Credits
BIOREFINING ROUTE - COMPULSORY MODULES:	
Induction	0
Advanced Reaction Kinetics for Energy	10
Energy from Biomass and Waste: Thermochemical Processes	10
Sustainability and Environmental Assessment	10
Process Design and Simulation	10
Bioprocess Engineering	10
Biofuels and Biorefining	10
Management for Technology	10
Computational Fluid Dynamics for Industrial Processes	10
Individual Thesis Project	80
Full-time students:	
Group Project	40
BIOREFINING ROUTE - ELECTIVE MODULES:	
Part-time student to choose one:	(40)
Group Project	40
Dissertation	40
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months. This course is also offered on a part-time basis. Students would instead attend the required modules of the taught component according to a schedule agreed with the course director. Part time students taking the group project would still be expected to complete the group project within the same time and with full-time students.

Alternatively, part time students may opt to undertake an individual dissertation instead of the group project over a period of six months. MSc individual research projects for part time students are commonly undertaken in collaboration with the candidate's place of work.
All core modules are taught over one week, with the following week largely free of structured teaching to allow time for more independent learning and reflection, and completion of assignments.

Applied modules are taught over two weeks, with the assignment completed during that period.

7. Course Level Assessment Strategy[4]

Taught modules: The thought modules are designed to deliver a high-quality academic experience and enable students' achievements to be assessed reliably and aligned with module and course levels' ILOs.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

For every module, the full details of the assessment, including the purpose, requirements, and expected standards are clearly specified and provided to students. Assessments are developed to provide equal opportunities for all students. The quality of every assessment, against module ILOs, is critically reviewed internally and externally. The module assessments are reviewed annually to identify and implement any potential improvements.

The assessment criteria for core modules are designed to ensure students can utilise acquired engineering and analytical tools (i.e. computational fluid dynamics, life cycle assessment, and techno-economic analysis) and advanced knowledge to design, develop, and evaluate chemical products and processes. For applied modules, students are expected to demonstrate their capability to engage with a range of real-world applications. Therefore, the assessments are designed with a developmental purpose to ensure sufficient feedback on students' performance is provided throughout the process.

Summative assessments are based on a combination of examination, individual course work, and individual or group presentations. The individual course work assessments are designed based on short and extended reports to simulate different scenarios of professional practices in workplaces. Presentations and course work assessments require students to apply their acquired technical skills to design, develop, and evaluate a specific case, and report their findings. The summative feedback on students' works is provided within 20 working days after the submission, in the form of specific and general comments via the VLE. On the other hand, formative feedback is provided throughout the lectures; practical, tutorial and Q&A sessions; and experimental- and simulation-based laboratories to ensure students are able to identify their strengths and limitations, and how to improve their performance.

Group Project: The group project provides the students with the opportunity to gain professional skills expected of the workplace. In addition to technical skill practice, students develop a range of soft skills such as team working, problem solving, communication skills and reflective practice. The students work in small consultancy teams typically on a client sponsored project for a period of 10 weeks. Many teams will be made up of students from different courses giving the students the opportunity of working in an interdisciplinary team. The students are responsible for interpreting the brief, developing a project plan, selecting and implementing a methodology, deriving results, analysing the results and drawing conclusions in alignment with the aims and objectives. All students participate in a peer review activity providing them with the opportunity to reflect on the practices of their colleagues as well as their own. Peer review feedback is provided individually by an independent member of academic staff. A single group report is produced and the project is presented orally at the concluding Exhibition Day, both elements are summatively assessed by independent markers and a group mark is assigned for element. Individual assessment is derived from supervisor observation and meeting minute actions and an individual reflective report where the students reflect on the development of three soft skill competencies based on objectives that they set for themselves. The team working competency is mandatory as one of the three skills for each student.

Dissertation: Part time students are not required to complete the Group Project undertaken by the full time registered students on a SWEE MSc course. An alternative assignment takes the form of a dissertation or design project which in most situations will be based around a topic relevant to the work of the part-time student. It is evident that some aspects of the Group Project experience that the work-based dissertation replaces – for example the client interaction and group dynamics components will not directly replicated by undertaking this assignment. It is expected that these experiences would normally be a part of the normal working life of the part-time student.

It is expected that the dissertation will normally consist of the following elements: Abstract, Background context, Introduction to the theme(s) addressed within the dissertation, setting out the issues that will be covered, Methodology, In depth analysis/discussion of the topics discussed, Concluding remarks, References, Appendices (if relevant). Two supervisors are allocated to the dissertation and supervision follows the model used for the independent research project. The student will submit a 6000 word report and will give an oral presentation of their work. Both elements of assessment will be marked by independent assessors.

Individual Research Project/Thesis: The individual research project requires students to further develop problem definition, hypothesis setting, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions in the context of research questions relevant to the course followed by a student. The student is required to communicate their findings successfully via a standard thesis (Energy), and an oral presentation based around a poster. The projects are designed to integrate knowledge, the taught modules, and apply understanding and skills from the group project, to deliver a high quality written thesis and oral presentation. The individual research project/thesis is typically delivered through collaboration with an industrial sponsor, or it may be an 'internal' project reflecting the research interests of the School.

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-ENE-INWK Occ A	Induction	Gill Drew	30		0	Y		05/10/20	09/10/20	N/A	AO	N/A				N/A	
2	N-BPE-PCP	Advanced Reaction Kinetics for Energy	Peter Clough	30		10	N		19/10/20	30/10/20	50	ICW	100				FT 31/10/20 PT 14/11/20	05/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education.
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	N-PSE-CETIP Occ A	Computational Fluid Dynamics for Industrial Processes	P Verdin	30		10	Y		09/11/20	20/11/20	50	ICW	100				FT 21/11/20 PT 05/12/20	05/21
4	N-ACE-SPD	Separation and Purification Design	Vasilije Manovic	30		10	N		23/11/20	04/12/20	50	ICW	100				FT 05/12/20 PT 19/12/20	05/21
5	N-BPE-BPT	Biofuels and Biorefining	Vinod Kumar	35		10	N		23/11/20	04/12/20	50	ICW	100				FT 05/12/20 PT 19/12/20	05/21
6	N-ACE-SEA	Sustainability and Environmental Assessment	Gill Drew	25		10	Y		07/12/20	18/12/20	50	ICW	100				FT 19/12/20 PT 02/01/21	05/21
7	N-BPE-PPO	Pilot Plant Operations	Stuart Wagland	40		10	Y		11/01/21	22/01/21	50	GPRES ICW	25 75				22/01/21 FT 23/01/21 PT 06/02/21	05/21
8	N-BPE-BE	Bioprocess Engineering	Vinod Kumar	30		10	N		11/01/21	22/01/21	50	ICW	100				FT 23/01/21 PT 06/02/21	05/21
9	N-PSE-PSD Occ A	Process Design and Simulation	Dawid Hanak	25		10	Y		25/01/21	05/02/21	50	ICW	100				FT 06/02/21 PT 20/02/21	05/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
10	N-PSE-TSOD Occ A	Thermal Systems Operation and Design	Ali Nabavi	35		10	Y		08/02/21	19/02/21	50	ICW	100				FT 20/02/21 PT 06/03/21	05/21
11	N-BPE-EFB	Energy from Biomass and Waste: Thermochemical Processes	Ying Jiang	25		10	N		08/02/21	19/02/21	50	ICW	100				FT 20/02/21 PT 06/03/21	05/21
12	G-MTI Occ A	Management for Technology	Richard Adams	27		10	Y		22/02/21	26/02/21	40	EX	100				Exam week 4 22-26/03/21	
13	I-ENE-GRPP Occ A	Group Project	Gill Drew	16		40	Y		01/03/21	07/05/21	50 50 50 50	GCW GPRES ICW RP	64 16 10 10				05/05/21 30/04/21 08/05/21 NA	
14	I-ENE-DISS Occ A	Dissertation (P-T option only)	G Drew	10		40	Y		01/03/21	24/09/21	50	IPROJ IPRES	80 20				24/09//21 W/C 20/09/21	
15	I-ENE-THESIS Occ A	Individual Research Project	G Drew	20		80	Y		10/05/21	10/09/21	50 50	OR THESIS	10 90				23/08/21-30/08/21 06/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
G-MTI	Management for Technology	School of Management	• Advanced Mechanical Engineering • REMS EngD • Offshore Engineering (Engineering route) • Offshore Engineering (Management route) • Energy Systems and Thermal Processes • Energy Systems and Thermal Processes (Muscat) • Process Systems Engineering (Muscat) • Advanced Chemical Engineering (General route) • Advanced Chemical Engineering (Biorefining route) • • Thermal Power Computational Techniques in Engineering
N-ACE-SEA	Sustainability and Environmental Assessment	Advanced Chemical Engineering	Renewable Energy (Management Route)
N-PSE-PSD	Process Design and Simulation	Advanced Process Engineering	• Process Systems Engineering (Muscat) • Advanced Chemical Engineering (general Route) • Advanced Chemical Engineering (Biorefining route) • Advanced Process Engineering Energy Systems and Thermal Processes (Cranfield)
N-PSE-TSOD	Thermal Systems and Operation and Design	Advanced Process Engineering	• Advanced Process Engineering • Energy Systems and Thermal Processes • Advanced Chemical Engineering (General route) • Energy Systems and Thermal Processes (Muscat) Process Systems Engineering (Muscat)
N-PSE-CETIP	Computational Fluid Dynamics for Industrial Processes	Advanced Process Engineering	• Process Systems Engineering (Muscat) • Advanced Chemical Engineering (General route) • Advanced Chemical Engineering (Biorefining route)

			• Energy Systems and Thermal Processes • Energy Systems and Thermal Processes (Muscat) • Advanced Process Engineering

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have 3 written examinations, 5 - 7 pieces of assessment by submitted work and 2 -3 elements of assessment by presentation or viva.

This approach has been adopted because:

- Assess the knowledge of the students using methods appropriate to the nature of the subject area.
- Help the students to improve their technical writing and oral presentation skill.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate in Advanced Chemical Engineering

General Route

Award ILOs / **Module No.**	ILO1	ILO2	ILO3 (only for the General Route)
2	ICW	ICW	
3		ICW	ICW
4	ICW	ICW	ICW
6		ICW	ICW
7		GPRES/ICW	GPRES/ICW
9	ICW	ICW	
10	ICW	ICW	ICW

Biorefining Route

Award ILOs / Module No.	ILO1	ILO2	ILO4 (only for the Biorefining route)
2	ICW	ICW	
5	ICW	ICW	ICW
6		ICW	ICW
3		ICW	ICW

Award ILOs / Module No.	ILO1	ILO2	ILO4 (only for the Biorefining route)
8		ICW	ICW
9	ICW	ICW	
11	ICW	ICW	ICW

B. Postgraduate Diploma in Advanced Chemical Engineering

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

General and Biorefining Route

Award ILOs / Module No.	ILO5	ILO6	ILO7
12	EX		
13		GCW GPRES ICW	GCW GPRES ICW
14		IPROJ IPRES	

C. MSc in Advanced Chemical Engineering

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Both Routes

Award ILOs / Module No.	ILO8	ILO9
15	OR/THESIS	OR/THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Graduates from the General route will be equipped with advanced interdisciplinary skills in chemical engineering, which includes theoretical and practical elements in operation, design, and control of a wide

range of chemical and energy processes. Graduates from the Biorefining route will be equipped with fundamental understanding of chemical engineering and solid skills to address the challenges of the rapidly growing and dynamic bioenergy sector. Both routes include training in management applied to the energy sector which will enable graduate engineers to effectively fulfil a wider role in a business organisation.

Graduates are likely to work in companies competing in a range of industries, including chemicals, petrochemicals, biochemicals, conventional energy and bioenergy, food, materials, consultancy and management. Those wishing to continue their education via PhD or MBA studies in the chemical or energy sectors will be greatly facilitated by the interdisciplinary, project-oriented profile that they will have acquired through this course.

COURSE SPECIFICATION

Cranfield University: Course Specifications
Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	MSc in Advanced Lightweight and Composite Structures
Course code	MSACSFTC (Registry to create PgDip and PgCert codes)
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Structures, Assembly and Intelligent Automation
Course Director	Dr Hessam Ghasemnejad
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	No
Is the Degree apprenticeship integrated or non-integrated?	No
Is the Mastership offered as an open and/or closed course?	No
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University Entry Requirements (2.2 in an Engineering related subject)
UK Qualifications Framework Level	QAA FHEQ level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	1 year full-time
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Structures, Assembly and Intelligent Automation where the research interests include:

- Structural analysis (linear/non-linear).
- Numerical methods development (mesh and meshless methods).
- Crashworthiness and material response to impact loading (ranging from quasi-static to dynamic).

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course has previously been accredited formally by Royal Aeronautical Society (RAeS) and IMechE.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Provide in-depth understanding of the importance / implications of using advanced materials in the development of lightweight structures and their response to a range of loading (from quasi-static to dynamic loads).
- Acquire a systematic understanding of structural behaviour and failure and develop an awareness of impact and crash protection issues and phenomena, with the ability to apply this knowledge to structural design.
- Meet employer demand for graduates who have strong applied analytical skills in structural behaviour and failure, who can practically apply this knowledge to real engineering problems using the latest industry standard numerical tools.
- To develop a firm grasp of the relationship of basic phenomena to real life engineering systems, and develop industrially relevant and marketable applied skills in structures and crashworthiness.
- To supply high grade personnel to the structures and crashworthiness communities in UK, European and world industry, including aerospace, automotive, offshore and defense sectors.
- To provide a prime focus for Cranfield's growing activity in analysis and design for structural crashworthiness and impact.

This programme is intended for the following range of students:

- Any 1st or 2nd class UK honours degree (or equivalent) in an engineering related discipline.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Solve analytical and numerical problems for complex sub-structures and to analyse modern computer-based solutions for technical problems.

ILO 2. Examine how properties of an advanced materials affect the design process.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 3. Assess the stress analysis in modern structural development and their significance for economic design.

ILO 4. Plan the implementation of modern lightweight materials in advanced structural design and to prepare correct methods to practical demonstrations of processes.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Appraise a thorough technical understanding of modern lightweight materials, including a critical evaluation of existing processes and methods.

ILO 6. Judge and evaluate results and outcomes of various types of analysis (experimental, analytical and numerical) related to the advanced lightweight structures.

ILO 7. Compose a work program for evaluating new and existing design of lightweight materials structures.

ILO 8. Resource and task work programs individually and as part of a team, estimating the time and cost associated with delivery of requirements.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Lectures.
- Computer based workshops.
- Tutorial / video sessions (where appropriate)/
- The group and individual projects are used to develop research and presentation skills (feedback provided to aid development and time management skills).
- The students will be exposed to seminars from leading national and international figures in crashworthiness and impact fields.
- Industrial visits (where appropriate).
- IT and Library Training Courses.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction (1) 6 modules from 2-9	0 60
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction (1) Modules 2-9 Group Design Project	0 80 40
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Induction (1) Modules 2-9 Group Design Project (10) Individual Research Project (11)	0 80 40 80
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months. Each module is taught over one, or two weeks, depending upon module length.

Sufficient "free" time is allocated in the timetables to provide additional time for independent learning and reflection. In addition, the larger contact hour modules are split over two weeks, with the timetable specifically designed to incorporate at least a one week break between parts to allow students to consolidate the previously taught material, before attending the concluding part(s) of the module.

7. Course Level Assessment Strategy[4]

The assessment tasks are challenging and are designed to enable students to demonstrate the full range of learning, skills and attributes and equip them with the skills they require to succeed after graduation in academic, policy oriented or practitioner service. Therefore, a range of assessment practices is employed across modules. Students are not only required to write essays but also to give oral presentations, defend their arguments and conclusions by way of interview, and to write employability relevant policy briefing documents and a written dissertation.

Course Team also offers:

• Working with course teams to help integrate assessments across modules
• Presenting to staff on aspects of integrated assessment
• Workshops on engaging students with formative assessment and feedback
• Resources and strategies for increasing clarification of standards and criteria

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module of Independent module[8] (%)	Weighting within multi-part module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment and/or Submission exam date[11]	Assessment / Exam Retake date
1		N-ALS-INWK	Induction Week (ALSI Course)	Dr Hessam Ghasemnejad	16		0	N	05/10/20	05/10/20	09/10/20	N/A	AO	N/A				N/A	
2		N-ALS-ACAS	Advanced Composite Analysis and Impact	Dr Hessam Ghasemnejad	20		10	N	12/10/20	12/10/20	16/10/20	40	ICW	100				16/11/20	22/01/21
3		N-ALS-ICM	Introduction to Continuum Mechanics	Dr Iman Dayyani	20		10	N	26/10/20	26/10/20	30/10/20	40	EX	100				Week 2	03/2021
4		N-ALS-TS	Thin-walled Structures	Dr Yigeng Xu	20		10	N	09/11/20	09/11/20	13/11/20	40	EX	100				Week 2	06/2021

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%. This will be at the Board of Examiners discretion.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module of Independent module[8] (%)	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment and/or Submission exam date[11]	Assessment / Exam Retake date
5		N-ALS-FEM	Finite Element Methods	Dr Iman Dayyani	20		10	N ST	23/11/20	23/11/20	04/12/20	40	EX	100				Week 5	06/2021
6		N-ALS-MCS2	Materials Characterisation and Failure Simulations	Dr Mehdi Yasaee	20		10	N	08/02/21	08/02/21	12/02/21	40	IC W	100				12/03/21	05/2021
7		N-AVD-SS	Structural Stability	Dr Wenli Liu	20		10	Y	25/01/21	25/01/21	05/02/21	40	EX	100				Week 5	June 2021
8		N-ALS-CRASH	Crashworthiness	Dr Hessam Ghasemnejad	30		10	N	15/03/21	15/03/21	19/03/21	40	IC W	100				23/04/21	05/2021
9		N-ALS-SIC	Advanced Simulation for Impact	Dr Mehdi Yasaee	20		10	N	01/03/21	01/03/21	05/03/21	40	IC W	100				19/03/21	06/21
10		N-ALS-GA	Group Design Project	Dr Mehdi Yasaee	20		40	N	11/01/21	11/01/21	15/01/21	50			100 GPROJ	GPRES GCW	20 80	28/05/21	N/A
11		N-ALS-THES	Individual Research Project	Dr Hessam Ghasemnejad	20		80	N	07/06/21	07/06/21	20/08/21	50			100 THESIS	IPRES THESIS	20 80	03/09/21	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-AVD-SS	Structural Stability	Aerospace Vehicle Design	Aerospace Vehicle Design
N-ALS-FEM	Finite Element Methods	Advanced Lightweight & Composite Structures	Shared Teaching with CSTE

8. How are the ILOs assessed?

The following assessment types are utilised:

- Exam, assignment, group and individual projects

This approach has been adopted because:

- The analytical skills can be assessed by the exam while the numerical skills are mainly assessed by the assignments which give students an opportunity to apply their knowledge in practical applications. The experimental studies are examined by individual and group projects which judge students' capabilities in planning and evaluating of technical solutions in the advanced lightweight structures.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.
1	Not Assessed	
2	ICW	ICW
3	EX	EX
4	EX	EX
5	EX	EX
6	ICW	ICW
7	EX	EX
8	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.
1	Not Assessed			
2	ICW	ICW		
3	EX	EX		
4	EX	EX		
5	EX	EX		EX
6	ICW	ICW		ICW
7	EX	EX	EX	EX
8	ICW	ICW	ICW	ICW
9	ICW	ICW	ICW	ICW
10	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.
1	Not Assessed							
2	ICW	ICW						
3	EX	EX						
4	EX	EX						
5	EX	EX		EX				
6	ICW	ICW		ICW				
7	EX	EX	EX	EX				
8	ICW	ICW	ICW	ICW				
9	ICW	ICW	ICW	ICW				
10	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW	GPRES GCW
11	IPRES THESIS	IPRES THESIS	IPRES THESIS	IPRES THESIS	IPRES THESIS	IPRES THESIS	IPRES THESIS	IPRES THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic

staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

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Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

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Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

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1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

Based on the past five years, the following patterns have emerged for typical career paths and employability of graduands:

- Return to home EU institution to complete double degree
- Continued Higher Education - PhD at different UK institutions and at Cranfield University
- Direct employment / Graduate trainee schemes (Automotive / Aerospace / Offshore/Defence)
- Consultancy – Software Development / Software Application / Crashworthiness, etc.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	MSc in Advanced Materials
Course code	MSADMFTC, MSADMPTC, PDADMFTC, PDADMPTC, PCADMFTC, PCADMPTC
Academic Year	2020
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Enhanced Composites and Structures Centre
Course Director	Dr David Ayre
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	**No**
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	Not applicable
Is the Degree apprenticeship integrated or non-integrated?	Not applicable
Is the Mastership offered as an open and/or closed course?	Not applicable
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	One year full-time, three years part-time
Course Start Month(s)	Full-time: October. Part-time: October.

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Manufacturing Theme where the research interests include:

- Enhanced Composites and Advanced Structures.
- Surface Engineering and Nanotechnology
- Precision Engineering
- Welding Engineering and Laser Processing

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the Institute of Materials, Minerals and Mining, Institution of Mechanical Engineers (IMechE), Institution of Engineering and Technology (IET), Royal Aeronautical Society (RAeS) and The Welding Institute (TWI).

Students completing an accredited degree are deemed to have met part or all of the academic requirements for registration as a Chartered or Incorporated Engineer and are in a strong position to move on to achieve professional engineering status after a period of initial professional development in industry.

2. What are the aims of the course?

AIM
The aim of the course is to provide graduate scientists and engineers with a fundamental understanding of materials properties and processing, and the necessary skills to apply their knowledge in a wide range of careers in engineering and related industries.

OBJECTIVES
The objectives of the course are to provide students with:

1. A scientific understanding of materials properties and an appreciation of how this understanding can be applied to relevant problems.
2. A scientific understanding of the processes and manufacturing routes used to convert materials into engineering products, and of the influence of processing conditions on product performance.
3. An introduction to a wide range of specific materials, including metals, polymers, ceramics and composites, and to the basic principles of materials selection for engineering and other applications.
4. An introduction to a research environment, providing familiarity with testing and processing equipment, practical approaches to problem solving, critical evaluation of data, and use of information technology.
5. The skills required to pursue a successful career in engineering and related industries.

On successful completion of the course students should be able to:

- Apply their understanding of materials properties and processing characteristics to problems in the areas of materials development, materials and process selection, and component design.
- Plan, execute and manage materials-related projects.
- Operate effectively in a team.
- Make effective oral and written presentations of their work.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- recent graduates wishing to extend their knowledge and skills in the above areas.
- qualified engineers wishing to apply their skills into new areas.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Demonstrate a systematic understanding of materials properties and an appreciation of how this understanding can be applied to relevant problems.
ILO 2. Demonstrate a critical awareness of a range of techniques for assessing the structure and properties of materials.
ILO 3. Demonstrate knowledge and scientific understanding of the processes and manufacturing routes used to convert materials into engineering products, and the influence of processing conditions on product performance.
ILO 4. Demonstrate knowledge of specific materials and their applications, including metals, polymers, ceramics and composites.
ILO 5. Use basic principles of materials selection for engineering and other applications.
ILO 6. Demonstrate an ability in practical approaches to problem solving.
ILO 7. Critically evaluate data.
ILO 8. Demonstrate a basic understanding of fracture mechanics and an awareness of approaches to failure assessment (by choice of module)
ILO 9. Make effective use of finite element analysis programmes (by choice of module).

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 10. Demonstrate knowledge of some key general, personnel and project management techniques and an awareness of the less science-dependent aspects of technology.
ILO 11. Demonstrate an awareness of current research/development in selected topics in the field of materials.
ILO 12. Make effective oral and/or written presentation of their work.
ILO 13. Operate effectively in a team.
ILO 14. Undertake an appraisal of technical and/or commercial literature.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 15. Demonstrate a critical awareness of current research/development in selected topics in the field of materials.
ILO 16. Undertake substantial critical appraisal of technical and/or commercial literature.

ILO 17. Carry out substantial scientific programmes of study.
ILO 18. Discuss their work and relate it to the work of others.
ILO 19. Demonstrate originality in the application of knowledge in relation to an extended individual project.
ILO 20. Plan, execute and manage materials-related projects.

4. How is the course taught?

Students will be supported in their learning and personal development by:

Comprehensive course materials are provided, as well as a web-site using the Virtual Learning Environment (VLE). Students are guided through the use of interactive exercises, group and individual discussion. Students engage in class activities to practise the techniques taught.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2, 3, 7	30
ELECTIVE MODULES:	
Three Modules from 4, 6, 8, 9	30
RECOMMENDED MODULE	
Introduction	0
TOTAL:	60

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2, 3, 7	30
ELECTIVE MODULES:	
Three Modules from 4, 6, 8, and either 9 or 10	30
RECOMMENDED MODULE	
Introduction	0
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2 to 9 Group Project (11a)	80 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	120

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2 to 8	70
ELECTIVE MODULES:	
Choose from module 9 or 10 Group Project (11a) or Dissertation (11b).	10 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2 to 9 Group Project Individual Research Project (12)	80 40 80
RECOMMENDED MODULE	
Introduction	0
TOTAL:	200

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2to 8 Individual Research Project (12)	70 80
ELECTIVE MODULES:	
Choose from module, 9 or 10 Group Project (11a) or Dissertation (11b).	10 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in September/ October and are expected to complete the course within 11 calendar months.

This course is also offered on a part-time basis. The overall duration of the part-time course would normally be 2 years; the maximum overall duration normally permitted will be 3 years.
Part-time Students are encouraged to take the Group Project component and only in exceptional circumstances, and with approval from the Group Project Co-ordinator, will be permitted to replace the Group Project with an individual dissertation.

Part-time students also have the option to attend Design, Durability and Integrity of Composite Aircraft Structures in place of a non-compulsory module. . If you are interested in this option, please discuss this with the Course Director before selecting your elective options.

The course has been structured through discussions with advisors from a range of industries centred on materials. The course comprises an introductory week and eight one week modules which are assessed,

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

and an assessed group project and individual project. The course covers a broad range of materials areas. Specialisation is provided though suitable group and individual projects.

7. Course Level Assessment Strategy[4]

The course comprises taught modules (PG certificate, PG diploma, MSc) a group project (PG Diploma, MSc) and an individual research project (MSc). The intended learning outcomes for each module and project component are introduced to the students at the start of each module and project. Students are provided marking scheme information for all summative assessments and opportunities to revise/discuss content and strategies prior to completion of the assessments to ensure students are better informed to deliver.

Each taught module is assessed separately in addition to the assessment of group project work and individual research project work. Activities during the module delivery allow formative feedback to be provided either individually to each student or generally to the student cohort. Such activities include individual student exercises, group exercises, presentation of group work, class discussions, interactive class quizzes. (lab) demonstrations with limited student interaction, software package tutorials and final recap with question and answer session at end of most modules.

The Introduction to Materials Engineering module (module 2) forms the basis of the course and is assessed by individual course work. A practice examination opportunity is provided in October to give the students experience of the Cranfield University examination procedure and identify the level of revision required. Summative assessments are varied, aligning with module ILOs and being designed specifically for each individual module. Assessments include closed book examinations, written assignments, group and individual oral presentations, use of associated software packages (documented reports) and reflective writing. The taught module ILOs and feedback from assessments (formative and summative) all develop skills that are further assessed in the group project work and individual research project work.

Assessment of project work (group and individual) is by a combination of observed behaviour, reflective writing, oral presentations (poster and powerpoint) and project reports. Formative feedback is provided during the projects (by supervisors, sponsors, technical staff and peers).

Multi-part assessments are applied to several modules and usually comprise of a short oral presentation at the end of the taught module and written coursework. The feedback provided to the students after the oral presentation is intended to improve the quality of the written coursework. The diversity of assessment also provides students the opportunity to improve their written and spoken communication skills and their presentation skills.

The summative assessments are undertaken by the students throughout the academic year, with first written assessment marks and feedback being provided mid-December, but feedback on oral presentations (summative assessment) is provided late October. However the majority of feedback efficiently accessed by students is the formative feedback provided during the week of delivery during class activities.

Summative assessment feedback is primarily provided through the Virtual Learning Environment – written course work is marked and feedback provided within the recommended 20 working day period. General feedback on examinations is provided (posted on VLE) based on a sample size of exam question responses.

Full-time and part-time students are assessed identically where circumstances allow. The only provision for difference is in the Group Project/Dissertation (module 11a/11b); part-time students can be allowed to undertake a dissertation in place of the group project work where it can be demonstrated that a group project activity is unsuitable due to part-time student working restrictions.

Course modules

The following modules outline all parts of the programme leading to MSc. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within [8]	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-MAT-INWK	Introduction	Dr Sue Impey	18		0	Y	28/09/20	28/09/20	02/10/20	N/A	AO	N/A				N/A	
2	I-MAT-A1009	Introduction to Materials Engineering	Dr David Ayre	30		10	Y	05/10/20	05/10/20	09/10/20	40	ICW	100				02/11/20	
3	I-MAT-A1011	Additive and Subtractive Manufacturing Technologies	Dr Isidro Durazo-Cardenas	30		10	Y	12/10/20 19/10/20	12/10/20 Stream 2 19/10/20 Stream 1	16/10/20 Stream 2 23/10/20 Stream 1	40			100 MULTI	ICW GPRES	70 30	16/11/20 23/10/20	Re-assessment date to be set by agreement of the Module

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module of multi-part assessments [9](100%)	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																		Leader as/when required.
4	I-MAT-A1015	Failure of Materials and Structures	Dr Muhammad Khan	32		10	Y	26/10/20	26/10/20	30/10/20	40	EX	100				18/12/20	Manufacturing resit exams will be during week commencing: 17/05/21
5	I-MNU-A1018	General Management	Mr Matthew Caffrey	32		10	Y	30/11/20	30/11/20	04/12/20	40	EX	100				08/01/21	Manufacturing resit exams will be during week commencing: 17/05/21
6	I-MAT-A1014	Finite Element Analysis	Dr Muhammad Khan/	35		10	Y	09/11/20	09/11/20	13/11/20	40			100 MULTI	PRES ICW	10 90	07/12/20 30/11/20	Re-assessment date to be set by agreement of the Module Leader as/when required.
7	I-MAT-A1017	Materials Selection	Dr Sue Impey/ Dr David Ayre	34		10	Y	11/01/21	11/01/21	15/01/21	40			100 MULTI	IPRES ICW	10 90	15/01/21 08/02/21	Re-assessment date to be set by agreement of the Module Leader as/when required.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
8	I-MAT-A1016	Surface Science and Engineering	Prof John Nicholls	30		10	Y	25/01/21	25/01/21	29/01/21	40	ICW	100				22/02/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
9	I-MAT-A1013 occurrence A	Composites Manufacturing for High Performance Structures	Mr Andrew Mills	35		10	Y	16/11/20	16/11/20 Occ A	20/11/19	40	ICW	100				04/01/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
10	N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures (option when available)**	Dr Yigeng Xu	35	5	10	Y	12/07/21	12/07/21	16/07/21	40	ICW	100				13/09/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
11a	I-MAT-GRPP	Group Project	Dr David Ayre	20		40	Y	01/02/21	01/02/21 Occ A FT	27/04/21 FT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed	20 80 50 50	27/04/21 04/05/21 04/05/21 04/05/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
			Dr Supriyo Ganguly						01/02/21 Occ B PT	27/08/21 PT	50	GCW ICW	80 20		behaviour GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/08/21 01/09/21 01/09/21 01/09/21	
11b	I-MAT-DISS	Dissertation for Part Time Students	Dr Sue Impey/ Dr David Ayre	20		40	Y	08/02/21	08/02/21	31/08/21	50	ICW	100				27/08/21	
12	I-MNU-THESIS	Individual Research Project	Dr Muhammad Khan Dr Muhammad Khan	20		80	Y	08/02/21 30/04/21	Occ A = PT 08/02/21 Occ B = FT 30/04/21	PT 27/08/21 FT 27/08/21	50 50	THESIS OR THESIS OR	90 10 90 10				27/08/21 01/09/21 27/08/21 01/09/20	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
I-MAT-INWK	Introduction	Manufacturing Technology and Materials Programme	Welding Engineering, Aerospace Materials, Manufacturing Technology and Management Metal Additive Manufacturing
I-MAT-A1009	Introduction to Materials Engineering	Advanced Materials	Aerospace Materials, Manufacturing Technology and Management
I-MAT-A1011	Additive and subtractive Manufacturing Technologies	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing
I-MAT-A1015	Failure of Materials and Structures	Advanced Materials	Aerospace Materials, Aerospace Manufacturing
I-MNU-A1018	General Management	Engineering & Management of Manufacturing Systems	Manufacturing Technology and Management, Global Product Development and Management, Management and Information Systems, Engineering & Management of Manufacturing Systems, Engineering Competence, Metal Additive Manufacturing
I-MAT-A1014	Finite Element Analysis	Advanced Materials	Manufacturing Technology and Management, Aerospace Materials, Metal Additive Manufacturing
I-MAT-A1017	Materials Selection	Advanced Materials	Aerospace Materials EngD Sustainable Materials and Manufacturing
I-MAT-A1016	Surface Science and Engineering	Advanced Materials	Manufacturing Technology and Management, Aerospace Materials
I-MAT-A1013	Composites Manufacturing for High Performance Structures	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing, Aerospace Materials, Renewable Energy Marine Structures EngD
N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures	Airworthiness	Airworthiness, Military Aerospace and Airworthiness, Aerospace Materials, Aircraft Engineering
I-MAT-GRPP	Group Project	Advanced Materials	Aerospace Materials, Manufacturing Technology and Management, Aerospace Manufacturing, Engineering and

			Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Cyber-Secure Manufacturing, Welding Engineering, Metal Additive Manufacturing
I-MAT-DISS	Dissertation for Part Time Students	Advanced Materials	Aerospace Materials, Aerospace Manufacturing, Cyber-Secure Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Metal Additive Manufacturing, Manufacturing Technology and Management, Welding Engineering
I-MNU-THESIS	Individual Research Project	Aerospace Manufacturing	Advanced Materials, Aerospace Materials, Cyber-Secure Manufacturing`, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Metal Additive Manufacturing, Manufacturing Technology and Management, Welding Engineering

8. How are the ILOs assessed?

The following assessment types are utilised:

Students can expect to have either examinations or assessment by submitted work and elements of assessment by presentation or viva.

This approach has been adopted in order to ensure that students demonstrate their understanding through a wide range of learning techniques, but are not disadvantaged through any one approach.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO1 & ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9
2	ICW	ICW	ICW		ICW	ICW		
3		ICW			ICW	ICW		
4					EX	EX	EX	
6					ICW	ICW		ICW
7	ICW	ICW	ICW	ICW	ICW	ICW		
8		ICW			ICW			
9		ICW			ICW			

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO10	ILO11	ILO12	ILO13	ILO14
5	EX				
11a		GPROJ	GPROJ	GPROJ GPRES	GPROJ
11b		ICW	ICW		ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO15	ILO16	ILO17	ILO18	ILO19	ILO20
12	THESIS OR	THESIS	THESIS	THESIS OR	THESIS	THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic

staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

This course takes graduates on to a wide range of careers involving materials, with responsibilities in research, development, design, engineering, consultancy and management in industries including aerospace, automotive, medical, sports, food and drink processing, chemical processing and power generation.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 06/03/2020

1. What is the course?

Course information

Course Title	Advanced Mechanical Engineering
Course code	MSAMEFTC, MSAMEPTC, PDAMEFTC, PDAMEPTC, PCAMEFTC, PCAMEPTC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Full time, Part time
Location(s)[1] of Study	Cranfield
School(s)	School of Water, Energy and Environment
Theme	Energy & Power
Centre	Centre for Thermal Energy Systems and Materials
Course Director	Dr Joy Sumner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	No
Is the Degree apprenticeship integrated or non-integrated?	No
Is the Mastership offered as an open and/or closed course?	No

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	A first or second class UK Honours degree (or equivalent) in mathematics, physics or an engineering discipline. Other recognised professional qualifications or several years' relevant industrial experience may be accepted as equivalent; subject to approval by the Course Director.
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full-time MSc, PgDip and PgCert - one year, Part-time MSc, PgDip and PgCert - up to three years
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the Energy & Power Theme where the research interests include:

fluid mechanics, structural integrity, renewable energy and biofuels.

Cranfield University interacts with the following institutions and in the following ways:

Double degree relationships with European academic institutions have been developed (France, Italy and Spain) and future collaborations with other institutions are planned.

Plans are in place to:
- Establish an industrial advisory committee
- Develop relationships with appropriate international industries

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the Institution of Mechanical Engineers (IMechE) and the Energy Institute.

2. What are the aims of the course?

Cranfield University offers this course in order to:

Provide advanced, post-graduate education in the theory and practice of Mechanical Engineering. The course includes a broad range of Mechanical Engineering topics particularly relevant to the Energy sectors including Mechanical Engineering Design and Assessment. Material presented in the course modules deals with the design, operation and optimisation of machinery, structural integrity and project management. The course will appeal to graduates and practicing engineers who wish to enhance their understanding of Mechanical Engineering with a view to management of large engineering projects. It will also appeal to students as a conversion course from other branches of engineering and as an upskilling course particularly for overseas graduates. This is a broad course complementing the existing specialist MSc courses that the School of Water, Energy and Environment provides.

This programme is intended for the following range of students:

- Graduates and practicing engineers who wish to enhance their knowledge of various mechanical engineering fields with a view to managing key engineering projects.
- Graduates currently in employment, or overseas graduates, who wish to extend their technical qualifications or up-skill their qualifications.
- Graduates with science degrees or from other branches of engineering who wish to pursue a career change and require a conversion course.
- Candidates with other educational qualifications but who possess considerable relevant experience.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Advanced Mechanical Engineering

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically evaluate advanced mechanical engineering techniques necessary for solutions in the energy sectors.

ILO 2. Design appropriate strategies for employing advanced technologies and management issues to provide solutions for international industries and/or research organisations.

ILO 3. Appraise, evaluate and interpret information and theories applied to the engineering solution of problems in fluid dynamics and loading, computational fluid dynamics, fatigue and fracture, analytical and computational stress analysis, materials degradation and engineering component life cycles/sustainability.

ILO 4. Assess and interpret management methodologies and techniques that apply to the planning and execution of engineering projects, performed both individually and in teams, and for which self-direction and the ability to work effectively and professionally under time pressure are required.

B. Postgraduate Diploma in Advanced Mechanical Engineering

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Integrate knowledge, understanding and skills from the taught modules in a real-life situation to address problems faced by industrial clients; creating new problem diagnoses, designs, or system insights; and communicating findings in a professional manner in written, oral and visual forms.

C. MSc in Advanced Mechanical Engineering

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 6. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, evaluate findings critically and draw justifiable conclusions, demonstrating self-direction and originality of thought.

ILO 7. To communicate their individual research via a thesis and in an oral presentation in a style suitable for academic and professional audiences.

4. How is the course taught?

Students will be supported in their learning and personal development by:

Engaging with the wider learning environment at Cranfield through attendance of seminars and lectures arranged from time to time. It is confirmed that the course will be delivered by conventional means with no element of distance learning and/or flexible delivery. The students will have access to the e-learning support through Blackboard.

The taught programme is generally delivered from October to February and is divided into 5 core and 3 applied modules. Each core module is generally delivered over one week, whereas each applied module is delivered over two weeks at Cranfield.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction Week	0
Structural Integrity	10
Fluid Mechanics & Loading	10
Computational Fluid Dynamics for Renewable Energy	10
Management For Technology.	10
ELECTIVE MODULES:	
2 modules from:	
Engineering Stress Analysis: Theory and Simulations	10
Risk & Reliability Engineering	10
Applied Materials and Corrosion	10
Component Design	10
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction week	0
Fluid Mechanics & Loading	10
Risk & Reliability Engineering	10
Engineering Stress Analysis: Theory and Simulations	10
Computational Fluid Dynamics for Renewable Energy	10
Structural Integrity	10
Management for Technology	10

Component Design Applied Materials and Corrosion Group project (Full time students)	10 10 40
ELECTIVE MODULES:	
Part Time Students must choose one of: Group Project OR Dissertation	 40 40
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Induction week Fluid Mechanics & Loading Risk & Reliability Engineering Engineering Stress Analysis: Theory and Simulations Computational Fluid Dynamics for Renewable Energy Structural Integrity Management for Technology Component Design Applied Materials and Corrosion Group project (Full time students) Individual Research Project	0 10 10 10 10 10 10 10 10 40 80
ELECTIVE MODULES:	
Part Time Students must choose one of: Group Project OR Dissertation	 40 40
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of

your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

This course is also offered on a part-time basis for which students most register in October, and to complete the course within 24 or 36 (accordingly to the study plan agreed) calendar months.

Taught part 1: Modules
Each module is delivered over two weeks, using a combination of face to face and online activities. Modules are given in the period between October and February. There are two exam periods; at the end of the first term and at the end of the second term. Full time students will undertake these modules in the same academic year. Part time students will agree a time plan with the Course Director before the start of the first year of their studies.

Taught part 2: Group Project / Dissertation (part time students only)
The Group Project takes place after the completion of the taught modules phase and consists of a total of 16 contact hours with a member of the teaching staff and 384 hours of private study and collaboration with the student members of the group. This corresponds roughly to 1.5 contact hours and 38 private study/group working hours per week. This module is compulsory for full time students, and optional for part time students. Part time students have the option of completing a Dissertation as an alternative to the Group Project. If part time students chose to take the Group Project module instead of completing a Dissertation they are required to attend (in person or remotely, ie through WebEx) the weekly group project meetings. A member of the teaching staff attends these meetings and attendance is recorded. It is compulsory for the part-time students to attend in person the first Group Project meeting (usually on the last week of February) and the last meeting, when a group presentation with a poster is held. The majority of the work involved in the group project occurs outside the weekly meetings, and is planned and organized by the students. For part time students, this collaboration outside the weekly meetings can be performed through attendance in person/remotely, phone, e-mail, written interim reports, etc. The group will nominate

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

a minute taker and chair weekly, who take notes of these activities and report them to the group supervisor. Furthermore, the students use a shared drive owned by the Department, this is a repository for all the material produced and collected during the project. The supervisor, as member of the teaching staff, has access to it and he/she can monitor in a direct way the progresses of both part-time and full-time students.

Students opting for the Part-Time Dissertation will be assigned a supervisor by the Course Director and will agree with the supervisor an appropriate topic of study. This may be related to a workplace/industrial activity that is relevant to the student's work environment. The Dissertation will include a comprehensive literature review of classical and contemporary related material and also a discussion and properly argued conclusions. Where appropriate the Dissertation will acknowledge the work and contribution of others. The Dissertation module will be assessed in a similar way to the Group Project by presentation and formal report.

Taught Part 3: Individual Research Project
For full time students, the Individual Research Project takes place during the third term (April-September). By the end of March each year, each student will be allocated to a project supervisor who will guide them in selecting a research project. **Part time students** should define their research projects, to be undertaken commonly either partly or totally at their place of work, by the beginning of the second year of registration.

After the completion of the Group Project, full time students commence working on their research projects on a full-time basis. The research activity for part-time students starts commonly at the beginning of second year of registration (i.e. after successfully completing three taught modules). All students are required and must maintain regular contact (meetings, telephone conversations or e-mail correspondence) with their personal supervisor to discuss progress.

7. Course Level Assessment Strategy[4]

Taught modules:

- The assessment strategy for the taught modules is to have a wide range of assessment types. This includes:
    - Written assignments (individual course work):
        - Engineering Stress Analysis: Theory and Simulations:
        - Fluid Mechanics and Loading: A clear assignment discussing three technical areas.
        - Component Design: a report on student design projects.
        - Computational Fluid Dynamics for Renewable Energy: To attempt and reflect upon the application of CFD.
        - Applied Materials and Corrosion: A simulated lab report with expanded discussion section.
    - Exams:
        - Risk and Reliability Engineering: Demonstrate the understanding and ability to apply the theories and concepts taught in the module
        - Structural Integrity: Demonstrate the understanding and ability to apply the theories and concepts taught in the module
        - Management for Technology:
- Summative assessment will address the course ILOs:
    - Engineering Stress Analysis: Theory and Simulations: 3
    - Fluid Mechanics and Loading: 1 & 3
    - Risk and Reliability Engineering: 3
    - Structural Integrity: 3
    - Computational Fluid Dynamics for Renewable Energy: 1 & 3

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

    - Applied Materials and Corrosion: 1, 2 & 3
    - Component Design: 1, 2 & 3
    - Management for Technology: 4
- The reports will help students in their future employment and professional practice in disseminating information, while the exams are intended to evaluate students' handling of applying a novel situation to an existing framework for solution.
- Formative feedback includes:
    - Guided Exercises/Numerical Sessions (Fluid Mechanics and Loading, Structural Integrity): to take students through representative problems and familiarise them with different tactics for tackling them.
    - Case studies/Examples workshops (Fluid Mechanics and Loading, Risk and Reliability Engineering, Applied Materials and Corrosion): to allow students to discuss real world examples of the theory they are learning.
    - Group discussions (Risk and Reliability Engineering, Applied Materials and Corrosion): engage in and contribute to group discussions during the lectures, practical sessions and workshop.
    - Practical/Workshop Sessions (Fluid Mechanics and Loading, Component Design, Risk and Reliability Engineering, Structural Integrity, Computational Fluid Dynamics for Renewable Energy, Applied Materials and Corrosion, Management for Technology): to allow experience of representative skill sets.
    - Student Presentations (Applied Materials and Corrosion): students practice presentation skills, reflect upon their experience, and get feedback from staff.
- The VLE is used:
    - In Engineering Stress Analysis: Theory and Simulation to provide formative feedback at the end of each day.
    - In Structural Integrity to provide formative feedback at the end of each day.

Group Project:
The group project provides the students with the opportunity to gain professional skills expected of the workplace. In addition to technical skill practice, students develop a range of soft skills such as team working, problem solving, communication skills and reflective practice. The students work in small consultancy teams typically on a client-sponsored project for a period of 10 weeks. Many teams will be made up of students from different courses giving the students the opportunity of working in an interdisciplinary team. The students are responsible for interpreting the brief, developing a project plan, selecting and implementing a methodology, deriving results, analysing the results and drawing conclusions in alignment with the aims and objectives. All students participate in a peer review activity providing them with the opportunity to reflect on the practices of their colleagues as well as their own. Peer review feedback is provided individually by an independent member of academic staff. A single group report is produced and the project is presented orally at the concluding Exhibition Day, both elements are summatively assessed by independent markers and a group mark is assigned for element. Individual assessment is derived from supervisor observation and meeting minute actions and an individual reflective report where the students reflect on the development of three soft skill competencies based on objectives that they set for themselves. The team working competency is mandatory as one of the three skills for each student.

Dissertation:
Part time students are not required to complete the Group Project undertaken by the full time registered students on a SWEE MSc course. An alternative assignment takes the form of a dissertation or design project which in most situations will be based around a topic relevant to the work of the part-time student. It is evident that some aspects of the Group Project experience that the work-based dissertation replaces – for example the client interaction and group dynamics components will not directly replicated by undertaking this assignment. It is expected that these experiences would normally be a part of the normal working life of the part-time student.

It is expected that the dissertation will normally consist of the following elements: Abstract, Background context, Introduction to the theme(s) addressed within the dissertation and setting out the issues that will be covered, Methodology, In depth analysis/discussion of the topics discussed, Concluding remarks, References, Appendices (if relevant). Two supervisors are allocated to the dissertation and supervision follows the model used for the independent research project. The student will submit a 6000 word report and will give an oral presentation of their work. Both elements of assessment will be marked by independent assessors.

Individual Research Project/Thesis:
The individual research project requires students to further develop problem definition, hypothesis setting, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions in the context of research questions relevant to the student's course. The student is required to communicate their findings successfully via a thesis, written in the style of a standard thesis, and via an oral presentation based around a poster. The projects are designed to integrate knowledge from the taught modules, and apply understanding and skills from the group project, to deliver a high quality written thesis and oral presentation. The individual research project/thesis is typically delivered through collaboration with an industrial sponsor, or it may be an 'internal' project reflecting the research interests of the School.

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-ENE-INWK Occ A	Induction	Gill Drew	24		0	Y		05/10/20	09/10/20	N/A	AO	N/A				N/A	
2	N-AME-RR Occ A	Risk and Reliability Engineering	Dawid Hanak	27		10	Y		12/10/20	23/10/20	50	EX	100				Exam week 2 4-8/01/21	05/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	N-AME-FML	Fluid Mechanics and Loading	Liang Yang	30		10	Y		26/10/20	06/11/20	50	ICW	100				FT 08/11/20 PT 22/11/20	05/21
4	N-AME-ESA	Engineering Stress Analysis: Theory and Simulations	Ali Mehmanparast	32		10	Y		09/11/20	20/11/20	50	ICW	100				FT 21/11/20 PT 05/12/20	05/21
5	N-AME-SI	Structural Integrity	Ali Mehmanparast	38.5		10	Y		23/11/20	04/12/20	50	EX	100				Exam week 2 4-8/01/21	05/21
6	I-OOT-A1076	Applied Materials and Corrosion	Joy Sumner	30		10	Y		07/12/20	18/12/20	50	ICW	100				FT 19/12/20 PT 02/01/21	05/21
7	N-REE-CFDR	Computational Fluid Dynamics for Renewable Energy	Patrick Verdin	30		10	Y		25/01/21	05/02/21	50	ICW	100				FT 06/02/21 PT 20/02/21	05/21
8	N-AME-CD	Component Design	Paul Lighterness	70		10	N		08/02/21	19/02/21	50	ICW	100				FT 20/02/21 PT 06/03/21	05/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	G-MTI Occ A	Management for Technology	Richard Adams	27		10	Y		22/02/21	26/02/21	40	EX	100				Exam week 4 22-26/03/21	05/21
10	I-ENE-GRPP Occ A	Group Project	Gill Drew	16		40	Y		01/03/21	07/05/21	50 50 50 50	GCW GPRES ICW RP	64 16 10 10				05/05/21 30/04/21 08/05/21 NA	
11	I-ENE-DISS Occ A	Dissertation (P/T students only)	Gill Drew	10		40	Y		01/03/21	24/09/21	50	IPROJ IPRES	80 20				24/09//21 W/C 20/09/21	
12	I-ENE-THESIS Occ A	Energy Individual Research Project	Gill Drew	20		80	Y		10/05/21	10/09/21	50 50	OR THESIS	10 90				23/08/21-30/08/21 06/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
G-MTI	Management for Technology	School of Management	• Advanced Mechanical Engineering • REMS EngD • Offshore Engineering (Engineering route) • Offshore Engineering (Management route) • Energy Systems and Thermal Processes • Energy Systems and Thermal Processes (Muscat) • Process Systems Engineering (Muscat) • Advanced Chemical Engineering (Engineering route) • Advanced Chemical Engineering (Management route)
N-AME-ESA	Engineering Stress Analysis: Theory and Simulations	Advanced Mechanical Engineering	• Offshore Engineering (Engineering route) • Renewable Energy (Engineering route)
N-AME-RR	Risk and Reliability Engineering	Advanced Mechanical Engineering	• Advanced Process Engineering • Process Systems Engineering (Muscat) • Offshore Engineering (Management route)
N-AME-SI	Structural Integrity	Advanced Mechanical Engineering	• Offshore Engineering (Engineering and Management route) • REMS EngD
N-REE-CFDR	Computational Fluid Dynamics for Renewable Energy	Advanced Mechanical Engineering	• Offshore Engineering (Engineering route)
N-AME-FML	Fluid Mechanics and Loading	Advanced Mechanical Engineering	• Renewable Energy (Engineering route) • Offshore Engineering (Engineering route)
I-OOT-A1076	Applied Materials and Corrosion	Offshore Engineering	• Advanced Mechanical Engineering

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have three written examinations, seven pieces of assessment by submitted work and two elements of assessment by presentation or viva. This approach has been adopted in order to provide a balance between formal examination and a less rigid written/verbal communication.

Formal lecture courses are examined in accordance with the School of Water, Energy and Environment practice. Prior to the examinations taking place all examination papers are seen and approved first by a member of the department and then by the course external examiner.

The underlying assessment strategy across all modules will be to examine the understanding of mechanical engineering principles and applications. This will be achieved by testing the ability to solve realistic multi-disciplinary problems within a Mechanical Engineering context. Proper application and appreciation of mechanical engineering models and methodologies will be paramount to the successful completion of the course.

Coursework will be set to reinforce and expand taught elements of the course. This will be a combination of open ended assignments and analytical/numerical based problem solving. Coursework will be assessed on the rigour and quality of the reports with merit given to diligence and evidence of understanding of the underlying methods.

- Each course member is required to make a formal presentation on his/her Individual Research Project.
- Upon submission, all theses are reviewed by two internal examiners (one examiner being the course member's supervisor), plus the external examiner.
- If the Individual Research Project mark awarded by the internal examiners varies significantly, then a third internal examiner is appointed.
- All course members are subject to a presentation or viva voce examination in the presence of members of Academic staff.

Assessment of Individual MSc Theses
The Individual Research Project (IRP) tests:

- The ability to define the project by reference to scientific, technical and/or commercial literature, the critical appraisal of such literature and the justification of the research;
- The ability to plan and manage the research programme, to define the work to be carried out and to report the results in a clear manner;
- The ability to analyse the work, relate it to the work of others where appropriate and to be self-critical;
- To communicate the work, its results and analysis in a technical and well-presented document.

Assessment of the Group Project (GP)
The Group project tests:

- The ability to undertake the design of an engineering component or system, and substantiate the design through analysis;
- The ability to plan and manage the design project programme, to define the work to be carried out and to report the results in a clear manner;
- The ability to analyse the design, relate it to the work of others where appropriate and to be self-critical;

- To communicate the design, its results and analysis in an oral presentation and in a technical and well-presented document.

Assessment of the Dissertation (Part-Time option) module tests:

- The ability to plan, structure and manage a detailed study of an engineering process, system, component or methodology and to communicate results in a clear manner;
- The ability to assemble a workplace/industrial activity into a coherent study formulating properly argued conclusions and where appropriate building upon and acknowledging the work and contribution of others;
- The ability to analyse and where appropriate to relate to the work of others and to be self-critical;
- To communicate the dissertation in an oral presentation and in a technical and well-presented document.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.
3	ICW	ICW	ICW	
4	ICW	ICW	ICW	
2	EX	EX	EX	
5	EX	EX	EX	
6	ICW	ICW	ICW	
7		ICW	ICW	
8	ICW	ICW	ICW	
9			EX	EX

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 5.
10	GCW GPRES ICW RP
11	IPROJ IPRES

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 6.	ILO 7.
12	THESIS OR	THESIS OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

NONE

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Graduates from the course will be equipped with the academic skills and requirements to successfully pursue a career in a Mechanical Engineering discipline whether this is technical, management or research.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Advanced Motorsport Engineering
Course code	MSAMGFTC, PDAMGFTC, PCAMGFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-Time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering Centre
Course Director	Mr Clive Temple
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	First or Upper Second class UK Honours degrees or the international equivalent in engineering, aerospace, materials science and closely related disciplines such as Maths and Physics, who wish to gain knowledge of the engineering, , science, technologies and management relevant to motorsport. For students where their first language is not English they will need to provide evidence that they have achieved a satisfactory test result in an English qualification. The minimum requirement is IELTS – 7 or an equivalent, approved test.
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Transport Systems Theme, Advanced Vehicle Engineering Centre and other centres within the School where the research interests include:

- Active and passive aerodynamics
- Computational Fluid Dynamics (CFD)
- Carbon reduction and environmental impact
- Alternative energy sources, energy recovery systems and energy efficiency
- High temperature surface engineering including coatings
- Low carbon vehicles
- Powertrain development and refinement including Internal Combustion Engine (ICE), hybrids and Electric Vehicles (EV)
- Condition monitoring and reliability
- Precision engineering
- Simulation including the supply of race car simulators to F1 (Cranfield Simulation)
- Structural integrity and FIA approved impact testing including F1 and Le Mans Prototype (LMP) (Cranfield Impact Centre)
- Tyre modelling and characterisation
- Vehicle dynamics including on circuit and off road
- Vehicle light weighting, novel materials and composites with special reference to niche vehicles such as competition cars and motorcycles.
- Electronics and data acquisition
- Mechatronics
- The motorsport business cluster, technology transfer and diversification

Teaching and assessment is also provided by staff at the Shrivenham campus. Students benefit from access to motorsport related facilities at both campus sites.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the following until September 2021

- The Institution of Mechanical Engineers (IMechE)
- The Institution of Engineering and Technology (IET)
- The Royal Aeronautical Society (RAeS)

2. What are the aims of the course?

Cranfield University offers this course in order to:

- provide students with a sound understanding of the fundamental scientific, engineering and managerial principles as applied to motorsport, and their implementation within a high performance technology context
- provide students with a clear knowledge of the design, construction and operation of competition vehicles, and related aspects of materials science, aerodynamics, structural analysis, vehicle systems, and management techniques related to motorsport.
- equip students with the skills required for the planning, execution and reporting of motorsport projects and to prepare them for a variety of roles in motorsport.

This programme is intended for the following range of students:

- First or Upper Second class UK Honours degrees or the international equivalent in engineering, aerospace, materials science and closely related disciplines such as Maths and Physics, who wish to gain knowledge of the engineering, management, science and technologies relevant to motorsport. Maths and physics applicants will be expected to understand mechanical and aeronautical engineering as applied to cars and motorcycles. All applicants should demonstrate an involvement of working with cars and motorcycles, even if this is through hobby interests.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. analyse key engineering and business subjects as applied to motorsport
ILO 2. judge the technologies which underpin motorsport engineering
ILO 3. rate business and engineering related disciplines in the context of motorsport

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. formulate managerial skills for a group project
ILO 5. evaluate one or more motorsport engineering applications.
ILO 6. assess their personal development with reference to individual contribution and peer assessment in a team working context.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 7. appraise an area or areas of motorsport engineering through individual research.
ILO 8. synthesise their individual research in the form of a thesis report and poster

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Problem-based learning - this kind of learning encourages self-conducted, individualised learning and thereby also the students' own responsibility for learning, it should also support the personal and professional growth of the student.

- Use of experiences from laboratory or industrial practice, as a starting point when training abilities for problem solving and critical analysis, should greatly increase integration between theory and practice.
- Theoretical class exercises as a means for the students to learn how to apply variations of common solutions to standard problems and students get feedback from colleagues and lecturers.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Introduction to Motorsport	0
ELECTIVE MODULES:	
To accumulate 60 credits from Modules 2-9	60
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Introduction to Motorsport Modules 2-9 Group Design Project	0 80 40
ELECTIVE MODULES:	
N/A	N/A
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Introduction to Motorsport Modules 2-9 Group Design Project Individual Research Project	0 80 40 80

ELECTIVE MODULES:	
N/A	N/A
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in September and are expected to complete the course within 12 calendar months, submitting their thesis, undertaking the oral examination with poster and attending the industrial thesis exhibition in September (students with restricted thesis are not required to attend the exhibition).

Each module is taught over five days, usually with an intervening week for assimilation and time to work on the assignments or revise for examinations.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

7. Course Level Assessment Strategy[4]

The assessment strategy encompasses individual as well as group work. There is a blend of assignments and examinations across the assessed modules, although it is important to note that each module has one form of assessment. The modules contribute 80 credits (40%). Where the group design project is concerned students are assessed in terms of their group and individual contribution and reflection. The assessment comprises group report and presentation, a self reflective review and contribution evaluation based on evidence such as meeting minutes and peer review. This equates to 40 credits in total (20%). Finally the remaining 80 credits (40%) are assigned to the individual research project. Here the distribution is 80% for the technical report and 20% for the thesis viva with research project poster. The combination of these forms of assessment with their various weightings determine the award of the Master's degree. In addition there are exit routes of Postgraduate Diploma (PgD) and Postgraduate Certificate (PgC) should the student not attain the MSc award. Students will be supported in their learning and personal development by:

- Problem-based learning - this kind of learning encourages self-conducted, individualised learning and thereby also the students' own responsibility for learning, it should also support the personal and professional growth of the student.
- Use of experiences from laboratory or industrial practice, as a starting point when training abilities for problem solving and critical analysis, should greatly increase integration between theory and practice.
- Theoretical class exercises as a means for the students to learn how to apply variations of common solutions to standard problems and students get feedback from colleagues and lecturers.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to MSc. Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1		I-MEM-INWK	Induction and Introduction to Motorsport	Clive Temple	17	0	0	Y	01/09/20	30/09/20	02/10/20	N/A	AO	N/A				N/A	N/A
2		I-MEM-A1519	Motorsport Structural Analysis	Dr Veronica Rodriquez Marchante	35	0	10	N	25/01/21	25/01/21	05/02/2021	50	ICW	100				08/02/2021 08:30	At the next available opportunity which may not be until the course runs the

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																			following year
3		I-MEM-A1001	Motorsport Electronics and Data Acquisition	Dr Kim Blackburn	35	0	10	Y	19/10/20	19/10/20	30/10/20	50	EX	100				June 2021	At the next available opportunity which may not be until the course runs the following year
4		I-MEM-A1007	Motorsport Vehicle Dynamics	Dr James Brighton	35	0	10	Y	22/02/2021	22/02/2021	05/03/2021	50	EX	100				June 2021	At the next available opportunity which may not be until the course runs the following year)
5		I-MEM-A1006	Motorsport Aerodynamics	Prof Kevin Garry	35	0	10	N	30/11/20	30/11/20	04/12/20	50	GCW	100				04/01/2021 08:30	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
6		I-MEM-A1012	Computational Fluid Dynamics for Motorsport	Clive Temple	35	0	10	N	04/01/2021	04/01/2021	08/01/2021	50	GCW	100				25//01/2021 08:30	At the next available opportunity which may not be until the course runs the following year
7		I-MEM-A1005	The Business of Motorsport	Clive Temple	35	0	10	Y	16/11/20	16/11/20	20/11/20	50	GCW	100				30/11/2020 08:30	At the next available opportunity which may not be until the course runs the following year
8		I-MEM-A1004	Composite Structures for Motorsport	Dr Veronica Marchante Rodriguez	35	0	10	N	08/02/21	08/02/21	19/02/21	50	EX	100				June 2021	At the next available opportunity which may not be until the course runs the following year
9		I-MEM-A1008	Motorsport Powertrains	Clive Temple	35	32	10	Y	05/10/20	05/10/20	09/10/20	50	ICW	100				19/10/2020 08:30	At the next available

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																			opportunity which may not be until the course runs the following year
10		I-MEM-GRPP	Group Design Project	Clive Temple / Dr Kim Blackburn	40	0	40	Y	01/10/2020	19/02/21	14/05/21	50	GPROJ GPRES ICW	64 16 20				07/05/2021 10/05/2021 14/05/2021	N/A
11		I-MEM-THESIS	Individual Research Project	Clive Temple / Dr Kim Blackburn	40	n/a	80	Y	01/10/20	17/05/21	03/09/21	50	THESIS OR	80 20				27/08/2021 31/08/2021 - 01/09/2021	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
I-MEM-INWK	Induction and Introduction to Motorsport	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1001	Motorsport Electronics and Data Acquisition	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1007	Motorsport Vehicle Dynamics	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1005	The Business of Motorsport	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1008	Motorsport Powertrains	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-GRPP	Group Design Project	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-THESIS	Individual Research Project	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1012	CFD for Motorsport	Shared Teaching with Aerospace Dynamics (AD) (N-ASD-AOCFD Introduction to CFD)	

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have written examinations, assessment by submitted work and elements of assessment by oral presentation or viva. However, only one form of assessment will be used in relation to a taught module, either an assignment or a closed book examination.

This approach has been adopted in order to offer diversity in assessing students in relation to learning outcomes. The Course also employs peer- and self-assessment activities to reinforce the reflective abilities that are necessary for working effectively in teams. These encourage student involvement with their learning, and give them some sense of responsibility with regards to the unit of study.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.
1	AO	AO	AO
2	ICW	ICW	
3	EX	EX	EX
4	EX	EX	EX
5	GCW	GCW	GCW
6	ICW	ICW	ICW
7		GCW GPRES	GCW GPRES
8	EX	EX	EX
9	ICW	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 4.	ILO 5.	ILO 6.
10	GCW	GPRES GPRAC GCW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 7.	ILO 8.
11	THESIS	OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A	N/A	N/A	N/A
		N/A	N/A

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

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1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as

a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

Engineering roles in motorsport and high performance engineering including design roles, technical sales engineering posts and track-side related positions. Former students have gone onto careers in F1, Indy Cars and other single seat formulae, WRC, WRX. Moto GP, BSB, endurance racing including LMP and GT categories, touring cars, electric vehicle racing series such as FIA Formula E, motorsport equipment manufacturers and suppliers, automotive OEMs, niche high performance engineering companies and consultancies.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc Advanced Motorsport Mechatronics
Course code	MSAMMFTC, PDAMMFTC, PCAMMFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PGDip, PGCert
Mode of delivery	Full-Time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering Centre
Course Director	Clive Temple
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	NA
Apprenticeship Standard the course is mapped to	NA
Is the Degree apprenticeship integrated or non-integrated?	NA
Is the Mastership offered as an open and/or closed course?	NA
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements and IELTS 7
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	One year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Transport Systems, Advanced Vehicle Engineering Centre where the research interests include:

motorsport engineering and business, vehicle electrification including powertrain, Internal Combustion Engine (ICE), and hybrid powertrain, advanced control, multi-domain modelling, autonomous technologies, low carbon vehicles, vehicle dynamics on circuit and off road, simulation, electronics and data acquisition. Beyond the centre we will draw upon Cranfield's research related expertise and underpinning facilities.

Cranfield University interacts with the following institutions and in the following ways:

The Engineering Council in relation to the IET, IMechE and RAeS for accreditation

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

The course will seek accreditation from the RAeS, IET and the IMechE, after it has run for two years, to comply with the accreditation rules. The course has been designed in almost exactly the same way as the existing MSc Advanced Motorsport Engineering and MSc Automotive Mechatronics, which have recently received (or renewed) the accreditation from the RAeS, IET and the IMechE through the Engineering Council.

2. What are the aims of the course?

- Provide students with a sound understanding of the fundamental scientific, engineering and managerial principles involved in motorsport, and their implementation within a high performance technology context
- Provide students with an overview of the knowledge of the design, construction and operation of competition vehicles, and related aspects of aerodynamics, vehicle dynamics, vehicle systems, control systems, electronics, data acquisition, simulation and the business context of and management techniques related to motorsport and high performance engineering.
- Equip students with the skills required for the planning, execution and reporting of Motorsport mechatronics related projects and to prepare them for a variety of roles in motorsport, either within the factory and/or working trackside with competition teams and their suppliers.
- Meet employer demand for post graduate engineers who have applied analytical skills in motorsport mechatronics and niche high performance vehicle system and component design to meet the challenge of motorsport competition with reference to the technical and sporting regulations. These include the demands associated with the safety of competitors, officials, spectators, along with vehicle and trackside safety. The M-level graduates developed skills will also support performance, competitive advantage and sustainability with reference to environment considerations.

- Provide a primary training and dissemination route for Cranfield University's increasing research portfolio in the area of low carbon vehicle technologies and design methods.
- Supply to the motorsport, niche high performance and mainstream automotive segments (and associated supply chains) high calibre post graduate engineers with the technical, managerial qualities, transferable skills and independent learning ability to make them effective in organisations that utilise mechatronics in their businesses.

This programme is intended for the following range of students:

- First or Second class UK Honours degrees or the international equivalent in engineering, aerospace, mathematics, physics and closely related disciplines such as electronics who wish to gain knowledge of the engineering, management, science and technologies relevant to motorsport mechatronics.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Analyse methodologies and design considerations, in relation to engineering, including mechatronics applications, and business subjects in the context of motorsport.
ILO 2. Evaluate the performance of a range of technologies which underpin motorsport engineering, with reference to those related to mechatronics systems;
ILO 3. Assess the impact of different mechatronic systems as applied to motorsport, using simulation tools and benchmarking.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Select and then apply a range of managerial techniques and business solutions within a group project environment;
ILO 5. Evaluate the engineering trade-offs and design constraints of one or more motorsport mechatronics applications in relation to a motorsport engineering group design project;
ILO 6. Assess their personal development with reference to individual contribution and peer assessment in a team working context.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 7. Appraise an area or areas of motorsport mechatronics through individual research;
ILO 8. Synthesise their individual research in the form of a thesis report and poster.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Provision of lectures from academics, leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Blackboard.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.

- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, LabView, AVL Boost, Control Desk, ChassisSim and Dymola.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages (academic licences or commercial licences where the supporting companies make these available.
- Provision of a Personal Development Programme integrated throughout the Taught Modules, Group Design and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning, networking and project management).
- Problem-based learning - this kind of learning encourages self-conducted, individualised learning and thereby also the students' own responsibility for learning; it should also support the personal and professional growth of the student.
- Use of experiences from laboratory or industrial practice, as a starting point when training abilities for problem solving and critical analysis, should greatly increase integration between theory and practice.
- Theoretical class exercises including motorsport related case studies as a means for the students to learn how to apply variations of common solutions to standard problems and students get feedback from colleagues and lecturers.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
N/A	
ELECTIVE MODULES:	
60 credits from modules 2-9	60
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules: 1-9 Group Project: 10	80 40
ELECTIVE MODULES:	
N/A	

TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Modules: 1-9 Group Project: 10 Individual Research Project: 11	80 40 80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

6. How is the course structured?

Full-time students register for the course in September and are expected to complete the course within 12 calendar months.

Within the first term, all students will attend most of the MSc Advanced Motorsport Engineering modules. During the second term, students will attend most of the MSc Automotive Mechatronics modules. The Group Design Project will be distributed over term 2. For the duration of the 3rd term, students will have the opportunity to undertake their individual Research Project. There are no elective elements within the individual courses.

7. Course Level Assessment Strategy[4]

The assessment strategy encompasses individual as well as group work. There is a blend of assignments and examinations across the assessed modules, although it is important to note that each module has one form of assessment. The modules contribute 80 credits (40%). Where the group design project is concerned students are assessed in terms of their group and individual contribution and reflection. The assessment comprises group report and presentation, a self reflective review and contribution evaluation based on evidence such as meeting minutes and peer review. This equates to 40 credits in total (20%). Finally the remaining 80 credits (40%) are assigned to the individual research project. Here the distribution is 80% for the technical report and 20% for the thesis viva with research project poster. The combination of these forms of assessment with their various weightings determine the award of the Master's degree. In addition there are exit routes of Postgraduate Diploma (PgD) and Postgraduate Certificate (PgC) should the student not attain the MSc award. Students will be supported in their learning and personal development by:

- Provision of lectures from academics, leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Blackboard.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.
- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, LabView, AVL Boost, Control Desk, ChassisSim and Dymola.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages (academic licences or commercial licences where the supporting companies make these available.
- Provision of a Personal Development Programme integrated throughout the Taught Modules, Group Design and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning, networking and project management).
- Problem-based learning - this kind of learning encourages self-conducted, individualised learning and thereby also the students' own responsibility for learning; it should also support the personal and professional growth of the student.
- Use of experiences from laboratory or industrial practice, as a starting point when training abilities for problem solving and critical analysis, should greatly increase integration between theory and practice.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

- Theoretical class exercises including motorsport related case studies as a means for the students to learn how to apply variations of common solutions to standard problems and students get feedback from colleagues and lecturers.

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1		I-MEM-INWK	Induction and Introduction to Motorsport	Clive Temple	35	0	0	Y	01/09/20	28/09/20	02/10/20	N/A	AO	N/A				N/A	N/A
2		I-MEM-A1001	Motorsport Electronics and Data Acquisition	Dr Kim Blackburn	35	0	10	Y	19/10/20	19/10/20	30/10/20	50	EX	100				JUNE 2021	At the next available opportunity which may not be until the course runs the following year

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Minimum Mark[7] - 40% or	Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date		Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3		I-MEM-A1007	Motorsport Vehicle Dynamics	Dr James Brighton	35	0	10	Y	22/02/2021	22/02/2021	05/03/2021	50	EX	100				June 2021	At the next available opportunity which may not be until the course runs the following year
4		N-AP-AM03	Vehicle Control Applications	Dr Abbas Fotouhi	30		10	Y	08/02/2021	08/02/2021	15/02/21	50	EX	100				June2021	Sept 2021
5		I-MEM-A1005	The Business of Motorsport	Clive Temple	35	0	10	Y	16/11/20	16/11/20	20/11/20	50	GCW	100				30/11/2020 08:30	At the next available opportunity which may not be until the course runs the following year
6		I-MEM-A1008	Motorsport Powertrains	Clive Temple	35	32	10	Y	05/10/20	05/10/20	09/10/20	50	ICW	100				19/10/2020 08:30	At the next available opportunity which may not be until the course runs the following year
7		N-AP-AM01	Mechatronics Modelling for Vehicle Systems	Dr Stefano Longo	30		10	Y	30/11/20	30/11/20	04/12/20	50	EX	100				June2021	Sept 2021

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
8		N-AP-AM02	Advanced Control and Optimisation	Dr Daniel Auger	30		10	Y	11/01/21	11/01/21	15/01/21	50	ICW	100				22/01/2021	Sept 2021
9		N-AP-AM04	Embedded Vehicle Control Systems	Dr Stefano Longo	30		10	Y	25/01/21	25/01/21	29/01/21	50	ICW	100				05/02/2021	Sept 2021
10		I-MEM-GRPP	Group Design Project	Clive Temple / Dr Kim Blackburn	40	0	40	Y	01/10/2020	19/02/21	14/05/21	50	GPROJ GPRES ICW	64 16 20				07/05/2021 10/05/2021 14/05/2021	At the next available opportunity which may not be until the course runs the following year
11		I-MEM-THESIS	Individual Research Project	Clive Temple and Dr Kim Blackburn	10		80	Y	01/10/20	17/05/21	03/09/21	50	THESIS OR	80 20				27/08/2021 31/08/2021 - 01/09/2021	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
I-MEM-INWK	Induction and Introduction to Motorsport	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1001	Motorsport Electronics and Data Acquisition	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1007	Motorsport Vehicle Dynamics	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
N-AP-AM03	Vehicle Control Applications	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
I-MEM-A1005	The Business of Motorsport	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-A1008	Motorsport Powertrains	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
N-AP-AM01	Mechatronics Modelling for Vehicle Systems	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AM02	Advanced Control and Optimisation	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AM04	Embedded Vehicle Control Systems	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
I-MEM-GRPP	Group Design Project	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics
I-MEM-THESIS	Individual Research Project	Advanced Motorsport Engineering	Advanced Motorsport Mechatronics

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have written examinations, assessment by submitted work and elements of assessment by oral presentation or viva. However, only one form of assessment will be used in relation to a taught module, either an assignment or a closed book examination.

This approach has been adopted because:

This approach has been adopted in order to offer diversity in assessing students in relation to learning outcomes. The Course also employs peer- and self-assessment activities to reinforce the reflective abilities that are necessary for working effectively in teams. These encourage student involvement with their learning, and give them some sense of responsibility with regards to the unit of study.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3
1	AO		
2	EX	EX	EX
3	EX	EX	EX
4	EX	EX	EX
5	GCW	GCW	
6	ICW	ICW	ICW
7		EX	EX
8		ICW	ICW
9	ICW		ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 4	ILO 5	ILO 6
10	GPROJ	GPROJ ICW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 7	ILO 8
11	THESIS	OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

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As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Engineering roles, especially mechatronics related ones, in motorsport and high performance engineering: students are likely to go onto careers in F1, Formula E, WRC, WRX, Moto GP, endurance racing, touring cars, motorsport equipment manufacturers and suppliers, automotive OEMs and consultancies.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 06/03/2020

1. What is the course?

Course information

Course Title	Advanced Process Engineering
Course code	MSAPRFTC, MSAPRPTC, PDAPRFTC, PDAPRPTC, PCAPRFTC, PCAPRPTC
Academic Year	2020/21
Valid entry routes	Cranfield - PgCert, PgDip, MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-Time, Part-Time
Location(s)[1] of Study	Cranfield
School(s)	School of Water, Energy and Environment
Theme	Energy & Power
Centre	Climate and Environmental Protection
Course Director	Dr Dawid P Hanak
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	No
Is the Degree apprenticeship integrated or non-integrated?	No

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Mastership offered as an open and/or closed course?	No
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	1 year Full-Time, 3 years Part-time
Course Start Month(s)	October for Cranfield

Institutions delivering the course

This course is delivered by the School of Water, Energy and Environment, Energy Theme, Centre for Climate and Environmental Protection where the research interests include:

- Computer-aided process engineering for design, operation, simulation and optimisation of low-carbon energy systems and industrial processes, including carbon capture, utilization, energy from waste, negative CO_2 emission technologies;
- Thermodynamic, economic and environmental assessment of process and energy technologies; and
- Development and testing of technologies for clean fuel production, clean energy and industrial materials production, and emission control.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course at Cranfield is currently accredited by the Institution of Mechanical Engineers (IMechE) until 2020, pending reaccreditation. The course is also accredited by the Energy Institute.

This course seeks re-accreditation by the Institution of Mechanical Engineers and accreditation by both the Energy Institute and the Institution of Chemical Engineers. To meet the PSRB accreditation requirements, the curriculum of the course has been redesigned to reflect the environmental narrative, focus on sustainability, reliability and safety in the process engineering design. Moreover, an emphasis on professional development, ethics and the role of the engineer has been placed throughout the taught component of the course.

2. What are the aims of the course?

Advanced Process Engineering (APE) MSc integrates applied learning experience with internationally-recognised research of the Advanced Process Engineering team, professional development, mentoring and teamwork to transform the engineering and applied science graduates into engineering leaders who will solve global challenges.

The APE MSc content comprises engineering ‘know-how’ related to design, operation and control of a wide range of process plants, including those in chemical, pharmaceutical, water, food and drink,

oil and gas, petrochemical and power industries. A strong emphasis is placed on economic and environmental aspects of process engineering, as well as on risk and reliability throughout the process lifetime (from design to decommissioning). The curriculum of the APE MSc also aims to develop employability and 21st century skills through research-based and applied learning, staff and peer-to-peer mentoring, teamwork, and employment of state-of-the-art computer-aided engineering methods. The course participants also become members of the Advanced Process Engineering team and, through their applied assignments and project, contribute towards solving global challenges.

The course builds on the legacy of the Process Systems Engineering MSc that has evolved over the past 10 years as a result of discussions with Industrial Advisory Panels, employers, sponsors and previous students. The innovation in assessment and delivery has been developed through the review exercise (Sustainability and Innovation Leaders) at SWEE. As a result, the content of the programme of study is updated regularly to reflect changes arising from technical advances, economic factors and changes in legislation, regulations and standards, as well as to meet the requirements of the target audiences.

This programme is intended for the following range of students:

- Engineering and applied science graduates and practicing engineers wishing to pursue a technical management and leadership career in the strongly growing process industry sector.
- Engineering and applied science graduates aiming to develop their start-ups to deliver disruptive solutions in decarbonisation of the process industry.
- Applicants are required to have at least a UK 2nd class honours degree or its equivalent. Applications from candidates with lesser qualifications but with considerable relevant working experience will be considered

3. <u>What should students expect to achieve in completing the course?</u>

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Advanced Process Engineering

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Evaluate the technical, environmental and economic issues involved in the design and operation of process plants and the current practice in process industries.

ILO 2. Create effective and innovative designs, as well as operation, optimisation and control strategies for a broad range of processes via proper methodologies and relevant software.

ILO 3. Design industrial processes, analyse their performance and solve industrial challenges using appropriate theoretical and practical process engineering methods (including risk assessment and management, computer-aided process modelling, economic assessment) to develop well-substantiated recommendations from process feasibility and safety standpoints.

ILO 4. Apply, critically evaluate and reflect on key technical management and leadership principles, including project management, people management, technology marketing, product development and economics, through their own experience

ILO 5. Apply independent learning, especially via the effective use of information retrieval systems and a competent and professional approach to solving problems and optimising the application of existing and emerging technologies.

B. Postgraduate Diploma in Advanced Process Engineering

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO6. Integrate knowledge, skills and behaviours from the taught modules in a real-life situation to address problems faced by industrial clients; creating new problem diagnoses, designs, or system insights; communicating findings in a professional manner in written, oral, and visual forms; and reflecting on their personal development in a critical and professional manner to enhance self-awareness and identify further development needs.

C. MSc in Advanced Process Engineering

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO7. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, evaluate findings critically and draw justifiable conclusions, demonstrating self-direction and originality of thought.

ILO8: To communicate their individual research via a thesis and in an oral presentation in a style suitable for academic and professional audiences.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- A dedicated electronic VLE site
- One-day workshop in MATLAB training
- Computer-aided process engineering training
  Joining Advanced Process Engineering team
  Arrangement of attendance of relevant modules offered by other MSc programmes

The taught programme is generally delivered from October to December and from January to February. The eight modules are divided into 5 core modules and 3 applied modules. Each module is allocated two weeks on the timetable and will be delivered flexibly during this time, using a combination of online and face to face interactions. The five core modules will be assessed by either an exam or an assignment. The applied modules build on and apply the material taught in the core modules and utilise more interactive teaching methods, such as workshops and practicals. The applied modules are assessed by assignment submitted at the end of the two weeks..

The Group Project is delivered between March and May. Each group will typically include 4-6 students and an academic supervisor will be assigned to each group. Formal project review meetings will be held on a bi-weekly basis at which each student will be required to provide a brief presentation on the work performed to date. The academic supervisor will participate in these project review meetings to record attendance, assess the individual oral presentations and level of contribution to the project and to provide guidance as appropriate. Students taking the group project are required to participate in at least 80% of these review meetings. Additionally, it is expected that students will meet and work on the project outside of the formal meetings. A (student) project co-ordinator will be nominated to ensure that these meetings are used to good effect and appropriate minutes are taken and findings reported to the academic supervisor. Students will be required to attend in person the initial and final project review meetings.

Part-time students have the option to carry out a dissertation project in place of the Group project.

The Individual Research Project is typically delivered between May and September. Each student is allocated a supervisor, who will guide and assess the student work. During the Individual research project period, the supervisor and the student should meet at least every two weeks to review progress made and agree future actions.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction	0
Process Instrumentation and Control Engineering	10
Sustainability and Economic Assessment	10
Process Design and Simulation	10
Advanced Control Systems	10
Computational Fluid Dynamics for Industrial Processes	10
Risk & Reliability Engineering	10
ELECTIVE MODULES:	
N/A	
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction	0
Research Methods and Project Management	10
Sustainability and Economic Assessment	10
Process Design and Simulation	10
Advanced Control Systems	10
Thermal Systems Operation and Design	10
Risk & Reliability Engineering	10
Process Instrumentation and Control Engineering	10
Computational Fluid Dynamics for Industrial Processes	10
Group Project (Compulsory for Full-Time Students)*	40

ELECTIVE MODULES:	
*Part Time Students: Group Project OR Dissertation	 40 40
TOTAL:	120

C. MSc (at Cranfield)

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Induction Research Methods and Project Management Sustainability and Economic Assessment Process Design and Simulation Advanced Control Systems Thermal Systems Operation and Design Risk & Reliability Engineering Process Instrumentation and Control Engineering Computational Fluid Dynamics for Industrial Processes Group Project (Compulsory for Full-Time Students)* Individual Research Project	0 10 10 10 10 10 10 10 10 40 80
ELECTIVE MODULES:	
Part Time Students: Group Project OR Dissertation	 40 40
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of

your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October) and are expected to complete the course within 12 calendar months.

This course is also offered on a part-time basis. Students would instead attend the required modules of the taught component according to the schedule agreed with the course director. MSc research projects are commonly undertaken in collaboration with the candidate's place of work.

Each module is taught over two weeks, with the second week largely free of structured teaching to allow time for more independent learning and reflection.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exit routes are provided as fall back routes for MSc candidates.

7. Course Level Assessment Strategy[4]

Advanced Process Engineering MSc integrates applied learning experience with professional development, mentoring and teamwork to transform the engineering and applied science graduates into engineering leaders who will solve global challenges. A broad range of assessment tasks, which are designed to stimulate and challenge the students, are incorporated in the modules and projects to enable the students to develop a portfolio of work that demonstrate a full range of skills and attributes. These are aligned with the specific competencies in the UK-SPEC and designed to incorporate innovative approaches to learning and assessment.

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[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Each module includes both summative and formative assessment, which enable the course team to provide rapid and relevant feedback to the students. The details regarding specific tasks (type, length, requirements) and their classification (formative/summative) are clearly stated in each module descriptor. The module assessments are designed to address the course ILOs 1-6. Considering the variety in backgrounds and experiences of the APE cohorts, the first module (*Risk and Reliability Engineering*) is assessed by the closed-book exam. This will enable them to assimilate in the new learning environment and will be the starting point to the transition to more applied learning.

In the second module (*Research Methods and Project Management*) students will develop and write the research proposal that will enable them to develop skills in project management (scoping, planning, resources, risk assessment), literature review and design of research methodology that are not only required to complete their group and individual projects successfully, but also to develop as project managers and leaders in process engineering. Ability to concisely describe the considered process, present the assumptions used to develop the models and designs, and accurately discuss the results is crucial for process engineers. Moreover, process engineers and project managers need to be able to prepare reports of varying lengths and containing only key information and message tailored to the target audience.

Therefore, in the third (*Computational Fluid Dynamics for Industrial Processes*) and fourth (*Advanced Control Systems*) students will write the technical reports on their modelling and design work with the emphasis placed on discussion of the feasibility of their results. Through this they will learn how to tailor their written communication to the technical and expert audience.

In the fifth (*Sustainability and Economic Assessment*) and seventh (*Process Design and Simulation*) modules, students will be required to write short essays, which are tailored to a less technical audience, on their analysis of the given case study. This is to help them recognise that writing a more concise report may be more challenging and time consuming. This will also enable students to develop relevant skills to communicate their technical and design work concisely.

In the sixth (*Process Instrumentation and Control Engineering*) module, students will be required to undertake a practical lab work and present their results via group practical (formative) and individual assessment (summative). This will allow them to develop technical communication and presentation skills, essential in work as a process or project engineer. In the eight (*Thermal Systems Operation and Design*) module, students will receive three independent design and optimisation task. They will be asked to present their approach to problem solving, discuss results and recommendations for each task in a single report. Process engineers need to handle multiple tasks at the same time. Therefore, this assessment task has been designed to enable students to plan their work, prioritise tasks and ensure each task is completed to a satisfactory quality. Importantly, each module will incorporate opportunities for formative feedback via group discussion, individual presentations, case studies and individual coursework. The students will receive the feedback during or immediately after the formative tasks took place.

The taught modules are followed by the group project (dissertation for PT students), which addresses the course ILO 6, and individual research project, which addresses the ILOs 7-8. The former is assessed by the group report and presentation that simulates the work environment. Students have an opportunity to reflect on their performance during the group project. Their contribution to the project is also assessed by their supervisor. The latter is assessed by the individual thesis and oral presentation. They will also receive formative feedback from their supervisors during the regular progress meetings.

To ensure APE students develop relevant employability skills and different skills relevant to professional practice, they are asked to submit a reflective review (500-750 words) for each module and a group project, in addition to their module assessment. This will enable them to critically reflect on what they have learnt in that particular module and how the knowledge, skills and behaviours will help them to develop their

careers. The feedback will be provided by the course director on each reflective review and then on the reflective portfolio as a whole after the completion of group project.

Course modules

The following modules outline all parts of the programme leading to **MSc in Cranfield**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-ENE-INWK Occ A	Induction	Gill Drew	24		0	Y		05/10/20	09/10/20	N/A	AO	N/A				N/A	
2	N-AME-RR Occ A	Risk and Reliability Engineering	Dawid Hanak	27		10	Y		12/10/20	23/10/20	50	EX	100				Exam week 2 4-8/1/21	05/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	N-APE-RMPM	Research Methods and Project Management	Gill Drew	20		10	Y		26/10/20	06/11/20	50	ICW	100				FT 07/11/20 PT 21/11/20	05/21
4	N-PSE-CETIP Occ A	Computational Fluid Dynamics for Industrial Processes	Patrick Verdin	30		10	Y		09/11/20	12/11/20	50	ICW	100				FT 21/11/20 PT 05/12/20	05/21
5	N-PSE-ACS Occ A	Advanced Control Systems	L Lao	30		10	Y		23/11/20	04/12/20	50	ICW	100				FT 05/12/20 PT 19/12/20	05/21
6	N-APE-SEA	Sustainability and Economic Assessment	Dawid Hanak	30		10	N		07/12/20	18/12/20	50	ICW	100				FT 19/12/20 PT 02/01/21	05/21
7	N-APE-PICE	Process Instrumentation and Control Engineering	L Lao				N		11/01/21	22/01/21	50	ICW	100				FT 23/01/21 PT 06/02/21	05/21
8	N-PSE-PSD Occ A	Process Design and Simulation	Dawid Hanak	25		10	Y		25/01/21	05/02/21	50	ICW	100				FT 06/02/21 PT 20/02/21	05/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	N-PSE-TSOD Occ A	Thermal Systems Operation and Design	Ali Nabavi	30		10	Y		08/02/21	19/02/21	50	ICW	100				FT 20/02/21 PT 06/03/21	05/21
10	I-ENE-GRPP Occ A	Group Project	Gill Drew	16		40	Y		01/03/21	07/05/21	50 50 50 50	GCW GPRES ICW RP	64 16 10 10				05/05/21 30/04/21 08/05/21 NA	
11	I-ENE-DISS Occ A	Dissertation for part time students	Gill Drew	10		40	Y		01/03/21	24/09/21	50	IPROJ IPRES	80 20				24/09/21 W/C 20/09/21	
12	I-ENE-THESIS Occ A	Energy Individual Research Project	Gill Drew	20		80	Y		10/05/21	10/09/21	50 50	OR THESIS	10 90				23/08/21- 30/08/21 06/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-AME-RR	Risk and Reliability Engineering	Advanced Mechanical Engineering	• Advanced Process Engineering • Offshore Engineering (Management route) • Process Systems Engineering (Muscat)
N-PSE-ACS	Advanced Control Systems	Advanced Process Engineering	• Energy Systems and Thermal Processes • Advanced Process Engineering • Process Systems Engineering (Muscat)
N-PSE-CETIP	Computational Fluid Dynamics for Industrial Processes	Advanced Process Engineering	• Advanced Chemical Engineering • Energy Systems and Thermal Processes • Advanced Process Engineering • Process Systems Engineering (Muscat)
N-PSE-PSD	Process Design and Simulation	Advanced Process Engineering	• Advanced Chemical Engineering • Energy Systems and Thermal Processes • Advanced Process Engineering • Process Systems Engineering (Muscat)
N-PSE-TSOD	Thermal Systems Operation and Design	Advanced Process Engineering	• Advanced Chemical Engineering – General Route • Advanced Process Engineering • Process Systems Engineering (Muscat)

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have 6–8 written examinations, 7 pieces of assessment by submitted work and 4–5 elements of assessment by presentation or viva.

This approach has been adopted in order to:

- Assess the knowledge of the students using methods appropriate to the nature of the subject area
- Help the students to improve their technical writing and oral presentation skills

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate at Cranfield

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.
2	EX		EX	EX	EX
4		ICW	ICW		
5		ICW	ICW		
6	ICW	ICW			ICW
7		ICW	ICW		
8	ICW	ICW	ICW	ICW	ICW

B. Postgraduate Diploma at Cranfield

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.
3				ICW	ICW	
9	ICW	ICW	ICW		ICW	
10						GCW GPRES ICW RP
11						IPROJ IPRES

C. MSc at Cranfield

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 7.	ILO 8.
12	THESIS	THESIS

Award ILOs / Module No.	ILO 7.	ILO 8.
	OR	OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and

national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Graduates of the course have been successful in gaining employment in:

- Engineering consultancies and design practices
- Industries:
  - Oil and gas
  - Petrochemical
  - Chemical
  - Pharmaceutical
  - Water
  - Power
  - Food and drink
- Research organisations
- Academic institutions

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

COURSE TITLE: MSc in Advanced Water Management

Date of first publication/latest revision: 10/04/17/ May 2020

1. What is the course?

Course information

Course Title	Advanced Water Management
Course code	MSAWMFTC MSAWMPTC PDAWMFTC PDAWMPTC PCAWMFTC PCAWMPTC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert,
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield Campus
School(s)	School of Water, Energy and Environment
Theme	Water
Centre	Cranfield Water Sciences Institute
Course Director	Dr Dolores Rey Vicario
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Minimum 2nd class UK honours degree or equivalent or relevant industrial experience. Language proficiency for non-UK students: TOEFL: 237 (computer version), 580 (paper version), or TOEIC: 830, or IELTS: 6.5 minimum, or Cambridge certificate: C or above
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years, Full-time PgCert - one year, Part-time PgCert - two years, Full-time PgDip - one year, Part-time PgDip - two years
Course Start Month(s)	Full-time: October Part-time: throughout the year (October preferred, other times on case by case basis)

Institutions delivering the course

This course is delivered by the Cranfield Water Sciences Institute where the research interests include the science, engineering and management of water in municipal, industrial and natural environments, encompassing treatment technologies, engineering, irrigation, socioeconomics and policy. Research across the Department also focuses on soil and water sciences in the context of land management for food, fibre and bio-energy crops, environmental services and biodiversity, using expertise in biophysical and social sciences and agricultural engineering.

The MSc Advanced Water Management has been developed in collaboration with employers in response to the increased demand for water managers with the appropriate blend of skills and creativity to provide solutions to the complex problems of the future. This programme provides the skills and knowledge required to assess, plan, execute and implement strategies for the sustainable management of water in natural, semi-natural and man-made environments. It addresses the common themes pertaining to water and sanitation in all situations.

Cranfield University actively engages external speakers from across the water sector to deliver the Advanced Water Management course, including from:

- The Environment Agency
- The Open University
- Anglian Water

Cranfield University also actively seeks sponsorship and support for individual thesis projects from water sector employers to provide professional experience and development opportunities for students. Thesis sponsors and supporters include:

- The Environment Agency
- Canal and River Trust
- Atkins
- Affinity Water)
- RSPB, Regional Wildlife Trusts

Cranfield University has agreements with a number of top quality European higher education institutions through its European Partnership Programme (EPP). Within these agreements students from partner institutions have the opportunity to take a Master of Science (MSc) at Cranfield University as an alternative to the final year of their home university programme. The EPP provides a feeder-stream of European students to Advanced Water Management and in doing so contributes to the diversity of the class.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)
This course is accredited formally by Chartered Institution of Water and Environmental Management (CIWEM) until October 2021.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Provide the appropriate science & technology background to manage water effectively and efficiently in natural, semi-natural and man-made environments

This programme is intended for the following range of students:

- Graduates with science, engineering, geography or related degrees keen to pursue careers in water management
- Graduates currently in employment keen to extend their qualifications or to pursue a career change
- Individuals with other qualifications but who possess considerable relevant experience

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Advanced Water Management

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Identify the principal controls on water quantity, water quality and aquatic ecology, and assess the relative importance of natural and anthropogenic factors.

ILO 2. Interpret and critically evaluate the quality of environmental information, research and data, and determine relevance for application in relation to solving academic and practical problems.

ILO 3. Select and apply appropriate analytical, statistical, modelling or decision-support tools to existing environmental data, and interpret the findings in the context of current environmental regulation.

ILO 4. Develop and critically assess appropriate and sustainable solutions to environmental water management problems in natural and man-made environments with due regard to the technical, social and institutional constraints imposed by the surrounding environment.

B. Postgraduate Diploma in Advanced Water Management

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Integrate knowledge, understanding and skills from the taught modules in a real-life situation to address problems faced by industrial clients; creating new problem diagnoses, designs, or system insights; and communicating findings in a professional manner in written, oral and visual forms.

C. MSc in Advanced Water Management

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 6. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, evaluate findings critically and draw justifiable conclusions, demonstrating self-direction and originality of thought.

ILO 7. To communicate their individual research via a thesis and in an oral presentation in a style suitable for academic and professional audiences.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Structured teaching and learning activities in the taught modules (e.g. lectures, workshops, computer practicals) that support students in their completion of the assessments and provide discipline-specific and transferable skills training
- Being provided with the opportunity to undertake externally sponsored or supported thesis project research
- Undertaking field and laboratory work within the context of group and thesis projects to integrate and apply knowledge and skills
- Students are allocated project supervisors for their thesis and group projects who guide the research and provide formative feedback on reports and presentations
- Course Director, Module Convenors, and other academic staff are readily available for informal advice and feedback

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits

COMPULSORY MODULES:	
Induction	0
ELECTIVE MODULES:	
Any three of the following modules: Surface and groundwater hydrology: processes, measurement and modelling Good ecological status Managing flood and drought risk Water in cities and catchments	 20 20 20 20
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction Surface and groundwater hydrology: processes, measurement and modelling Good ecological status Managing flood and drought risk Water in cities and catchments Group Project (Full-time students)	0 20 20 20 20 40
ELECTIVE MODULES:	
Part Time Students: Group Project OR Dissertation	 40 40
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Induction Surface and groundwater hydrology: processes, measurement and modelling Good ecological status Managing flood and drought risk Water in cities and catchments Group Project (Full-time students) Thesis Project	0 20 20 20 20 40 80
ELECTIVE MODULES:	
Part Time Students: Group Project OR	 40

Dissertation	40
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Please see the module descriptors and material on the Virtual Learning Environment (Blackboard) for details on the individual elements of the course. Each module is taught over four weeks, with the fourth week largely free of structured teaching to allow time for more independent learning and reflection. Some modules use a 'flipped' structure where the independent learning week precedes the structured teaching week. The 'flipped' module requires students to prepare material (data analysis, presentations, etc.) for case-study based workshops the second week. Group projects are located after the taught modules, between February and April. Individual thesis research projects are run from May till the end of August with thesis submission and oral assessment in early September.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

All options are also offered on a part-time basis and such students are expected to complete the course within 2 to 3 years. Part-time students are not restricted to starting in October. Instead they are offered individual guidance on the best sequence of study based on their prior knowledge and availability to attend.

7. Course Level Assessment Strategy[4]

Students on the course will be assessed by a variety of assessments during modules, group project and thesis period. The summative assessment plan for the modules is outlined in the table below. All four modules will be assessed by individual coursework, but they cover a range of styles that a graduate of the course may be expected to write at the early stages of their career. The assessments have been mapped against the course level ILOs to ensure they cover the core learning across the course. Summative assessment will be complemented by on-going formative assessment and feedback within modules.

Assessment strategy for Advanced Water Management

Module	Module Assessment	Course Level ILOs
Surface and Groundwater Hydrology: processes, measurement and modelling	Individual Course Work - Design, implement, evaluate and apply a numerical hydrological model for a local catchment case study to evaluate the impact of future climate and non-climate changes on the catchment and discussing the implications for catchment management. The catchment conceptualisation, model development, analysis and conclusions are presented in an individual technical report (15 pages max, including figures, tables and references).	ILO1, ILO3
Good Ecological Status	Individual Course Work - An independently written scientific report that assesses the spatial and temporal variation in the ecological and chemical quality of a surface waterbody based on field data collected during the module and publicly available data sources, interprets findings based on catchment influences and ecological interactions, and proposes additional variables to include in future studies (15 pages A4 max, including figures, tables and references).	ILO1, ILO2, ILO3
Managing Flood and Drought Risk	Individual Course Work - The student will research and write a paper on one of a selection of topics provided by the module convenor related to the planning for or response to flood or drought events (3000 word limit, excluding abstract, references and tables).	ILO1, ILO4
Water in Cities and Catchments	Individual Course Work - An individual report that critically evaluates the current environmental, water resource, flood risk and development plans for a case study city/town to identify possible conflicts or unrealised synergies and proposes integrated solutions (15 pages A4 max, including figures, tables and references	ILO1, ILO2, ILO3, ILO4
Group Project	Group and Individual Course Work - The students work in small consultancy teams typically on a client sponsored project for a period of 10 weeks. The students are responsible for interpreting the brief, developing a project plan, selecting and implementing a methodology, deriving	ILO5

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

	results, analysing the results and drawing conclusions in alignment with the aims and objectives. All students participate in a peer review activity providing them with the opportunity to reflect on the practices of their colleagues as well as their own. Peer review feedback is provided individually by an independent member of academic staff. A single group report is produced and the project is presented orally at the concluding Exhibition Day, both elements are summatively assessed by independent markers and a group mark is assigned for each element. Individual assessment is derived from supervisor observation and meeting minute actions and an individual reflective report where the students reflect on the development of three soft skill competencies based on objectives that they set for themselves. The team working competency is mandatory as one of the three skills for each student.	
Dissertation (Part-time students only)	Individual Course Work - Part time students are not required to complete the Group Project undertaken by the full time registered students on a SWEE MSc course. An alternative assignment takes the form of a dissertation or design project which in most situations will be based around a topic relevant to the work of the part-time student. It is evident that some aspects of the Group Project experience that the work-based dissertation replaces – for example the client interaction and group dynamics components will not directly replicated by undertaking this assignment. It is expected that these experiences would normally be a part of the normal working life of the part-time student. It is expected that the dissertation will normally consist of the following elements: Abstract, Background context, Introduction to the theme(s) addressed within the dissertation, setting out the issues that will be covered, Methodology, In depth analysis/discussion of the topics discussed, Concluding remarks, References, Appendices (if relevant). Two supervisors are allocated to the dissertation and supervision follows the model used for the independent research project. The student will submit a 6,000 word report and will give an oral presentation of their work. Both elements of assessment will be marked by independent assessors.	ILO6, ILO7
Individual Thesis Project	Individual Course Work -The individual research project requires students to further develop problem definition, hypothesis setting, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions in the context of research questions relevant to the course followed by a student. The student is required to communicate their findings successfully via a thesis, written in the style of a scientific paper and an oral presentation based around a poster. The projects are designed to integrate knowledge, the taught modules, and apply understanding and skills from the group project, to deliver a high quality written thesis and oral presentation. The individual research project/thesis is typically delivered through collaboration with an industrial sponsor, or it may be an ‘internal’ project reflecting the research interests of the School.	ILO6, ILO7

Course modules

The following modules outline all parts of the programme leading to MSc. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-WAT-INWK	Induction Week	J MacAdam	24		0	Y	05/10/20	05/10/20	09/10/20	N/A	AO	N/A				N/A	
2	I-AWM-SGH	Surface and Groundwater Hydrology: processes, measurement and modelling	I Holman	60		20	Y	12/10/20	12/10/20	30/10/20	40	ICW	100				FT - 07/11/20 PT – 21/11/20	May 2021
3	I-AWM-GES	Good ecological status	P Campo Moreno	60		20	Y	09/11/20	09/11/20	27/11/20	40	ICW	100				FT - 05/12/20 PT – 19/12/20	May 2021

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
4	I-AWM-MFDR	Managing flood and drought risk	D Rey Vicario	60		20	Y	07/12/20	07/12/20	15/01/21	40	ICW	100				FT - 23/01/21 PT – 06/02/21	May 2021
5	I-AWM-WCC	Water in Cities and Catchments	R Grabowski	60		20	Y	25/01/21	25/01/21	12/02/21	40	ICW	100				FT - 20/02/21 PT – 06/03/21	May 2021
PROJECTS																			
6	I-WAT-GRPP	Group Project	J MacAdam	16		40	Y	22/02/21	22/02/21	07/05/21	50 50	GCW GPRES ICW RP	64 16 10 10				30/04/21-16.00hrs 04/05/21 08/05/21 08/05/21	
7	I-WAT-DISS	Individual Project (PT MSc and PgDip only)	J MacAdam	10		40	Y	22/02/21	22/02/21	24/09/21	50	IPROJ IPRES	80 20				24/09/21 Week commencing - 20/09/21	
8	I-WAT-THESIS	Individual Research Project	J MacAdam	20		80	Y	10/05/21	10/05/21	10/09/21	50	THESIS OR	90 10				06/09/21 –16.00hrs Week commencing – 24/08/21 and 31/08/21	Sept 2022

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
I-AWM-SGH	Surface and Groundwater Hydrology: processes, measurement and modelling	Advanced Water Management	Water and Waste Infrastructure Systems Engineered for Resilience (Water-WISER) CDT
I-AWM-GES	Good Ecological Status	Advanced Water Management	Water and Waste Infrastructure Systems Engineered for Resilience (Water-WISER) CDT
I-AWM-MFDR	Managing Flood and Drought Risk	Advanced Water Management	Water and Waste Infrastructure Systems Engineered for Resilience (Water-WISER) CDT
I-AWM-WCC	Water in Cities and Catchments	Advanced Water Management	Water and Waste Infrastructure Systems Engineered for Resilience (Water-WISER) CDT

8. How are the ILOs assessed?

The following assessment types are utilised:

The MSc course is assessed as three elements:

- the taught modules (40%) are assessed by in-module assessment (including coursework, which focuses on application of principles studied and class tests, which support underpinning knowledge);
- group projects (20%) are assessed by means of a written group report and presentations. Individual design projects (PTs) are assessed by means of a written dissertation.
- the research project (40%), is assessed by a thesis and an oral examination.

This approach has been adopted because:

Different types of assessments enable the evaluation of a range of M-level skills. A mixture of both individual and group assessments is important in helping students to develop both individual skill and team work related skills. Group and thesis projects follow the completion of the taught part of the course and at this stage more emphasis is on enquiry based learning and problem solving.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4
1				

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4
2	ICW		ICW	
3	ICW	ICW	ICW	
4	ICW			ICW
5	ICW	ICW	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 5
6	GCW GPRES ICW RP
7	IPROJ IPRES

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO6	ILO 7
8	THESIS OR	THESIS OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and

procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

On completion, graduates have a broader network of global contacts, increased opportunities for individual specialism in their chosen career, and the capability to make an immediate and real contribution to improved water supply and sanitation. Cranfield Advanced Water Management graduates are highly sought after by employers. Typical employers include:

- Environment Agency
- Wildlife Trusts
- Local Government
- Water utilities e.g. Thames Water, Yorkshire Water
- International engineering consultancies (e.g. MWH, Halcrow, Atkins)

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: May 2020

1. What is the course?

Course information

Course Title	MSc in Aerospace Computational Engineering
Course code	MSACNFTC, MSACNPTC, PDACNFTC, PDACNPTC, PCACNFTC, PCACNPTC
Academic Year	2019/2020
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield
School(s)	School of Aerospace, Transport and Manufacturing (SATM)
Theme	Aerospace
Centre	Computational Engineering Sciences
Course Director	Dr. Laszlo Konozsy
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - three years
Course Start Month(s)	September

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing (SATM), Aerospace Theme, Centre of Computational Engineering Sciences where the research interests include:

- Fluid dynamics of single- and multi-phase and multi-species flows.
- Steady and unsteady aerodynamics for investigating laminar and turbulent flows.
- Transitional flows, classical and advanced turbulence modelling.
- Heat transfer and its application related to complex flow problems.
- Development of advanced numerical methods for a broad range of fluid flow problems.
- Scientific and high performance computing.
- Computational fluid dynamics with the applications in aerospace, automotive, environmental, energy, micro- and nanotechnology, nuclear, bio-medical, chemical and defence sectors.
- Computer vision.
- Vibro-acoustics for condition monitoring.
- Computational engineering for fluids and solids.
- Software Engineering for Technical Computing, Computer Aided Engineering

Cranfield University interacts with the following institutions and in the following ways:

The course has a strong association with a number of academic institutions world-wide that regularly supply students onto MSc courses in the Centre of Computational Engineering Sciences at Cranfield University. Students may follow the course as part of a double degree arrangement with their home institution whereby the final year of their five year programme is replaced with the MSc here at Cranfield. Other students are self-funded.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

We will be seeking accreditation for IET, IMechE, and RAeS. This course is designed to align with the MSc in Computational and Software Techniques in Engineering and the MSc in Computational Fluid Dynamics, which are already accredited.

2. What are the aims of the course?

- Provide a comprehensive training programme in Aerospace Computational Engineering (ACE) which will enhance the skills of the graduate student through a detailed introduction to the state-of-the-art computational methods and their applications for digital age aerospace engineering applications.
- Combination of both computational flow physics and computational science to enable the student to understand the current suite of digital techniques for aerospace simulations.
- Access to the university High Performance Computing (HPC) facilities for teaching and research projects and opportunity to work on research projects proposed by industry.

- Provide a unique opportunity to work within a team on a cutting edge group project based on a digital wind tunnel for aerospace applications through the Cranfield Aerospace Integrated Research Centre (AIRC).
- Provide a unique opportunity for cross-disciplinary education and knowledge transfer in the computational engineering of fluid and solid mechanics for aerospace industrial applications.
- Produce graduate engineers and leaders for the rapidly expanding digital simulation age focusing on fully integrated digital design for aerospace applications to understand and implement numerical methods on various computing platforms for aerospace applications.
- Provide a CPD opportunity through the part-time course option for qualified engineers wishing to extend their knowledge of Aerospace Computational Engineering and incorporate CFD into their practice.
- Equip graduates with the knowledge, understanding and skills required to enable them to meet the demand of an evolving workplace that requires highly qualified engineers possessing core software engineering skills together with competency in mathematical analysis techniques.
- Develop suitably trained and qualified engineers, scientists and mathematicians enabling them to apply the analytical, computational and software skills to the solution of practical engineering IT problems in industrial, commercial and governmental organisations.

This programme is intended for the following range of students:

- UK students with an honours degree in Engineering, Computer Science, Mathematics, Physics.
- Mature students with at least 5 years relevant industrial experience.
- Students studying at recognised EU Universities with at least 4 years of relevant academic study.
- Recent graduates wishing to extend their knowledge and skills in the above areas.
- Qualified engineers wishing to apply their skills in new areas.
- Qualified engineers working with computational methods in a particular area wishing to extend their knowledge and enhance their practice by knowledge transfer from different application areas.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Assess and evaluate the selection of computer languages, software tools, and technologies, and apply them to solve practical problems of a computational nature in aerospace engineering solutions.

ILO 2. Distinguish the principles of numerical analysis, concepts of stability, approximation and convergence, and estimate the numerical solution of the system of algebraic equations.

ILO 3. Create original software solutions to aerospace computational engineering problems by using industry standard software libraries, packages and engineering tools.

ILO 4. Assess the state-of-the-art computational methods for incompressible and compressible flows used in aerospace engineering including the understanding of the advantageous features and limitations of these methods to identify the possible sources of uncertainties for aerospace applications.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Compose written reports and prepare and deliver oral presentations that effectively communicate proposals, technical developments, and computational results.

ILO 6. Set up a systematic approach to mesh generation methods and visualisation techniques including their application and interpretation for aerospace engineering problems.

ILO 7. Distinguish between open source and commercial Computational Fluid Dynamics and Finite Element Analysis software packages relevant to aerospace application(s).

ILO 8. Use and select appropriate software packages to practical aerospace computational engineering application(s), and evaluate the outcome.

ILO 9. Critically evaluate a project to include: a) computational aerospace engineering methods; b) project outcomes and results; c) one or more aspects of strength and weakness of the selected methods; d) propose appropriate solutions for the investigated aerospace application; e) recommendations for the future work.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 10. Distinguish and assess systematic computational aerospace engineering methods for different industrially relevant fluid flow problems with the focus on planning and implementing assigned projects under time pressure, and undertake self-directed learning when necessary.

ILO 11. Assemble a body of relevant technical literature in the field of aerospace computational engineering and discuss and evaluate each work with respect to a technical problem relevant to an industrial application.

ILO 12. Propose, plan and implement an independent research project on a relevant technical topic of aerospace engineering and critically evaluate project results, discuss findings, and relate their contribution to other works in the field.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- A comprehensive set of carefully prepared lecture notes that form the basis for the teaching will be available to students on the VLE. This is perhaps the most valuable resource and reference point for the student starting a new module. Secondly, many lectures are given in PC Labs in conjunction with some form of programming. Students are encouraged, given time and practical assistance to develop their software skills. Part-time students applying to current MSc's within the CES centre are primarily coming from industry and contribute to the diverse structure of the centre. Therefore, the learning experience of part-time students will be supported by providing them with course material and support through distance learning techniques. Part-time students will be supported through regular consultations by using e.g. WebEx and Skype as a part of their study. For performing simulations, part-time students will have opportunity to access our High-Performance Computing facilities remotely. Regular meetings will be organised for each group when the group design project will be running and part-time students will be able to attend on these meetings either in person or online. Additionally, a Part-Time Student Advisor (PTA) will be appointed from the academic team who can advise on module selection for years 1 and 2 and maintain university and course updates whilst away from Cranfield thus ensuring the part-time student is prepared before attending any modules in Cranfield.
- The library resources and search facilities here at Cranfield. A thorough introduction to these resources and demonstrations of information retrieval skills is provided at the beginning of the course. The library facilities are extensive and there is a good representative selection of books and periodicals relevant to the course. Where an article, book or periodical is not available it can usually be obtained elsewhere via inter-library loans. Books, software and other resources are purchased by the group when it is necessary for one of the projects.
- This course uses assignment, group project and individual thesis project. This approach has been adopted in order to prepare the student with the requisite skills for a career in digital engineering, digital engineering management or research. This approach will enable the student to demonstrate an understanding of theory and application at masters level through written technical reports and papers and oral presentations. Since in this course practical application is key to development of understanding and skills acquisition, all taught modules are assessed by individual assignment. In addition, a group project will be assessed based on the skill sets

acquired through the taught components of the course. Finally, application of the knowledge and its understanding is also assessed through the thesis project.

- A programme of seminars given by external and internal speaker is also provided for the MSc in Aerospace Computational Engineering students. These reflect the course, sponsoring companies and associated research carried out in the group enabling the students to get an appreciation of related work going on in industry and other universities. Part-time students will usually be able to attend on the aforementioned seminars through e.g. WebEx and Skype as a part of their study. Furthermore, additional consultation hours and support will be offered by the module leaders between the end of their completed modules and the start of their subsequent modules.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-4 20 credits selected from Modules 5-8	40 20
ELECTIVE MODULES:	
n/a	
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-8 Group Project for full-time students (9) or Individual Dissertation for part-time students (10)	80 40
ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-8 Group Project for full-time students (9) or Individual Dissertation for part-time students (10)	80 40

Individual Research Project (11)	80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in September and are expected to complete the course within 11 calendar months.

Part-time students register for the course in September and are expected to complete the course within 3 years.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

Each module is taught over a period of one week. Practical work forms an important part of the teaching and so a significant amount of time is devoted to hands-on sessions with a software package or development environment. This also facilitates independent learning on the part of the student.

7. Course Level Assessment Strategy[4]

The MSc in Aerospace Computational Engineering course contains eight core modules (80 credits), one group design project (40 credits) and an individual thesis work (80 credits). Students have to complete seven assignments and take one exam, and the submission of a group design project report and an individual MSc thesis are required for the successful completion of the MSc course. Each module is taught over a period of one week. Practical work forms an important part of the teaching and so a significant amount of time is devoted to hands-on sessions with a software package or development environment. This also facilitates independent learning on the part of the student.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to **MSc**. Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1		N-CST-CPPI (NEW CODE)	C++ Programming (Integrated)	Dr Irene Moulitsas	32	0	10	Y	29/09/20	29/09/20	09/10/20	40	GCW Integrated Assessment	100				FT 07/12/2020 PT 21/12/2020	At the next available opportunity which may not be until the course runs the following year
2		N-CST-CMI (NEW CODE)	Computational Methods (Integrated)	Dr Irene Moulitsas	32	0	10	Y	29/09/20	29/09/20	09/10/20								

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate). If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3		N-CFD-NMCF	Numerical Modelling for Compressible Flows	Dr Panagiotis Tsoutsanis	20	0	10	Y	18/01/21	18/01/21	22/01/21	40	ICW	100				FT PT	At the next available opportunity which may not be until the course runs the following year
4		N-CFD-NMIF	Numerical Modelling for Incompressible Flows	Dr Laszlo Konozsy	20	0	10	Y	04/01/21	004/01/21	08/01/21	40	ICW	100				FT 17/03/21PT 31/03/21	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
5		N-ACN-AVBDS	Analysis and Visualisation of Big Data System and High Performance Computing	Dr Zeeshan Rana	20	0	10	N	19/10/20	19/10/20	23/10/20	40	ICW	100				FT 06/01/21PT 20/01/21	At the next available opportunity which may not be until the course runs the following year
6		N-ACN-MAAE	Modelling Approaches for Aerospace Applications	Dr Laszlo Konozsy	20	0	10	N	16/11/20	16/11/20	20/11/20	40	ICW	100				FT 24/02/21PT 10/03/21	At the next available opportunity which may not be until the course runs the following year
7		N-CST-CES	Computational Engineering Structures	Dr Karl Jenkins	35	0	10	Y	23/11/20	23/11/20	04/12/20	40	EX	100				Exam Week 5	Exam Week 6

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
8		N-ACN-VVAA	Validation and Verification for Aerospace Applications	Dr Zeeshan Rana	20	0	10	N	02/11/20	02/11/20	06/11/20	40	ICW	100				FT 10/02/21PT 24/02/21	At the next available opportunity which may not be until the course runs the following year
9		N-ACN-GP	Group Project	Dr Laszlo Konozsy	40	0	40		22/02/21	22/02/21	26/02/21	50			100	GPROJ RP	80 * 20	12/05/21 * 30/04/21 30/04/21	At the next available opportunity which may not be until the course runs the following year
10		N-ACN-DISS	Individual Dissertation (for Part-Time Students)	Dr Laszlo Konozsy	40	0	40		22/02/21	22/02/21	26/02/21	50			100	ICW RP	80 20	30/04/21 30/04/21	
11		N-ACN-THESIS	Individual Research Project	Dr Laszlo Konozsy	40	0	80		11/05/21	11/05/21		50 50	THESIS OR	90 10				20/09/21	

* * Group Project Assessment – 100% Multi-part Assessment – RP 20% submission deadline .30/04/21 GPROJ 80% comprises GPROJ (80%), submission deadline 12/04/21 and GPRES (20%), submission deadline . 30/04/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-CST-CPPI (NEW CODE)	C++ Programming (Integrated)	Computational and Software Techniques in Engineering	
N-CST-CMI (NEW CODE)	Computational Methods (Integrated)	Computational and Software Techniques in Engineering	
N-CFD-NMCF	Numerical Modelling for Compressible Flows	Computational Fluid Dynamics	
N-CFD-NMIF	Numerical Modelling for Incompressible Flows	Computational Fluid Dynamics	
N-CST-CES	Computational Engineering Structures	Computational and Software Techniques in Engineering	Shared teaching, with N-ALS-FEM

8. How are the ILOs assessed?

This course uses assignment, group project and individual thesis project.

This approach has been adopted in order to prepare the student with the requisite skills for a career in digital engineering, digital engineering management or research. It will enable the student to demonstrate an understanding of theory and application at masters level through written technical reports and papers and oral presentations. Since in this course practical application is key to development of understanding and skills acquisition, all taught modules are assessed by individual assignment. In addition, a group project will be assessed based on the skill sets acquired through the taught components of the course. Finally, application of the knowledge and its understanding is also assessed through the thesis project.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / **Module No.**	ILO1	ILO2	ILO3	ILO4
1	GCW			
2	GCW	GCW		GCW
3			ICW	ICW
4			ICW	ICW

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4
5		ICW		
6		ICW		
7				EX
8		ICW	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO5	ILO6	ILO7	ILO8	ILO9
9	GPROJ GPRES RP	GPROJ GPRES RP	GPROJ GPRES RP	GPROJ GPRES RP	GPROJ GPRES RP
10	ICW RP	ICW RP	ICW RP	ICW RP	ICW RP

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO10	ILO11	ILO12
11	OR THESIS	OR THESIS	OR THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
Two modules with an Integrated Assessment	N-CST-C++P04 – C++ Programming (Integrated) N-CST-CM Computational Methods (Integrated)	ICW	100

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

This Masters course in 'Aerospace Computational Engineering', with its blend of skills-based and subject-specific material equips students with the generic hands-on skills and up-to-date knowledge adaptable to

the wide variety of applications in the field of aerospace computational engineering. This will lead to opportunities within the rapidly expanding digital engineering sector and specifically to the aerospace industry where fully integrated digital techniques are used. This approach is widely used in companies such as Airbus, Boeing, Rolls Royce and Siemens.

Typically students seek employment in the computational aerospace engineering market. Enquiries regarding availability of potential employees are received from many quarters, both in the EU and elsewhere. There is considerable demand for personnel with expertise in aerospace engineering software development and for those who have strong technical programming skills in industry standard languages and tools. Graduates of the courses currently within the Centre of Computational Engineering Sciences are in demand by CAD vendors, commercial engineering software developers, aerospace, automotive, and other industries and research organisations. Successful students, have been particularly successful in finding long-term employment.

Some students may go on to register for PhD degrees, many, on the basis of their MSc research project. Thesis topics are most often supplied by individual companies on in-company problems with a view to employment after graduation - an approach that is being actively encouraged by a growing number of industries.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: May 2020

1. What is the course?

Course information

Course Title	MSc in Aerospace Dynamics with options in: Aerodynamics Flight Dynamics
Course code	MSASDFTC, MSASDPTC, PCASDFTC, PCASDPTC
Academic Year	2020-21
Valid entry routes	MSc, PgCert
Additional exit routes	
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Aeronautics
Course Director	Dr James Whidborne
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Aeronautics where the research interests include:

- Fluid Mechanics
- Flight Dynamics
- Applied Aerodynamics

Cranfield University interacts with the following institutions and in the following ways:

- We offer APL to students of the Empire Test Pilot School who wish to undertake this course and meet the standard entry requirements of the University.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by The Royal Aeronautical Society (RAeSoc) until AY 2021/22.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- equip candidates from backgrounds in engineering or physical science with the knowledge, understanding and skills required to enable them to contribute to the aerospace industry or to aerospace related research;
- develop a candidates' specialist technical skills and to give them an awareness of aerospace sciences so that their specialist skills can be most effectively applied;
- develop the candidates transferable skills for a professional career in the aerospace or related industry.

Postgraduate Certificate (PGCert) exit route is provided for candidates who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- Those with undergraduate qualifications in General Engineering, Mathematics or Physics seeking to move into the aerospace sector.
- Those with undergraduate qualifications in Aeronautical Engineering seeking to specialise in a specific branch of Aerospace Dynamics or to broaden their knowledge and understanding of this area.

- Those with the other academic qualifications together with the required number of years industrial experience such that they meet Cranfield University's equivalent entry requirements, who are looking to obtain a formal Masters level qualification in Aerospace Dynamics.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Demonstrate a systematic knowledge and critical evaluation of the key principles of the aerospace disciplines (aerodynamics, control, flight dynamics, etc.) and apply appropriate engineering analysis methodologies.

ILO 2. Demonstrate the ability to critically analyse the engineering aspects of aerospace applications, methodologies, systems and design. Assess limitations and apply theory, simulation or experimentation to mitigate deficiencies.

ILO 3. Demonstrate a critical judgement of their specialist subject area(s) at a level appropriate to new recruits to the aerospace industry such that they are able to contribute directly without significant further training with a knowledge and understanding of the commercial and social context in which the aerospace industry operates

ILO 4. Be able to apply their knowledge and understanding practically to the design and analysis of aerospace projects. Monitoring and adjusting both an individual programme of work and demonstrating the ability to work as an effective team member exercising initiative appropriately.

B. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Identify a research question. Collect and analyse research data investigating new and emerging aerospace applications

ILO 6. Develop project objectives.

ILO 7. Select and justify methodologies appropriate to the task. Selecting engineering analysis methodologies, experimental methodologies and design processes and adapting them where necessary

ILO 8. Plan and execute a work programme with reference to professional project management processes (e.g. time management; risk management; contingency planning; resource allocation; health and safety).

ILO 9. Evaluate and critically analyse literature; analyse data, synthesise a discussion, generate conclusions.

ILO 10. Place the findings of the work into the context of the work of others.

ILO 11. Communicate findings in the form of a thesis, formal presentation and viva.

4. How is the course taught?

Students will be supported in their learning and personal development by:

The requirement to undertake a Group Flight Test exercise (20 credits) which is conducted in conjunction with the National Flying Laboratory Centre (NFLC), based within the School of Aerospace, Transport and Manufacturing, Cranfield University. This element of the programme involves flights in the Jetstream aircraft flying laboratory, together with conventional supporting lectures, laboratory sessions and tutorials.

The taught element of the programme (80 credits) involves a considerable degree of choice such that candidates can select the module portfolio to reflect their personal career aspirations and skills. The final MSc option – Aerodynamics or Flight Dynamics, is determined by the choice of Research thesis topic.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
N/A	N/A
ELECTIVE MODULES:	
Taught Component – a total of 60 credits taken from modules 1-18	60
TOTAL:	60

B. MSc

The accumulation of 200 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Flight Experimental Methods (Group Flight Test Report) (module 1) Individual Research Project (module 20)	20 100
ELECTIVE MODULES:	
Taught Component – a total of 80 credits taken from modules 2-18	80
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of

your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

This course is also offered on a part-time basis. Candidates taking this route would instead register for a minimum of 3 years and agree with the Course Director beforehand a programme of work that meets the same minimum requirements as the full time variant, but over the longer period.

Individual modules are taught over a period of one, two or three weeks (usually, but not always arranged consecutively). The duration depends on whether the module contains 10, 20 or 30 hours of lecture contact time. These are normally arranged such that there are two hours of lectures per day, 5 days per week, with additional laboratory and/or tutorial sessions arranged during each week. Two modules would normally be offered during each week.

The formal taught part of the programme is split into two Teaching Periods each of nominally 11 weeks. A period during which formal written examinations can be scheduled follows each Teaching Period. For Masters candidates the remainder of the programme is devoted to the Research Thesis.

7. Course Level Assessment Strategy[4]

Assessments are designed to ensure that the Intended Learning Outcomes are achieved. Assessments for each module are summative, with non-assessed formative feedback provided during the module by a wide variety of mechanisms, including tutorial questions, lab exercises, class discussions, quizzes etc. A variety of summative assessments are used including closed-book examinations, individual course works, group course works, oral examinations, reports and for the IRP, a thesis report and a presentation. The choice of the assessment depends on the nature of the material, with fundamental principles more likely to be tested by examination and applications by assignment, some at a typical level in industry.

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[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to MSc. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	N-ASD-GFTR	Flight Experimental Methods (Group Flight Test Report)	Dr Alastair Cooke	50		20	N ST	12/10/20	12/10/20	06/11/20	50	GPRAC Peer Rvw Oral	70 10 20				18/12/2020 18/12/2020 18/12/2020	At the next available opportunity which may not be until the course runs the following year

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
2	N-ASD-CF	Compressible Flows	Dr Simon Prince	20		10	N	Group A 26/10/20 Group B 09/11/20	Group A 26/10/20 Group B 09/11/20	Group A 30/10/20 Group B 13/11/20	40	EX	100				Week1	At the next available opportunity which may not be until the course runs the following year
3	N-ASD-VF	Viscous Flow	Prof Kevin Garry	22		10	N	02/11/20	02/11/20	27/11/20	40	EX	100				Week 2	At the next available opportunity which may not be until the course runs the following year
4	N-ASD-CS	Control Systems	Dr James Whidborne	30		10	Y	09/11/20	09/11/20	20/11/20	40	ICW	100				22/01/2021	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
5	N-ASD-FRPSC	Fundamentals of Rotorcraft Performance, Stability and Control	Dr Alastair Cooke	10		5	N	18/01/2021	18/01/21	22/01/21	40	EX	100				Week 5	At the next available opportunity which may not be until the course runs the following year
6	N-ASD-FDP	Flight Dynamics Principles	Dr Alastair Cooke	20		10	N ST	16/11/20	16/11/20	27/11/20	40	ICW	100				15/01/2021	At the next available opportunity which may not be until the course runs the following year
7	N-ASD-TF	Introduction to Transonic Flow	Dr Nicholas Lawson	10		5	N	23/11/20	23/11/20	27/11/20	40	EX	100				Week 1	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
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8	N-ASD-FQFC	Flying Qualities and Flight Control	Dr Alastair Cooke	40		15	Y	25/01/21	25/01/21	05/02/21	40	ICW	100				12/03/2021	At the next available opportunity which may not be until the course runs the following year
9	N-ASD-MVCAA	Multivariable Control Systems for Aerospace Applications	Dr James Whidborne	30		10	Y	25/01/21	25/01/21	05/02/21	40	EX	100				Week 5	At the next available opportunity which may not be until the course runs the following year
10	N-ASD-AMS	Air-Vehicle Modelling and Simulation	Dr James Whidborne / Dr Mudassir Lone	28		10	Y	11/01/21	11/01/21	15/01/21	40	ICW	100				05/03/2021	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
11	N-ASD-LRA	Launch and Re-Entry Aerodynamics	Dr Simon Prince	10		5	Y	01/03/21	01/03/21	05/03/21	40	EX	100				Week 5	At the next available opportunity which may not be until the course runs the following year
12	N-ASD-TSA	Technology for Sustainable Aviation	Prof Kevin Garry	10		5	N	15/02/21	15/02/21	19/02/21	40	EX	100				Week 5	At the next available opportunity which may not be until the course runs the following year
13	N-ASD-POCFD	CFD for Aerospace	Dr Simon Prince	35		10	N	08/02/21	08/02/21	18/02/21	40	GCW	100				19/03/2021	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
14	N-ASD-EXA	Experimental Aerodynamics	Prof Kevin Garry	34		10	N ST	22/02/21	22/02/21	12/03/21	40	OR	100				29/03/2021	At the next available opportunity which may not be until the course runs the following year
15	N-ASE-GPS	Aerospace Navigation and Sensors	Dr Stephen Hobbs	24		10	Y	15/02/21	15/02/21	26/02/21	40	ICW	100				24/04/2021	At the next available opportunity which may not be until the course runs the following year
16	N-ASD-SAD	Supercritical Wing Design	Dr Simon Prince	10		5	N	30/11/20	30/11/20	04/12/20	40	ICW	100				12/02/2021	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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17	N-ASD-FASD	Fundamentals of Aircraft System Identification	Dr Mudassir Lone	20		10	Y	01/03/21	01/03/21	05/03/21	40	EX	100				Week 5	At the next available opportunity which may not be until the course runs the following year
18	N-ASD-AOCFD	Introduction to CFD	Dr Simon Prince	24		10	N	18/01/21	18/01/21	22/01/21	40	GCW	100				02/02/2021	At the next available opportunity which may not be until the course runs the following year
19	N-ASD-MDS	Modelling of Dynamic Systems	Dr James Whidborne	13		0	Y	26/10/20	26/10/20	30/10/20	N/A	AO	N/A				N/A	N/A
20	N-ASD-THESIS	Individual Research Project	Dr James Whidborne	0		100	N	19/04/21	19/04/21	28/08/20				100 MULTI	THESIS OR	85 15	19/08/2021 03/09/2021	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-ASD-CS	Control Systems	Aerospace Dynamics	Aerospace Vehicle Design
N-ASD-FQFC	Flying Qualities and Flight Control	Aerospace Dynamics	Flight Test and Flight Dynamics
N-ASD-MVCAA	Multivariable Control Systems for Aerospace Applications	Aerospace Dynamics	Flight Test and Flight Dynamics
N-ASD-AMS	Air Vehicle Modelling and Simulation	Aerospace Dynamics	Flight Test and Flight Dynamics
N-ASD-LRA	Launch and Re-Entry Aerodynamics	Aerospace Dynamics	Astronautics and Space Engineering
N-ASE-GPS	Aerospace Navigation and Sensors	Astronautics and Space Engineering	Astronautics and Space Engineering, Flight Test and Flight Dynamics
N-ASD-FASD	Fundamentals of Aircraft System Identification	Aerospace Dynamics	Flight Test and Flight Dynamics
N-ASD-MDS	Modelling of Dynamic Systems	Aerospace Dynamics	Aerospace Vehicle Design, Astronautics and Space Engineering
N-ASD-EXA	Experimental Aerodynamics		Shared Teaching with CFD N-CFD-CFDRW

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Candidates following the Masters programme can expect to have 6 - 10 written examinations, 4 - 8 pieces of assessment by submitted work and 1 - 3 elements of assessment by presentation or viva. (The range in each case depends on the modules selected within the two options available). This approach has been adopted in order to assess as broad a range as possible of a candidates' skills and abilities.

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Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4
N-ASD-GFTR	ICW	ICW	ICW	ICW
N-ASD-CF	EX			
N-ASD-VF	EX			
N-ASD-CS	ICW	ICW		ICW
N-ASD-FRPSC	EX			
N-ASD-FDP	ICW	ICW		ICW
N-ASD-TF	EX			
N-ASD-FQFC	ICW	ICW	ICW	ICW
N-ASD-MVCAA	EX			
N-ASD-AMS	GCW	GCW		GCW
N-ASD-LRA	EX			
N-ASD-TSA	EX		EX	
N-ASD-POCFD	GCW	GCW		GCW
N-ASD-EXA	OR	OR		
N-ASE-GPS	ICW	ICW	ICW	
N-ASD-SAD	ICW	ICW		ICW
N-ASD-FASD	EX	EX		
N-ASD-AOCFD	GCW	GCW		GCW

B. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 5	ILO 6	ILO 7	ILO 8	ILO 9	ILO 10	ILO 11
N-ASD-GFTR			ICW, OR		ICW, OR	ICW, OR	OR
N-ASD-POCFD			GCW				

Award ILOs / Module No.	ILO 5	ILO 6	ILO 7	ILO 8	ILO 9	ILO 10	ILO 11
N-ASD-EXA			ICW	ICW	ICW	ICW	OR
N-ASD-AOCFD			GCW		GCW	GCW	
N-ASD-THESIS	THESIS, OR	THESIS, OR	THESIS, OR	THESIS, OR	THESIS, OR	THESIS, OR	THESIS, OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey.

The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Aerospace Dynamics graduates obtain employment in a wide range of industrial organisations both within Europe and worldwide. Employment is predominantly within the Aerospace Industry but increasingly graduates are in demand from the Energy, Environment and Automotive sectors.

A significant proportion of graduates go on to undertake higher degrees both in the UK and overseas.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	MSc in Aerospace Manufacturing
Course code	MSAMFFTC, MSAMFPTC, PDAMFFTC, PDAMFPTC, PCAMFFTC, PCAMFPTC, MSAMSFTC, PCAMSFTC, PDAMSFTC
Academic Year	2020
Valid entry routes	MSc, PgDip, PgCert MSc (SINO UK)
Additional exit routes	PgDip (SINO UK), PgCert (SINO UK)
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Sustainable Manufacturing Systems Centre
Course Director	Dr Konstantinos Georgorakis
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	No
Is the Degree apprenticeship integrated or non-integrated?	No
Is the Mastership offered as an open and/or closed course?	No
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years, Full-time PgDip - one year, Part-time PgDip - two years, Full-time PgCert - one year, Part-time PgCert – two years SINO UK – 18 months.
Course Start Month(s)	Full-time: October and March. Part-time: throughout the year SINO UK - March

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Manufacturing Theme, Sustainable Manufacturing Systems Centre where the research interests include:

- Operations Management
- Manufacturing Systems Engineering
- Product-Service Systems
- Supply Chain Management
- Simulation and Modelling

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by Institution of Mechanical Engineers (IMechE), Institution of Engineering and Technology (IET), Royal Aeronautical Society (RAeS**.**

2. What are the aims of the course?

Cranfield University offers this course in order to prepare and develop future aerospace manufacturing engineers and managers/ leaders who will be able to manage major implementation programmes or instigate interventions that deliver improvements to the performance of their aerospace manufacturing businesses.

The objectives of the course have been set to:

- Equip students with the skills necessary for aerospace manufacturing/production systems and their supply chain.
- Develop student's awareness and understanding of manufacturing strategy and operations management to address aerospace manufacturing industry problems.
- Provide students with an appreciation of manufacturing technologies, concepts and tools relevant to the aerospace manufacturing sectors.
- Develop students' transferable skills such as analytical and interpersonal skills needed for the creative and effective application of knowledge to address aerospace manufacturing issues.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- Talented UK students with a high grade BSc level.
- Ambitious high quality students with an international background.
- Mid-career professionals who want to boost their career.

- Those wishing to work nationally or internationally with aerospace manufacturing companies that need to address manufacturing systems problems.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Demonstrate a systematic understanding of *aerospace manufacturing functions* including manufacturing systems, supply chain management and manufacturing strategy development.
ILO 2. Analyse different methods and techniques needed for credible aerospace manufacturing system design and improvement projects.
ILO 3. Develop original and in-depth knowledge of aerospace manufacturing operations and critically evaluate the appropriate applications of methodologies to support them.
ILO 4. Critically evaluate theories for the analysis and design tools and their application to (a) solve aerospace manufacturing problems in terms of technology and/or organisations and (b) increase the effectiveness of aerospace manufacturing systems.
ILO 5. Demonstrate comprehensive knowledge of aerospace materials including metals, ceramics and composites, aerospace structures, advanced joining techniques and precision machining.
ILO 6. Analyse and re-design aircraft assembly processes.
ILO 7. Analyse different assessment techniques to fracture mechanics.

In completing this course, and achieving the associated award, a diligent student should be able to:

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Demonstrate the ability to apply practical and rigorous approaches to formulate projects, develop engineering solutions and evaluate their effectiveness.
ILO 9. Asses some key project management techniques, and at the same time, demonstrate awareness of the less science-dependent aspects of technology.
ILO 10. Demonstrate transferable skills including, personal responsibility, complex decision making and independence for further learning.
ILO 11. Demonstrate ability to provide technical and additionally commercial leadership through planning industrial/research projects (budgets, people, tasks) and contributing to teams delivering under time pressures individually and as a team member.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 12. Synthesise a sound theoretical approach to critically evaluate data and information, undertaking a critical appraisal of technical and/or commercial literature.
ILO 13. Propose and bring about improvements to appropriate business standards.

4. How is the course taught?

The teaching methods include lectures, case studies, group exercises, field visits, seminar and computer-based demonstrations and exercises. All students attend a week of introductory lectures (given during the first week of the course). Within this induction week, students will be introduced to

personal development planning and asked to reflect on their transferable skills and to take ownership of their personal development during the course. Induction is followed by 8 weeks of assessed modules.

All MSc students will undertake a Group Project (full time students) or produce a Dissertation (part time students). The Group projects are group-based activities typically undertaken for 12 weeks between February and April (for October intake) or between August and October (for March intake). The projects are designed to integrate knowledge, understanding and skills from the taught modules in a real-life situation. The Group Project will typically involve a team of students between 5 and 8, working to investigate a manufacturing opportunity or solve a manufacturing problem. Part-time students are encouraged to take part in a part-time Group Project. Where this is not possible, this ca be replaced with an individual Dissertation. The topic is to be agreed between the University and the student.

All MSc students will undertake a research projects (thesis project) under the supervision of a member of academic staff. For the individual research project, each student is allocated a supervisor. Guidance sessions are provided as to what is required from the thesis and oral presentation.

In addition to the teaching methods outlined in section 3 above, students will be supported in their learning and personal development by:

- The use of Virtual Learning Environment, i.e. Blackboard
- On-demand tutorials
- Coaching throughout group project periods

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
Modules 2-6	50
ELECTIVE MODULES:	
Modules 7-10 (Select 1) NOTE: for the March intake some electives may not be available	10
RECOMMENDED MODULE:	
Induction	0

FULL TIME SINO UK STUDENTS (Exit Route only)

Description	Credits
COMPULSORY MODULES:	
Modules 2-6	50
ELECTIVE MODULES:	
Modules 7, or 8, (Select 1)	10
RECOMMENDED MODULE:	
Induction	0

TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	**Credits**
COMPULSORY MODULES:	
Modules 2-6 Group Project (12a)	50 40
ELECTIVE MODULES:	
Modules 7-11 (Select 3) NOTE: for the March intake some electives may not be available	30
RECOMMENDED MODULE:	
Induction	0
TOTAL:	120

FULL TIME SINO UK STUDENTS (Exit Route only)

Description	Credits
COMPULSORY MODULES:	
Modules 2-8, and 11 Group Project (12a)	80 40
RECOMMENDED MODULE:	
Induction	0
TOTAL:	120

PART TIME STUDENTS

Description	**Credits**
COMPULSORY MODULES:	
Modules 2-6	50
ELECTIVE MODULES:	
Modules 7-11 (Select 3) Group Project (12a) or Dissertation (12b). NOTE: for the March intake some electives may not be available	30 40
RECOMMENDED MODULE:	
Induction	0
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

FULL TIME STUDENTS

Description	**Credits**
COMPULSORY MODULES:	

Modules 2-6 Group Project (12a) Individual Research Project (13)	50 40 80
ELECTIVE MODULES:	
Modules 7-11 (Select 3) NOTE: for the March intake some electives may not be available	30
RECOMMENDED MODULE:	
Induction	0
TOTAL:	200

FULL TIME SINO UK STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2-8, and 11 Group Project (12a) Individual Research Project (13)	80 40 80
RECOMMENDED MODULE:	
Induction	0
TOTAL:	200

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2-6 Individual Research Project (13)	50 80
ELECTIVE MODULES:	
Modules 7-11 (Select 3) Group Project (12a) or Dissertation (12b). NOTE: for the March intake some electives may not be available	30 40
RECOMMENDED MODULE:	
Induction	0
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October or March and are expected to complete the course within 12 calendar months. MSc students must successfully complete 5 core modules and 3 elective ones, the Group Project and an Individual Research Project.

This course is also offered on a part-time basis. In such a situation, students typically complete the various components of the course over two or three years. Typical case is to complete four taught modules plus a Group Project/Dissertation in year 1 and the remainder of the modules plus the Thesis in year two and/or year 3.

SINO/UK students will complete the course over 18 months starting with first 3 modules in March to June of the first academic year, in China, and the remaining 5 modules, group project and thesis will be completed at Cranfield in the second academic year.

7. Course Level Assessment Strategy[4]

retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to an **MSc.** Other awards associated with the course include some or all of these modules.

October (Full-time + Part-time) Intake

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-MAN-INWK	Induction	Prof Konstantinos Salonitis	18		0	Y	28/09/20	28/09/20 Occ A	02/10/20	N/A	AO	N/A				N/A	
2	I-MNU-A1034	Operations Management	Mr John Patsavellas	32		10	Y	05/10/20	05/10/20 Stream 1 12/10/20 Stream 2 Occ A	09/10/20 Stream 1 16/10/20 Stream 2	40	EX	100				14/12/20	Manufacturing resit exams will be during week commencing 17/05/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	I-MNU-A1027	Manufacturing Systems Engineering	Dr Emanuele Pagone	32		10	Y	09/11/20	09/11/20 Occ A	13/11/20	40	ICW	100				18/01/21	Re-assessment date to be set by agreement of Module Leader as/when required.
4	I-MNU-A1038	Supply Chain Management	Dr Ahmed Al-Ashaab	32		10	Y	11/01/21	11/01/21 Occ A	15/01/21	40	GWC	100				08/02/21	Re-assessment date to be set by agreement of Module Leader as/when required.
5	I-MNU-A1019	Manufacturing Strategy	Dr Patrick McLaughlin	35		10	Y	25/01/21	25/01/21 Occ A	29/01/21	40			100 MULTI	GPRES GCW ICW	30 50 20	29/01/21 29/01/21 15/02/21	Re-assessment date to be set by agreement of Module Leader as/when required.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
6	I-MNU-A1047	Aircraft Assembly	Prof Phil Webb	34		10	N	18/01/21	18/01/21 Occ A	22/01/21	40	ICW	100				15/02/21	Re-assessment date to be set by agreement of Module Leader as/when required.
7	I-MAT-A1011	Additive and Subtractive Manufacturing Technologies	Dr Isidro Durazo-Cardenas	30		10	Y	19/10/20	19/10/20 Stream 1 12/10/20 Stream 2 Occ A	23/10/20 Stream 1 16/10/20 Stream 2	40			100 MULTI	ICW GPRES	70 30	16/11/20 23/10/20	Re-assessment date to be set by agreement of Module Leader as/when required.
8	I-MAT-A1013	Composites Manufacturing for High Performance Structures	Andrew Mills	35		10	Y	30/11/20	30/11/20 Occ B	04/12/20	40	ICW	100				11/01/21	Re-assessment date to be set by agreement of Module Leader as/when required.
9	I-MAT-A1015	Failure of Materials	Dr Muhammad	32		10	Y	26/10/20	26/10/20 Occ A	30/10/20	40	EX	100				18/12/20	Manufacturing resit exams

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
		and Structures	Khan															will be during week commencing 17/05/2021
10	I-WEE-A1110	Advanced Welding Processes	Dr Muhammad Khan	35		10	Y	16/11/20	16/11/20 Occ A	20/11/20	40	EX	100				08/01/21	Manufacturing resit exams will be during week commencing 17/05/2021
11	I-MNU-A1029	Operations Analysis	Prof Konstantinos Salonitis	32	8	10	Y	26/10/20	26/10/20 Occ A	30/10/20	40	EX	100				18/12/20	Manufacturing resit exams will be during week commencing 17/05/2021
12a	I-MAT-GRPP	Group Project	Dr David Ayre	20		40	Y	01/02/21	01/02/21 Occ A FT	27/04/21 FT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/04/21 04/05/21 04/05/21 04/05/21	
			Dr Supriyo Ganguly						01/02/21 Occ B PT	27/08/21 PT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/08/21 01/09/21 01/09/21 01/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
12b	I-MAT-DISS	Dissertation for Part Time Students	Prof Konstantinos Salonitis	20		40	Y	08/02/21	08/02/21	31/08/21	50	ICW	100				27/08/21	
13	I-MNU-THESIS	Individual Research Project	Dr Muhammad Khan	20		80	Y	08/02/21	Occ A = PT 08/02/21	PT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/21	
			Dr Muhammad Khan					30/04/21	Occ B = FT 30/04/21	FT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/20	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

March (Full-time) Intake

Module Number	Module code	Title	Module Leader	Contact hours[12]	Total hours delivered by Visiting Lecturers [13]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[14] - 40% or 50%	Type of Assessment	Weighting within module15 (%) of Independent assessments	Weighting within module of multi-part assessments [16](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[17]	Assessment Submission and/or exam date[18]	Assessment / Exam Retake date
1	I-MAN-INWK	Induction	Prof Konstantinos Salonitis	22		0	Y	04/03/21	04/03/21 Occ B	05/03/21	N/A	AO	N/A				N/A	
2	I-MNU-A1034	Operations Management	Mr John Patsavellas	32		10	Y	08/03/21	08/03/21 Occ B	12/03/21	40	EX	100				17/05/21	Resit exams will be with 2021/22 cohort in December 2021
3	I-MNU-A1027	Manufacturing Systems Engineering	Dr Emanuele Pagone	32		10	Y	26/04/21	26/04/21 Occ B	30/04/21	40	ICW	100				14/06/21	Re-assessment date to be set by agreement of Module Leader as/when required.
4	I-MNU-A1038	Supply Chain Management	Dr Ahmed Al-Ashaab	32		10	Y	10/05/21	10/05/21 Occ B	14/05//21	40	GCW	100				07/06/21	Re-assessment date to be set by

[12] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[13] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[14] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[15] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[16] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[17] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[18] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[12]	Total hours delivered by Visiting Lecturers [13]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[14] - 40% or 50%	Type of Assessment	Weighting within module15 (%) of Independent assessments	Weighting within module of multi-part assessments [16](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[17]	Assessment Submission and/or exam date[18]	Assessment / Exam Retake date
																		agreement of Module Leader as/when required.
5	I-MNU-A1019	Manufacturing Strategy	Dr Patrick McLaughlin	35		10	Y	21/06/21	21/06/21 Occ B	25/06/21	40			100 MULTI	GPRES GCW ICW	30 50 20	25/06/21 25/06/21 12/07/21	Re-assessment date to be set by agreement of Module Leader as/when required.
6	I-MNU-A1047	Aircraft Assembly	Prof Phil Webb	34		10	N	07/06/21	07/06/21 Occ B	11/06/21	40	ICW	100				05/07/21	Re-assessment date to be set by agreement of Module Leader as/when required.
7	I-MAT-A1011	Additive and Subtractive Manufacturing Technologies	Dr Isidro Durazo-Cardenas	30		10	Y	22/03/21	22/03/21 Occ B	26/03/21	40			100 MULTI	ICW GPRES	70 30	19/04/21 26/03/21	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
8	I-MAT-A1013	Composites Manufacturing for High Performance	Mr Andrew Mills	35		10	Y	24/05/21	24/05/21 Occ C	28/05/21	40	ICW	100				21/06/21	Re-assessment date to be set by agreement of

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[12]	Total hours delivered by Visiting Lecturers[13]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[14] - 40% or 50%	Type of Assessment	Weighting within module15 (%) of Independent assessments	Weighting within module of multi-part assessments[16]	Type of Assessment	Weighting of individual elements of multi-part assessment[17]	Assessment Submission and/or exam date[18]	Assessment / Exam Retake date
		Structures																Module Leader as/when required.
9	I-MAT-A1015	Failure of Materials and Structures	Dr David Ayre	32		10	Y	Not available for this intake			40	EX	100				Not available for this intake	
10	I-WEE-A1110	Advanced Welding Processes	Dr Wojciech Suder	35		10	Y	Not available for this intake			40	EX	100				Not available for this intake	
11	I-MNU-A1029	Operations Analysis	Prof Konstantinos Salonitis	32	8	10	Y	12/04/21	12/04/21 Occ B	16/04/21	40	EX	100				21/05/21	Resit exams will be with 2021/22 cohort in December 2021
12a	I-MAT-GRPP	Group Project	Dr David Ayre	20		40	Y	12/06/21	14/06/21 Occ C	29/10/21		GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	22/10/21 29/10/21 29/10/21 29/10/21	
12b	I-MAT-DISS	Dissertation for Part Time Students	Prof Konstantinos Salonitis					Not available for this intake										Not available for this intake

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[12]	Total hours delivered by Visiting Lecturers [13]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[14] - 40% or 50%	Type of Assessment	Weighting within module15 (%) of Independent assessments	Weighting within module of multi-part assessments [16](#)	Type of Assessment	Weighting of individual elements of multi-part assessment[17]	Assessment Submission and/or exam date[18]	Assessment / Exam Retake date
								e										
13	I-MNU-THESIS	Individual Research Project	Dr Muhammad Khan	20		80	Y	02/11/21	02/11/21 Occ C	28/02/22		THESIS OR	90 10				25/02/22 28/02/22	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

SINO/UK Intake (Full time students only) – March 2021 (3 modules in China will be 'AY 20/21 and modules on Cranfield campus will be 'AY 20/21'

Module Number	Module code	Title	Module Leader	Contact hours[19]	Total hours delivered by Visiting Lecturers[20]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[21] - 40% or 50%	Type of Assessment	Weighting within module22 (%) of Independent assessments	Weighting within module of multi-part assessments[23](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[24]	Assessment Submission and/or exam date[25]	Assessment / Exam Retake date
1	I-MAN-INWK	Induction	Prof Konstantinos Salonitis	18		0	Y	25/03/21	25/03/21	26/03/21	N/A	AO	N/A				N/A	
2	I-MNU-A1034	Operations Management	Mr John Patsavellas	32		10	Y	29/03/21	29/03/21 Occ C	02/04/21	40	EX	100				26/04/21	Resit exams will be with 2021/22 October cohort in December 2021
3	I-MNU-A1027	Manufacturing Systems	Dr Emanuele Pagone	32		10	Y	08/11/21	08/11/21 AY 21 Occ	12/1/21	40	ICW	100				10/01/22	Re-assessment

[19] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[20] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[21] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[22] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[23] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[24] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[25] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[19]	Total hours delivered by Visiting Lecturers [20]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[21] - 40% or 50%	Type of Assessment	Weighting within module22 (%) of Independent assessments	Weighting within module of multi-part assessments [23](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[24]	Assessment Submission and/or exam date[25]	Assessment / Exam Retake date
		Engineering							A									date to be set by agreement of Module Leader as/when required.
4	I-MNU-A1038	Supply Chain Management	Dr Ahmed Al-Ashaab	32		10	Y	10/01/22	10/01/22 AY 22 Occ A	14/01/22	40	GCW	100				07/02/22	Re-assessment date to be set by agreement of Module Leader as/when required.
5	I-MNU-A1019	Manufacturing Strategy	Dr Patrick McLaughlin	35		10	Y	31/05/21	31/05/21 AY 20 Occ C	04/06//21	40			100 MULTI	GPRES GCW ICW	30 50 20	**04/06/21** **04/06/21** **14/07/21**	Re-assessment date to be set by agreement of Module Leader as/when required.
6	I-MNU-A1047	Aircraft Assembly	Prof Phil Webb	34		10	N	17/01/22	17/01/22 AY 21 Occ	21/01/22	40	ICW	100				14/02/22	Re-assessment

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[19]	Total hours delivered by Visiting Lecturers [20]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[21] - 40% or 50%	Type of Assessment	Weighting within module22 (%) of Independent assessments	Weighting within module of multi-part assessments [23](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[24]	Assessment Submission and/or exam date[25]	Assessment / Exam Retake date
									A									date to be set by agreement of Module Leader as/when required.
7	I-MAT-A1011	Additive and Subtractive Manufacturing Technologies	Dr Isidro Durazo-Cardenas	30		10	Y	18/10/21	18/10/21 AY 21 Occ A	22/10/21	40			100 MULTI	ICW GPRES	70 30	15/11/21 22/10/21	Re-assessment date to be set by agreement of Module Leader as/when required.
8	I-MAT-A1013	Composites Manufacturing for High Performance Structures	Andrew Mills	35		10	Y	29/11/21	29/11/21 AY 21 Occ B	03/12/21	40	ICW	100				10/01/21	Re-assessment date to be set by agreement of Module Leader as/when required.
9	I-MAT-A1015	Failure of Materials and Structures	Dr David Ayre	32		10	Y	Not available for this intake			40	EX	100	40			Not available for this intake	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[19]	Total hours delivered by Visiting Lecturers [20]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark[21] - 40% or 50%	Type of Assessment	Weighting within module22 (%) of Independent assessments	Weighting within module of multi-part assessments [23](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[24]	Assessment Submission and/or exam date[25]	Assessment / Exam Retake date
10	I-WEE-A1110	Advanced Welding Processes	Dr Wojciech Suder	32		10	Y	Not available for this intake			40	EX	100	40			Not available for this intake	
11	I-MNU-A1029	Operations Analysis	Prof Konstantinos Salonitis	32	8	10	Y	26/04/21	26/04/21 AY 20 Occ C	30/04/21	40	EX	100				31/05/21	Resit exams will be with 2021/22 October cohort in December 2021
12a	I-MAT-GRPP	Group Project	Dr David Ayre	20		40	Y	31/01/22	31/01/22 AY 21 Occ A	26/04/22	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	26/04/22 03/05/22 03/05/22 03/05/22	
13	I-MNU-THESIS	Individual Research Project	Dr Muhammad Khan	20		80	Y	30/04/22	30/04/22 AY 21 Occ B	26/0822		THESIS OR	90 10				26/08/22 30/0822	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
I-MAN-INWK	Induction	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Management and Information Systems, Global Product Development and Management, Cyber-Secure Manufacturing Maintenance Engineering and Asset Management
I-MNU-A1034	Operations Management	Engineering and Management of Manufacturing Systems	Manufacturing Technology and Management, Engineering & Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Cyber-Secure Manufacturing, Engineering Competence
I-MNU-A1027	Manufacturing Systems Engineering	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, , Engineering Competence
I-MNU-A1038	Supply Chain Management	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems
I-MNU-A1019	Manufacturing Strategy	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems
I-MAT-A1011	Additive and Subtractive Manufacturing Technologies	Advanced Materials	Manufacturing Technology and Management
I-MAT-A1013	Composites Manufacturing for High Performance Structures	Advanced Materials	Manufacturing Technology and Management, Aerospace Materials, Renewable Energy Marine Structures EngD
I-MAT-A1015	Failure of Materials and Structures	Advanced Materials	Aerospace Materials
I-WEE-A1110	Advanced Welding Processes	Welding Engineering	Manufacturing Technology and Management, Welding Engineering, Renewable Energy Marine Structures EngD
I-MNU-A1029	Operations Analysis	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Manufacturing Technology and Management
I-MAT-GRPP	Group Project	Advanced Materials	Aerospace Materials, Manufacturing Technology & Management, Engineering & Management of Manufacturing

			Systems, Management and Information Systems, Global Product Development and Management, Cyber-Secure Manufacturing, Welding Engineering, Metal Additive Manufacturing, Maintenance Engineering and Asset Management
I-MAT-DISS	Dissertation for Part Time Students	Advanced Materials	Aerospace Materials, Manufacturing Technology & Management, Engineering & Management of Manufacturing Systems, Management and Information Systems, Global Product Development and Management, Cyber-Secure Manufacturing, Welding Engineering, Metal Additive Manufacturing, Maintenance Engineering and Asset Management
I-MNU-THESIS	Individual Research Project	Aerospace Manufacturing	Engineering & Management of Manufacturing Systems, Management and Information Systems, Global Product Development and Management, Cyber-Secure Manufacturing, Aerospace Materials, , Manufacturing Technology & Management, Welding Engineering, Metal Additive Manufacturing, Maintenance Engineering and Asset Management, Advanced Materials

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have at least two written examinations, and depending on the elective modules they undertake, between four and seven pieces of assessment by submitted work, one piece of group project work (including an assessment of personal contribution to group work), and one element assessed by a thesis and an oral presentation.

This approach has been adopted in order to perform formative and summative assessments of the students to demonstrate their ability in a range of contexts. Part time students will be assessed by dissertation in place of the group project.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7
1	Non Assessed						
2	EX	EX	EX	EX			
3	ICW	ICW	ICW	ICW			
4	GWC	GCW	GCW	GCW			
5		GPRES GCW ICW	GPRES GCW ICW	GPRES GCW ICW			
6	ICW	ICW	ICW	ICW	ICW	ICW	
7		ICW GPRES			ICW GPRES	ICW GPRES	ICW GPRES
8					ICW	ICW	ICW
9					EX		EX
10					EX		EX

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 8	ILO 9	ILO 10	ILO 11
11	EX	EX	EX	EX				
12a					GPRES GPROJ ICW	GPRES GPROJ ICW	GPRES GPROJ ICW	GPRES GPROJ ICW
12b					ICW	ICW	ICW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 12	ILO 13
13	THESIS OR	THESIS OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a

Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The intention of the course is to provide students with knowledge and understanding and associated transferrable skills to make a contribution to industry on graduation. Aerospace Manufacturing graduates will typically seek employment in aerospace manufacturing industry, consultancies or research institutions. Common starting roles are manufacturing engineer, industrial engineer, technical analyst, project manager and PhD researcher. With time (quicker for those with background experience) graduates progress to senior positions with significant responsibility for people, budgets and projects.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	MSc in Aerospace Materials
Course code	MSAMRFTC, MSAMRPTC, PDAMRFTC, PDAMRPTC, PCAMRFTC, PCAMRPTC
Academic Year	2020
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Surface Engineering & Precision Institute
Course Director	Dr Sue Impey
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	**No**
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years, Full-time PgDip - one year, Part-time PgDip - two years, Full-time PgCert - one year, Part-time PgCert - two years
Course Start Month(s)	Full-time: October. Part-time: October.

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Manufacturing Theme, where the materials related research interests include: where the research interests include:

- Enhanced Composites and Advanced Structures.
- Surface Engineering and Nanotechnology.
- Welding Engineering and Laser Processing
- Precision Engineering

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the Institution of Mechanical Engineers (IMechE), Institution of Engineering and Technology (IET), Royal Aeronautical Society (RAeS) and The Welding Institute (TWI).

Students completing an accredited degree are deemed to have met part or all of the academic requirements for registration as a Chartered or Incorporated Engineer and are in a strong position to move on to achieve professional engineering status after a period of initial professional development in industry.

2. What are the aims of the course?

AIM
The aim of the course is to provide graduate scientists and engineers with a fundamental understanding of materials properties and processing relevant for aeronautics and astronautics, and the necessary skills to apply their knowledge in aerospace engineering and related industries.

OBJECTIVES
The objectives of the course are to provide students with:

1. A scientific understanding of materials properties and an appreciation of how this understanding can be applied to problems relevant to aeronautics and astronautics.
2. An appreciation of the processes and manufacturing routes used to convert materials into engineering products, and of the influence of processing conditions on product performance.

3. An overview of a wide range of aerospace materials, including metals, polymers, ceramics and composites, and to the basic principles of materials selection for aerospace engineering.
4. An introduction to a research environment, providing familiarity with testing and processing equipment, practical approaches to problem solving, critical evaluation of data, and use of information technology.
5. The skills required to pursue a successful career in aerospace engineering and related industries.

On successful completion of the course students should be able to:

- Apply their understanding of materials properties and processing characteristics to problems in aerospace materials development, materials and process selection, and component design.
- Plan, execute and manage materials-related projects
- Operate effectively in a team
- Make effective oral and written presentations of their work.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- recent graduates wishing to extend their knowledge and skills in aerospace materials engineering
- qualified engineers wishing to apply their skills into new areas.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Demonstrate a critical awareness of a range of techniques for assessing the structure and properties of aerospace materials.
ILO 2. Describe, demonstrating scientific understanding, selected processes and manufacturing routes used to convert materials into aerospace engineering products, and the influence of processing conditions on properties and performance.
ILO 3. Discuss specific materials, their benefits and applications.
ILO 4. Use basic principles of materials selection for aerospace engineering and other applications.
ILO 5. Demonstrate an ability in practical approaches to problem solving.
ILO 6. Critically evaluate data.
ILO 7. Demonstrate a basic understanding of fracture mechanics and an awareness of approaches to failure assessment.
ILO 8. Make effective use of finite element analysis programmes.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate an awareness of current research and development in selected topics in the field of aerospace materials engineering.
ILO 10. Make effective oral and/or written presentation of their work.

ILO 11. Operate effectively in a team.
ILO 12. Undertake an appraisal of technical and/or commercial literature.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 13. Demonstrate a critical awareness of current research/development in selected topics in the field of aerospace materials.
ILO 14. Undertake substantial critical appraisal of technical and/or commercial literature.
ILO 15. Carry out substantial scientific programme of study.
ILO 16. Discuss their work and relate it to the work of others.
ILO 17. Demonstrate originality in the application of knowledge in relation to an extended individual project.
ILO 18. Plan, execute and manage materials-related projects.

4. How is the course taught?

Students will be supported in their learning and personal development by:

Comprehensive course materials are provided, as well as a web-site using the Virtual Learning Environment (VLE). Students are guided through the use of interactive exercises, group and individual discussion. Students engage in class activities to practise the techniques taught.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	**Credits**
COMPULSORY MODULES:	
Modules 2, 3, 8	30
ELECTIVE MODULES:	
Three modules from 4-7 and 9, Choose three modules from five	30
RECOMMENDED MODULE	
Introduction	0
TOTAL:	60

PART-TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2, 3, 8	30
ELECTIVE MODULES:	
Choose three modules from 5 -7 and 9, and either module 4 or 10,	30
RECOMMENDED MODULE	
Introduction	0
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2-9 Group Project (11a)	80 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	120

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2, 3 and 5 - 9	70
ELECTIVE MODULES:	
Choose either module 4 or 10 Group Project (11a) or Dissertation (11b).	10 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2-9 Group Project (11a) Individual Research Project (12)	80 40 80

RECOMMENDED MODULE	
Introduction	0
TOTAL:	200

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 2, 3 and 5 - 9 Individual Research Project (12)	70 80
ELECTIVE MODULES:	
Choose either module 4 or 10 Group Project (11a) or Dissertation (11b).	10 40
RECOMMENDED MODULE	
Introduction	0
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

This course is also offered on a part-time basis. In such a situation, students typically complete the various components of the course over two or three years. A typical case is to complete four taught modules plus a Group Project/Dissertation in year 1 and the remainder of the modules plus the Thesis in year two and/or year 3.

7. Course Level Assessment Strategy[4]

The course comprises taught modules (PG certificate, PG diploma, MSc) a group project (PG Diploma, MSc) and an individual research project (MSc). The intended learning outcomes for each module and project component are introduced to the students at the start of each module and project. Students are provided marking scheme information for all summative assessments and opportunities to revise/discuss content and strategies prior to completion of the assessments to ensure students are better informed to deliver.

Each taught module is assessed separately in addition to the assessment of group project work and individual research project work. Activities during the module delivery allow formative feedback to be provided either individually to each student or generally to the student cohort. Such activities include individual student exercises, group exercises, presentation of group work, class discussions, interactive class quizzes, (lab) demonstrations with limited student interaction, software package tutorials and final recap with question and answer session at end of most modules.

The Introduction to Materials Engineering module (module 2) forms the introduction to the course and is assessed by individual course work. A practice assessment opportunity is provided in October to give the students experience of the Cranfield University assessment procedure and identify the level of revision required.

Multi-part assessments are applied to several modules and usually comprise of a short oral presentation at the end of the taught module and written coursework. The feedback provided to the students after the oral presentation is intended to improve the quality of the written coursework. The diversity of assessment also provides students the opportunity to improve their written and spoken communication skills and their presentation skills.

Summative assessments are varied, aligning with module ILOs and being designed specifically for each individual module. Assessments include closed book examinations, written assignments, group and individual oral presentations, use of associated software packages (documented reports) and reflective writing. The taught module ILOs and feedback from assessments (formative and

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

summative) all develop skills that are further assessed in the group project work and individual research project work.

The summative assessments are undertaken by the students throughout the academic year, with first written assessment marks and feedback being provided mid-December, but feedback on oral presentations (summative assessment) is provided late October. However the majority of feedback efficiently accessed by students is the formative feedback provided during the week of delivery during class activities.

Summative assessment feedback is provided through the Virtual Learning Environment – written course work is marked and feedback provided within the recommended 20 working day period. General feedback on examinations is provided (posted on VLE) based on a sample size of exam question responses.

Assessment of project work (group and individual) is by a combination of observed behaviour, reflective writing, oral presentations (poster and powerpoint) and project reports. Formative feedback is provided during the projects (by supervisors, sponsors, technical staff and peers).

Full-time and part-time students are assessed identically where circumstances allow. The only provision for difference is in the Group Project/Dissertation (module 11a/11b); part-time students can be allowed to undertake a dissertation in place of the group project work where it can be demonstrated that a group project activity is unsuitable due to part-time student working restrictions.

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-MAT-INWK	Introduction	Dr Sue Impey	18		0	Y	28/09/20	28/09/20	02/10/20	N/A	AO	N/A				N/A	
2	I-MAT-A1009	Introduction to Materials Engineering	Dr David Ayre	30		10	Y	05/10/20	05/10/20	09/10/20	40	ICW	100				02/11/20	
3	I-MAT-A1005	Sustainable Aerospace Materials	Dr Sue Impey	30		10	N	19/10/20	19/10/20	23/10/20	40	GCW	100				16/11/20	Re-assessment date to be set by agreement of the Module Leader as/when required.

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
4	I-MAT-A1013 occurrence B	Composites Manufacturing for High Performance Structures	Mr Andrew Mills	35		10	Y	30/11/20	30/11/20	04/12/20	40	ICW	100				11/01/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
5	I-MAT-A1015	Failure of Materials and Structures	Dr Muhammed Khan	32		10	Y	26/10/20	26/10/20	30/10/20	40	EX	100				18/12/20	Manufacturing resit exams will be during week commencing: 17/05/21
6	I-MAT-A1007	Functional Materials	Dr Sue Impey	30		10	N	16/11/20	16/11/20	20/11/20	40	ICW	100				14/12/20	Re-assessment date to be set by agreement of the Module Leader as/when required.
7	I-MAT-A1014	Finite Element Analysis	Dr Muhammad Khan	35		10	Y	09/11/20	09/11/20	13/11/20	40			100 MULTI	IPRES ICW	10 90	07/12/20 30/11/20	Re-assessment date to be set by agreement of the Module Leader as/when required.
8	I-MAT-A1017	Materials Selection	Dr Sue Impey/ Dr David Ayre	34		10	Y	11/01/21	11/01/21	15/01/21	40			100 MULTI	IPRES ICW	10 90	15/01/21 08/02/21	Re-assessment date to be set by agreement of the Module

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																		Leader as/when required.
9	I-MAT-A1016	Surface Science and Engineering	Prof John Nicholls	30		10	Y	25/01/21	25/01/21	29/01/21	40	ICW	100				22/02/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
10	N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures - (option when available)**	Dr Yigeng Xu	35		10	Y	12/07/21	12/07/21	16/07/21	40	ICW	100				13/09/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
11a	I-MAT-GRPP	Group Project	Dr David Ayre	20		40	Y	01/02/21	01/02/21 Occ A FT	27/04/21 FT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/04/21 04/05/21 04/05/21 04/05/21	
			Dr Supriyo Ganguly						01/02/21 Occ B PT	27/08/21 PT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/08/21 01/09/21 01/09/21 01/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
11b	I-MAT-DISS	Dissertation for Part Time Students	Dr Sue Impey/ Dr David Ayre	20		40	Y	08/02/21	08/02/21	31/08/21	50	ICW	100				27/08/21	
12	I-MNU-THESIS	Individual Research Project	Dr Muhamma d Khan	20		80	Y	08/02/21	Occ A = PT 08/02/21	PT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/21	
			Dr Muhammad Khan					30/04/21	Occ B = FT 30/04/21	FT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/20	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
I-MAT-INWK	Introduction	Manufacturing Technology and Materials Programme	Welding Engineering, Advanced Materials, Metal Additive Manufacturing
I-MAT-A1009	Introduction to Materials Engineering	Advanced Materials	Manufacturing Technology and Management
I-MAT-A1015	Failure of Materials & Structures	Advanced Materials	Aerospace Manufacturing
I-MAT-A1014	Finite Element Analysis	Advanced Materials	Manufacturing Technology and Management, Metal Additive Manufacturing
I-MAT-A1017	Materials Selection	Advanced Materials	EngD in Sustainable Manufacturing Systems
I-MAT-A1016	Surface Science and Engineering	Advanced Materials	Manufacturing Technology and Management,
I-MAT-A1013	Composites Manufacturing for High Performance Structures	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing, Renewable Energy Marine Structures EngD
N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures	Airworthiness	Airworthiness, Military Aerospace and Airworthiness, Aerospace Materials, Aircraft Engineering
I-MAT-GRPP	Group Project	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Cyber-Secure Engineering Welding Engineering, Metal Additive Manufacturing
I-MAT-DISS	Dissertation for Part Time Students	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, , Management and Information Systems, Cyber-Secure Manufacturing, Welding Engineering, Metal Additive Manufacturing
I-MNU-THESIS	Individual Research Project	Aerospace Manufacturing	Aerospace Materials, Advanced Materials, Cyber-Secure Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems,

			Manufacturing Technology and Management, Welding Engineering, Metal Additive Manufacturing

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have at least two written examinations, and depending on the elective modules they undertake, between four and six pieces of assessment by submitted work, one piece of group project work (including an assessment of personal contribution to group work), and one element assessed by a thesis and an oral presentation.

This approach has been adopted in order to perform formative and summative assessments of the students to demonstrate their ability in a range of contexts. Part time students will be assessed by dissertation in place of the group project.

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Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 8
2	ICW	ICW	ICW		ICW	ICW	ICW	
3	GCW	GCW	GCW	GCW	GCW	GCW		
4	ICW	ICW	ICW		ICW			
5					EX	EX	EX	
6	ICW	ICW	ICW		ICW			
7					ICW	ICW		ICW
8			ICW	ICW	ICW	ICW		
9		ICW	ICW	ICW	ICW			
10							ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 9	ILO 10	ILO 11	ILO 12
11a	GPROJ	GPRES	GPROJ	GPROJ
11b	ICW	IPRES	ICW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 13	ILO 14	ILO 15	ILO 16	ILO 17	ILO 18
12	THESIS OR	THESIS	THESIS	THESIS OR	THESIS	THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The intention of the course is to provide students with knowledge and understanding and associated transferrable skills to make a contribution to industry on graduation. Aerospace Materials graduates will typically seek employment in the aerospace manufacturing industry, consultancies or research institutions related to the aerospace industry. However other related industries such as power generation, space, sports and automotive industries are also relevant. Common starting roles are materials engineer, design and development, project engineer, project manager and PhD researcher. With time (quicker for those with more background experience) graduates progress to senior positions with responsibility for people, budgets and projects.

COURSE SPECIFICATION

Cranfield University: Course Specifications
Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: September 2020

1. What is the course?

Course information

Course Title	MSc in Applied Artificial Intelligence
Course code	MSAAIFTC, MSAAIPTC, PCAAIFTC, PCAAIPTC, PDAAIFTC, PDAAIPTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	SATM
Theme	Aerospace
Centre	Centre for Autonomous and Cyberphysical Systems
Course Director	Dr Luca Zanotti Fragonara
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University Entry Requirements
UK Qualifications Framework Level	QAA FHEQ level 7
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc: 1year; Part-time MSc: up to 3 years.
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Autonomous and Cyberphysical Systems where the research interests include:

- Data analytics and visualization
- Artificial Intelligence/Machine learning for Computer vision
- Multi-agent and collaborative systems
- Autonomous systems
- Automation in Aerospace Engineering
- Time-series analysis/Hidden-Markov Models
- Explainable AI
- Human-Machine Interface

Cranfield University interacts with the following institutions and in the following ways:

Industrial Advisory board composed at 20/02/2019 by the following members: BAE Systems, Lockheed Martin, Boeing, QinetiQ, Airbus D&S, Plextek, Northrop Grumman, Spirent Communications, Bombardier, Barnard Microsystems Ltd, Overview Ltd, BioCarbon Engineering. The board proposes suitable topic for the Individual Research Projects.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

The plan is to apply for accreditation of the course to the IET (The Institution of Engineering and Technology) and the BCS (The British Computer Society). The accreditation bodies are forming at the moment in the area of AI, and it is possible that this MSc is going to help shape the accreditation rules. There is a close link with the Office for AI and the BCS in the definition of this accreditation rules and the course is going to be designed to comply with the existing documentation given by the BCS.

2. What are the aims of the course?

The course aims at training engineers in AI architectures and algorithms in order to leverage the power of AI in any engineering area. Particular attention is going to be given to real world problems, so that scalability and complexity of techniques is taken into account in the design of any architecture.

The course is targeted at both fresh graduates of STEM disciplines or to engineers currently working in the industrial sector wishing to train in AI in order to improve their career perspectives and bring benefits to their employers.

In more details, the specific aims of the course are:

- To provide the students a relevant theoretical knowledge of Artificial Intelligence methods.
- To provide the students a formation that will allow them to apply the AI knowledge to real world problems.

- To form students that are going to be able to analyse new real world AI problems, to critically evaluate different solutions and to create and design new AI applications.
- To meet the increasing demand of "AI practitioners" having a solid knowledge in AI.
- To support Cranfield University's mission to offer a comprehensive teaching offer in the aerospace sector.

This programme is intended for the following range of students:

- Engineers wishing to train/reskill in the area of AI.
- Graduates in Engineering disciplines, Computer Science or STEM area.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Differentiate intelligent architectures or machine learning algorithms, locate their role in complex systems and identify the appropriate applications.

ILO 2. Appraise the use of a range of professional coding practices to build reliable, reusable, scalable AI productions and services to time, quality and budget.

ILO 3. Design AI algorithms, techniques and methodologies by using appropriate statistical methods for sampling, distribution assessment, bias and error.

ILO 4. Identify and manage the technical, ethical, social and regulatory implications in the design and use of data and artificial intelligence methods.

ILO 5. Synthesise and critically compose appropriate medium to visualise AI based outputs and to prepare actionable stories relevant for business goals.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 6. Design artificial intelligence architectures/solutions, debate and solve their integration into more complex systems and critically assess their performance.

ILO 7. Appraise the use of experimental design, exploratory modelling and hypothesis testing to reach robust conclusions, by applying rigorous scientific methodologies in the AI area.

ILO 8. Critically judge the capability of AI solutions to be applied at scale to achieve business objectives.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Define a research question, develop aims and objectives, critically evaluate the existing literature, develop or execute an appropriate methodology on a subject relevant to the area of applied artificial intelligence.

ILO 10. Be able to communicate their results via a thesis and in an oral presentation in a style suitable for academic and professional audiences.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Lectures.
- Computer labs and practical sessions.
- Online contents on Virtual Learning Environment (Blackboard).
- Group Design Projects.
- Individual Research Projects.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction 3 and 8	0 20
ELECTIVE MODULES:	
Any four from 2,4,5,6,7,9	40
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction Modules 2-9 Group Design Project or Individual Dissertation (part-time)	0 80 40
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Induction Modules 2-9 Group Design Project or Individual Dissertation Project (part-time) Individual Research Project	0 80 40 80

TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 11 calendar months.

Part-time students register for the course in October and are expected to complete the course within 3 years.

The taught modules are typically delivered over 1 week, with lectures in the morning and laboratory, practical sessions or case studies in the afternoon.
Full-time students go through the course as recommended in the table.
Part-time students are recommended to complete 4 modules on the first year (suggested modules are: Systems Engineering, Intelligent and Cyber Physical Systems, Logic and Automated Reasoning and Ethical, Regulatory and Social Aspects of AI) and 4 modules, plus the Group Design Project on the second year (suggested modules are: Statistical Learning Methods, Search and Optimisation, Data Analytics and

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

Visualization, Deep Learning). In the case of part-time students the Group Design Project can be replaced by an Individual Dissertation during the second year. The final year is expected to be focused on the Individual Research Project.

7. Course Level Assessment Strategy[4]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The pre-requisite induction module will introduce the students to the course, the life on campus and some basic concepts of programming. This is an attendance-only module, hence is not going to be assessed. Modules 2-8 are introducing various practical aspects of applied AI and will be assessed through essays and reports. These will be of varying lengths, recognising that writing articles to a short length can be more challenging for some and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor. Students will write employability relevant policy briefing documents to equip them with the skills they require to succeed in the area of Applied Artificial Intelligence, Machine Learning or Data Science and to address the specific award ILOs 1-5. Students then have opportunities to develop their communication skills, as they are required to give a group presentation and individual presentation. The ability to work effectively in groups is a highly desirable skill, which has translated into ILOs 6-8. Feedback is given immediately after the group presentation. A number of formative tasks including group discussion, case studies and oral presentations supports the modules 2-9 and the group project. Formative feedback is given verbally within the classroom following discussions, via a written summary for case studies from the module leader and oral feedback provided by the tutor and peers for presentations. Students will also engage with an interactive learning activity, which incorporates formative feedback. The taught components precede the individual research project, so assessment can be used to develop skills required for this final research project. The course industrial advisory board proposes the topics of the individual research projects. Students are generally expected to be more self-directed in their learning during this research project and guidance will be provided through a pair of academic supervisors. The research project addresses ILOs 9 and 10 and takes the form of a Thesis. A small mark percentage, as defined by the module descriptor, is given by the final presentation of the student to the teaching team. Finally, a further, unassessed, occasion for dissemination and receiving formative feedback is through the final poster session to which all members of the industrial advisory boards are invited.

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module (%)[8]	Weighting within multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1		N-AAI-IDW	Induction week	Dr Luca Zanotti Fragonara	12	0	0	N	05/10/20	05/10/20	09/10/20	N/A	AO					N/A	N/A
2		N-AAI-SLM	Statistical Learning Methods	Dr Ivan Petrunin	28	0	10	N	Occ A 26/10/20 (FT) Occ B 07/12/20 (PT)	Occ A 26/10/20 (FT) Occ B 07/12/20 (PT)	Occ A 03/11/20 (FT) Occ B 11/12/20 (PT)	40 40	ICW ICW	100 100					Occ A 30/11/20 (FT) Occ A 14/12/2020 (PT) Occ B 18/01/21 (PT)	March 2021

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%)	Weighting of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3		N-AAI-SE	Systems Engineering	Dr Tim Mackley	30	0	10	N	09/11/20	09/11/20	13/11/20	40	ICW	100				FT 07/12/20 PT 18/12/20	March 2021
4		N-AAI-ICPS	Intelligent Cyber Physical Systems	Dr Saba Al-Rubaye	28	0	10	N	07/12/20	07/12/20	15/12/20	40	ICW	100				FT 11/01/2 PT 25/01/21	May 2021
5		N-AAI-SO	Search and Optimisation	Dr Luca Zanotti Fragonara	28	0	10	N	12/10/20	12/10/20	20/10/20	40	ICW	100				FT 20/11/20 PT 04/12/20	May 2021
6		N-AVC-LAR	Logic and Automated Reasoning	Dr Marta Ceccaroni	28	0	10	Y	01/02/21	01/01/21	1/02/21	40	ICW	100				FT 05/03/21 PT 19/03/21	May 2021
7		N-AAI-DAV	Data Analytics and Visualization	Dr Ivan Petrunin	28	0	10	N	23/11/20	23/11/20	02/12/20	40	ICW	100				FT 04/01/21 PT 18/01/21	May 2021
8		N-AAI-DL	Deep Learning	Dr Luca Zanotti Fragonara	28	0	10	N	FT Occ A 11/01/21 PT Occ B 15/03/21	FT Occ A 11/01/21 PT Occ B 15/03/21	FT Occ A 21/01/21 PT Occ B 19/03/21	40 40	ICW ICW	100 100				FT Occ A 08/02/21 PT Occ B 26/04/21	May 2021
9		N-AAI-ERS	Ethical, Regulatory and Social Aspects of AI	Dr Sarah Fletcher	35	0	10	N	01/03/21	01/03/21	08/03/21	40	EX	100				Exam Week 5	At the next available opportunity which may not be until the course runs the

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%)	Weighting of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																			following year
10		N-AAI-GDP	Group Design Project	Dr Luca Zanotti Fragonara	50	0	40	N	04/01/21	04/01/21 FT only	08/01/21	50			100	GCW IPRES	75 25	12/04/21 12/04/21	At the next available opportunity which may not be until the course runs the following year
11		N-AAI-DISS	Dissertation in Applied Artificial Intelligence	Dr Luca Zanotti Fragonara	20	0	40	N	01/10/20	Not currently available		50	IPROJ	100					At the next available opportunity which may not be until the course runs the following year
12		N-AAI-THESIS	Individual Research Project	Prof Antonios Tsourdos	20	0	80	N	19/04/21	19/04/21 (FT)	20/08/21 (FT	50			100	THESIS OR	85 15	20/08/21 27/08/21	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-AVC-LAR	Logic and Automated Reasoning	Autonomous Vehicles Dynamics and Control MSc	N/A

8. How are the ILOs assessed?

The following assessment types are utilised:

Exam, Individual Coursework assignment, Group and Individual Projects.

This approach has been adopted because:

MSc-level assessment of ILOs in the area of Engineering requires the students to exhibit a deep knowledge and comprehension of the topic, but also the capability of the students to synthesise and evaluate complex strategies for problem solving. Thus, in many practical engineering subject this can be readily done relying on individual coursework assignments on realistic applications and problems.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5
2	ICW	ICW	ICW		
3		ICW			
4		EX			
5	ICW		ICW		ICW
6	ICW		ICW		ICW
7	ICW	ICW	ICW	ICW	
8	ICW	ICW	ICW		
9		EX			

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 6	ILO 7	ILO 8
10 GDP	ICW GPRES	ICW GPRES	ICW GPRES
11 ID	IPROJ	IPROJ	IPROJ

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 9	ILO 10
10 GDP	ICW GPRES	ICW GPRES
11 ID	IPROJ	IPROJ
11 IRP	THESIS OR	THESIS OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that

students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The Applied Artificial Intelligence MSc course is designed both for improving the graduates' attractiveness to the market, broaden their career options and being more valuable resources if they are currently employed and attend the course as part of a traineeship program. Upon completion of the course, graduates will be exposed to the following opportunities:

- Research Degree (PhD);

- Direct employment or graduate schemes in a number of industries: Aerospace, Defence, Automotive, Public Sector, Transports.

- As possible career path, various role are available: Machine Learning Engineer, Applied Machine Learning Engineer, Data Scientist, Research Scientist, Big Data Engineer, Big Data Architect, Expert Analyst, Domain Expert, Software Engineer, Project/Program manager.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 06/07/20

1. What is the course?

Course information

Course Title	Applied Bioinformatics
Course code	MSABIFTC, MSABIPTC, PDABIFTC, PDABIPTC, PCABIFTC, PCABIPTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield
School(s)	School of Water, Energy and Environment
Theme	Environment & Agrifood
Centre	Cranfield Soil and Agrifood Institute
Course Director	Dr Fady Mohareb
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	L7 Bioinformatics Scientist (https://www.instituteforapprenticeships.org/apprenticeship-standards/bioinformatics-scientist-degree/)
Is the Degree apprenticeship integrated or non-integrated?	Non-integrated
Is the Mastership offered as an open and/or closed	Open

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

course?	
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	NA
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the Bioinformatics Group at Cranfield University, which comprises a team of entirely computer-based researchers who have been involved in several multi-million pound national and international projects, mainly funded by the BBSRC, EPSRC, the Wellcome Trust, the European Commission, and several companies including Unilever, Sanofi Aventis and GlaxoSmithKline. Our research activities include Next-Generation sequencing informatics, genome and transcriptome informatics, plant molecular biology, drug discovery, systems biology and food science. This wide range of research activities and collaborations gives us the opportunity to offer a variety of research projects to our MSc students that suit their individual research interests.

Cranfield University interacts with the following institutions and in the following ways:

Sanger, GlaxoSmithKline, Unilever, London School of Hygiene and Tropical Medicine (LSHTM), Sanofi Aventis, Rothamsted Research, the European Bioinformatics Institute, the Wellcome Trust Institute, University of Athens and Imperial College. Our teaching team at Cranfield University benefits from the input of a group of world-renowned experts in a range of applied sciences, including bioinformatics. We lead and collaborate in diverse research and consultancy projects, both nationally and internationally.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

This course aims to equip graduate scientists with the computational skills and awareness needed to manage, analyse and interpret the vast amounts of genomic, transcriptomic, proteomic and metabolic data now becoming available. On completion of this course, you will be able to apply information technology to the development of new sequencing analysis and diagnostic tools and platforms. Additionally, you will gain the skills to design and implement new software plugins to fulfill the need of the research community, and will be equipped with a diverse set of knowledge and skills that directly meet the requirements of employers in this sector.

This programme is intended for the following range of students:

- The course is aimed both at graduates with degrees in life sciences, biotechnology, food science, natural sciences or medicine and alternatively those with a computational background.

- Scientists in industry in areas such as molecular biology, cell biology, and analytical techniques requiring training, or who wish to acquire skills and expertise in the field of bioinformatics

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Applied Bioinformatics

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Define the field of bioinformatics and related disciplines, and demonstrate a critical awareness of current research in the area.
ILO 2. Use various programming languages to develop tailored bioinformatics applications to achieve specific computational biology tasks.
ILO 3. Effectively apply statistical methods and machine learning and pattern recognition algorithms to analyse and classify high throughput data.
ILO 4. Communicate the relevant concepts, both orally and in writing, to academics and practitioners from bioinformatics and related disciplines.

B. Postgraduate Diploma in Applied Bioinformatics

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO5. Apply automation tools for various bioinformatics tasks by integrating existing bioinformatics resources and tools
ILO6. Integrate various research platforms and programming languages in order to build bioinformatics solutions
ILO7. Organise and manage a programme of software development.
ILO8. Integrate knowledge, understanding and skills from the taught modules in a real-life situation
ILO9. Effectively work in a small project team to identify project objectives and select appropriate methodologies to address problems faced by industrial clients; collaborating with other team members to communicate findings in a professional manner in written, oral and visual forms.

C. MSc in Applied Bioinformatics

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO10. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.
ILO11. To communicate their findings successfully via a thesis, written in an approved School style and in an oral presentation.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Provision of lectures from external speakers to strengthen teaching in selected areas from academia and industry outside the University's area of expertise.
- Access to library resources, both on-campus and online, which are introduced at the beginning of the course by the Library Information Specialist

- Computational teaching in well-equipped facilities typical of those available to bioinformatics research scientists
- Timetabling designed to allow plenty of opportunity to assimilate information and seek further academic guidance where necessary
- Provision of a personal development programme as a self-directed activity of reflection and action planning, designed to encourage independent development of transferrable skills such as oral presentation, written communication and project management.
- The potential to carry out a research project in another organisation so alternative research environments can be experienced.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction module	
ELECTIVE MODULES:	
60 Credits from the following modules: Introduction to Bioinformatics Using Python Exploratory Data Analysis and Essential Statistics Using R Next Generation Sequencing Informatics Application of Bioinformatics in Epigenetics,Proteomicse and Metagenomics Machine Learning for Metabolomics Programming Using Java Data Integration and Interaction Networks Advanced Sequencing Informatics and Genome Assembly	 10 10 10 10 10 10 10 10
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Induction module Introduction to Bioinformatics Using Python Exploratory Data Analysis and Essential Statistics Using R Next Generation Sequencing Informatics	 10 10 10

Application of Bioinformatics in Epigenetics,Proteomicse and Metagenomics	10
Machine Learning for Metabolomics	10
Programming Using Java	10
Data Integration and Interaction Networks	10
Advanced Sequencing Informatics and Genome Assembly	10
Group project	40
TOTAL:	**120**

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Induction module	
Introduction to Bioinformatics Using Python	10
Exploratory Data Analysis and Essential Statistics Using R	10
Application of Bioinformatics in Epigenetics,Proteomicse and Metagenomics	10
Next Generation Sequencing Informatics	10
Machine Learning for Metabolomics	10
Programming Using Java	10
Data Integration and Interaction Networks	10
Advanced Sequencing Informatics and Genome Assembly	10
Group project	40
Thesis	80
ELECTIVE MODULES:	
TOTAL:	**200**

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of

your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

Part-time students register for the course in October and are expected to complete the course within 3 years.

Each module is taught over two weeks, with the second week largely free of structured teaching to allow time for more independent learning and reflection.

Teaching methods:

- Lectures, usually 1-2 hours in length, which will include visiting lecturers / external speakers.
- Interactive sessions including workshops and hands-on tutorials.
- Practical elements including computer lab classes, demonstrations and site visits.

7. Course Level Assessment Strategy[4]

The course assessment tasks enable students to demonstrate a full range of skills and attributes. The taught component is entirely assessed on the submitted coursework, which means that there are no exams and the individual modules are 100% assessed based on the assignment submitted at the end of each module. The core programming modules such as "Introduction to Bioinformatics using Python", "Essential Statistics using R" and "Introduction to Java Programming" will introduce the fundamentals of software development and program coding using the object-oriented programming and scripting concepts. These modules assessments are based on developing either a single stand-alone piece of software, or a series of scripts to achieve a bioinformatics solution for a given biological/life science

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

challenge. The software will be complemented with a short report covering the technical documentation for the implementation and a user manual as it is normally the case for bioinformatics software. For the core bioinformatics modules such as “Next Generation Sequencing Informatics”, “Data Science for Metabolomics”, and “Advanced Sequencing Informatics and Genome Assembly”, the assignment would typically be a mixture of a practical work (e.g. a report describing a process of data analysis performed as part of assignment objectives as well as the script developed for the analysis pipeline). The requirement of each assessment task is clearly stated within the module descriptor and clearly addressed to the module level ILOs. Specific award ILOs apply to different aspects of each of the taught modules, Group Project and Thesis Project. Students then have opportunities to develop their communication skills, as they are required to give a group presentations within the group project (formative assessment) and individual presentation (summative: Thesis Poster). The ability to work effectively in groups is a highly desirable skill that has translated into all ILOs. Modules are supported by a number of formative tasks including group discussion, one-to-one discussion during the computational practicals. Formative feedback is given verbally within the classroom following discussions, and oral feedback provided by the tutor and peers. Students will also engage with an interactive learning activity that incorporates formative feedback. For all modules peer review informs practice and tutorials guide progress, students are generally encouraged to support each other by asking and answering questions via the VLE. The taught components precede the research project, so assessment can be used to develop skills required for the individual research project. Students are generally expected to be more self-directed in their learning during Group Projects and Thesis Project and guidance will be provided through supervisors and induction workshops.

Course modules

The following modules outline all parts of the programme leading to **MSc**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	I-AGF-INWK	Induction module	A Medina Vaya	33	0	0	Y		05/10/20	09/10/20	N/A	AO	N/A				N/A	
2	I-BIX-PYT	Introduction to Bioinformatics Using Python	F Rezwan	25	0	10	N		12/10/20	16/10/20	40	ICW	100				FT 24/10/20 PT 07/11/20	05/21
3	I-BIX-STS	Exploratory Data Analysis and Essential Statistics Using R	F Rezwan	25	20	10	N		26/10/20	30/10/20	40	ICW	100				FT 07/11/20 PT 21/11/20	05/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
4	I-BIX-NGS	Next Generation Sequencing Informatics	F Mohareb	25	5	10	N		09/11/20	13/11/20	40	ICW	100				FT 21/11/20 PT 05/12/20	05/21
5	I-BIX-PRO	Application of Bioinformatics in Epigenetics, Proteomicse and Metagenomics	F Rezwan	25	20	10	N		23/11/20	27/11/20	40	ICW	100				FT 05/12/20 PT 04/01/21	05/21
6	I-BIX-JAV	Programming Using Java	F Mohareb	25	0	10	N		07/12/20	11/12/20	40	ICW	100				FT 04/01/21 PT 25/01/21	05/21
7	I-BIX-MET	Machine Learning for Metabolomics	M Anastasiadi	25	20	10	N		11/01/21	15/01/21	40	ICW	100				FT 23/01/21 PT 06/02/21	05/21
8	I-BIX-DAT	Data Integration and Interaction Networks	T Kurowski	25	3	10	N		25/01/21	29/01/21	40	ICW	100				FT 06/02/21 PT 20/02/21	05/21
9	I-BIX-SIM	Advanced Sequencing Informatics and Genome Assembly	F Mohareb	25	5	10	N		08/02/21	12/02/21	40	ICW	100				FT 20/02/21 PT 06/03/21	05/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
10	I-BIX-GRPP	Group Project: Building Bioinformatics Solutions	F Mohareb	16		40	N		01/03/21	07/05/21	50 50 50 50	GCW GPRES ICW RP	64 16 10 10				05/05/21 30/04/21 08/05/21 N/A	
11	I-AGF-THESIS	Individual Thesis Project	A Medina Vaya	20		80	N		10/05/21	10/09/21	50 50	THESIS OR	90 10				06/09/21 w/c 23/08/21-30/08/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module

8. How are the ILOs assessed?

The following assessment types are utilised:

Students on the MSc can typically expect to have eight pieces of individual assessment by submitted work, one piece of group project work, and one element assessed by a thesis and an oral presentation.

This approach has been adopted in order to assess the ability of the student to demonstrate their ability in a range of environments.

This approach has been adopted in order to assess the ability of the student to demonstrate their ability in a range of environments.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Applied Bioinformatics – Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.		
2	ICW	ICW				
3		ICW	ICW	ICW		
4	ICW		ICW	ICW		
5	ICW			ICW		
6		ICW	ICW			
7		ICW	ICW	ICW		
8	ICW	ICW				
9	ICW	ICW				

B. Applied Bioinformatics – Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	ILO 9.
10	GPROJ	GPROJ	GPROJ	GPROJ	GPROJ

Award ILOs / Module No.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	ILO 9.
			ICW		ICW
11			IPROJ IPRES		

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 10.	1LO 11.
12	THESIS/ OR	THESIS/ OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Our MSc opens doors to careers in industry, public research establishments and university research. The multidisciplinary nature of our course has allowed our students to follow diverse career paths in various medical-related sectors including:

- Pharmaceutical and Biotech companies
- Plant research institutes
- Food sector
- Public Institutions
- Bioinformatics research institutes
- IT companies

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 01/04/2020

1. What is the course?

Course information

Course Title	**Applied Mathematics and Operational Research Programme (AMOR)**, encompassing courses: I. Defence Simulation and Modelling (DSM) II. Military Operational Research (MOR)
Course code	I. **(DSM)** MSDSMFTR - PCDSMFTR - PDDSMFTR - MSDSMPTR - PCDSMPTR – PDDSMPTR, II. **(MOR)** MSMORFTR – PCMORFTR – PDMORFTR - MSMORPTR – PCMORPTR – PDMORPTR iii. SPAMRPTR
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert (both DSM and MOR)
Additional exit routes	PgDip, PgCert (both DSM and MOR)
Mode of delivery	Full-Time and Part-Time (both DSM and MOR)
Location(s)[1] of Study	Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Centre for Simulation and Analytics
Course Director	Mr J R Searle
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	DSM : Yes MOR : No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements. Minimum IELTS of 6.5
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full time students: 12 months Maximum part time registrations of: MSc 5 years, PgDip 4 years, PgCert 3 years.
Course Start Month(s)	Full time : September Part time : September, January

Institutions delivering the course

This course is delivered by the Centre for Simulation and Analytics, Cranfield Defence and Security where the research interests include the modelling and simulation of Defence systems for analysis, experimentation and training.

Cranfield University interacts with the following institutions and in the following ways:

- A range of Defence and industrial partners provide software to the SSEL (Simulation and Synthetic Environment Laboratory).
- The course is supported by external visiting speakers in order to illustrate the real-world application and relevance of the material being taught
- The topics for student research projects are often suggested by external agencies and companies.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Cranfield University offers this course in order to provide graduates with the technical qualities, transferable skills and independent learning ability necessary to make them effective in organisations that design, develop and use modelling and simulation in a defence context.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) entry and exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- Recent graduates wishing to acquire knowledge and skills in either modelling and simulation or military operational research or in order to obtain employment in the defence industry;

- Members of the Armed Forces working in or preparing to take up appointments in the area of modelling and simulation or of operational research;
- Graduates working in defence research organisations wishing to extend their knowledge of either modelling and simulation or operational research.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Defence Simulation and Modelling Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Appraise some of the issues involved in the design, development and application of models, simulations and Synthetic Environments (SEs)

ILO 2. Demonstrate an understanding of the broad principles of simulation software and how to apply this knowledge in creating and using a synthetic environment

ILO 3. Compare and critically evaluate some of the issues involved in procuring and using models and simulations for applications including training and analysis

For part-time PG Cert students, where a flexible path is available, note that some aspects may be limited by the elective module choices made.

B. Defence Simulation and Modelling Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Explain the fundamentals of models and simulations and Synthetic Environments (SEs) and their place in procurement, training, the development of future force structures and the efficient use of defence resources

ILO 5. Critically evaluate different methodologies used in modelling and simulation and SEs and compare their strengths and weaknesses and understand how to select an appropriate methodology for a given need or situation

ILO 6. Demonstrate knowledge of issues and trade-offs that must be considered when using models, simulations and SEs for analysis and training

ILO 7. Demonstrate understanding of the practical application of models, simulations and SEs in government and the defence industry

ILO 8. Plan, specify, configure and utilise a distributed simulation or synthetic environment system

ILO 9. Appraise and critically evaluate the appropriate hardware in creating and running models, simulations and SEs

C. Defence Simulation and Modelling MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 10. Demonstrate technical expertise, independent learning abilities and critical appraisal skills, by completing a modelling and simulation related project

D. Military Operational Research Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Understand the basic philosophy and methodologies of operational research

ILO 2. Appreciate examples of the practical application of operational analysis in government and defence industry

ILO 3. Distinguish between a limited range of the different modelling methodologies used in operational analysis and evaluate their strengths and weaknesses

ILO 4. Explain the reasons for using models and describe how operational analysis is applied to support defence decision making

ILO 5. Show transferable skills through an ability to communicate findings and issues to a subject specific audience

For part-time PG Cert students, where a flexible path is available, note that some aspects may be limited by the elective module choices made.

E. Military Operational Research Postgraduate Diploma

In addition to the intended learning outcomes outlined in D. above, a diligent student would also be expected to achieve the following in a topic relevant to their named award:

ILO 6. Explain the fundamental principles of modelling in operational analysis (military operational research) and be aware of the contribution of modelling in procurement, training, the development of future force structures and the efficient use of defence resources

ILO 7. Demonstrate an in-depth understanding of a wide range of the modelling methodologies used in operational analysis and to critically evaluate their strengths and weaknesses

ILO 8. Demonstrate knowledge of the detailed design issues and trade-offs that must be considered when specifying, developing or choosing model components

ILO 9. Demonstrate an understanding of knowledge of the issues involved in the design, development, verification, validation and application of operational analysis models and in the interpretation and communication of the results

ILO 10. Show understanding of examples of the practical application of operational analysis in government and defence industry

ILO 11. Explain the reasons for using models and describe how operational analysis is applied to support defence decision making

ILO 12. Demonstrate an ability to communicate subject specific findings to both a specialist and general audience

F. Military Operational Research MSc

In addition to the intended learning outcomes outlined in D. and E. above, a diligent student would also be expected to achieve the following in a topic relevant to their named award:

ILO 13. Demonstrate technical expertise, independent learning abilities and critical appraisal skills by completing an Operational Research related project.

4. How is the course taught?

Teaching methods:

- lectures from Cranfield staff and visiting speakers
- participative sessions, including tutorials and group exercises
- practical application elements, e.g. computer based demonstrations and practical sessions
- for the MSc: individual research project, with academic supervision

In addition to the teaching methods outlined above, students will be supported in their learning and personal development by:

- coursework involving investigation into a technical subject area and presentation to their peers
- participation on the modules by practitioners who are able to raise current issues and comment on the latest developments
- access to the Simulation and Synthetic Environment Laboratory (SSEL)
- an Academic Advisor (Personal Tutor) who gives advice on academic and other matters, acts as a link between students and the University academic authorities and monitors progress

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

Defence Simulation and Modelling

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

PgCert in Defence Simulation and Modelling – Full-time	**Credits**
COMPULSORY MODULES:	
Introductory Studies Foundations of Modelling & Simulation Modelling & Simulation Acquisition and Techniques Real Time Graphics War Gaming and Combat Modelling Advanced Module #1 Advanced Module #2	0 10 10 10 10 10 10
ELECTIVE MODULES:	
N/A	
TOTAL:	**60**

PgCert in Defence Simulation and Modelling – Part-time	**Credits**
COMPULSORY MODULES:	
Introductory Studies Foundations of Modelling & Simulation	0 10
ELECTIVE MODULES:	
5 modules chosen from: Modelling & Simulation Acquisition and Techniques	50 (10 credits per module)

Real Time Graphics War Gaming and Combat Modelling Synthetic Environment and Virtual Simulation Experimentation, Analysis and Trials for Simulation Weapon System Performance Assessment Networked and Distributed Simulation Advanced Module #1 Advanced Module #2 Networked and Distributed Simulation Exercise	
TOTAL:	**60**

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

PgDip in Defence Simulation and Modelling (Full-time and Part-time)	**Credits**
COMPULSORY MODULES:	
Introductory Studies Foundations of Modelling & Simulation Modelling & Simulation Acquisition and Techniques Real Time Graphics War Gaming and Combat Modelling Synthetic Environments and Virtual Simulation Experimentation, Analysis and Trials for Simulation Weapon System Performance Assessment Networked and Distributed Simulation Advanced Module #1 Advanced Module #2 Advanced Module #3 Networked and Distributed Simulation Exercise	0 10 10 10 10 10 10 10 10 10 10 10 10
ELECTIVE MODULES:	
N/A	
TOTAL:	**120**

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

MSc in Defence Simulation and Modelling (Full-time and Part-time)	**Credits**
COMPULSORY MODULES:	
Introductory Studies Foundations of Modelling & Simulation Modelling & Simulation Acquisition and Techniques Real Time Graphics War Gaming and Combat Modelling Synthetic Environments and Virtual Simulation Experimentation, Analysis and Trials for Simulation Weapon System Performance Assessment Networked and Distributed Simulation Advanced Module #1 Advanced Module #2 Advanced Module #3 Networked and Distributed Simulation Exercise	0 10 10 10 10 10 10 10 10 10 10 10 10

MSc Research Project	80
ELECTIVE MODULES:	
N/A	
TOTAL:	**200**

Military Operational Research

A. Postgraduate Certificate MOR

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

PgCert in Military Operational Research – Full-time	**Credits**
COMPULSORY MODULES:	
Introductory Studies Introduction to Operational Research Techniques Discrete and Continuous Simulation Decision Analysis War Gaming and Combat Modelling Advanced Module #1 Advanced Module #2	0 10 10 10 10 10 10
ELECTIVE MODULES:	
N/A	
TOTAL:	**60**

PgCert in Military Operational Research – Part-time	**Credits**
COMPULSORY MODULES:	
Introductory Studies Introduction to Operational Research Techniques	0 10
ELECTIVE MODULES:	
5 modules chosen from: Discrete and Continuous Simulation Decision Analysis War Gaming and Combat Modelling Statistical Analysis and Trials Weapon System Performance Assessment Intelligent Systems Logistics Modelling Advanced Module #1 Advanced Module #2 Advanced Module #3	50 (10 credits per module)
TOTAL:	**60**

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

PgDip in Military Operational Research (Full-time and Part-time)	**Credits**
COMPULSORY MODULES:	
Introductory Studies Introduction to Operational Research Techniques Discrete and Continuous Simulation Decision Analysis	0 10 10 10

War Gaming and Combat Modelling	10
Statistical Analysis and Trials	10
Weapon System Performance Assessment	10
Intelligent Systems	10
Logistics Modelling	10
Advanced Module #1	10
Advanced Module #2	10
Advanced Module #3	10
Advanced Module #4	10
ELECTIVE MODULES:	
N/A	
TOTAL:	**120**

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

MSc in Military Operational Research (Full-time and Part-time)	**Credits**
COMPULSORY MODULES:	
Introductory Studies	0
Introduction to Operational Research Techniques	10
Discrete and Continuous Simulation	10
Decision Analysis	10
War Gaming and Combat Modelling	10
Statistical Analysis and Trials	10
Weapon System Performance Assessment	10
Intelligent Systems	10
Logistics Modelling	10
Advanced Module #1	10
Advanced Module #2	10
Advanced Module #3	10
Advanced Module #4	10
MSc Research Project	80
ELECTIVE MODULES:	
N/A	
TOTAL:	**200**

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of

your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in September and are expected to complete the course within 12 calendar months.

The courses are also offered on a part-time basis. Part-time students normally register for their course in September or January, but if they have an appropriate background, it may be possible to register at a different time.

The maximum registration period for part-time students is:

- MSc – 5 years
- PgDip – 4 years
- PgCert – 3 years.

The full-time PgCert requires successful completion of 4 standard taught modules and 2 self-study 'Advanced' modules. More flexibility is however available for part-time PgCert students, who may choose from a range of elective modules in order to arrange their studies with respect to their other commitments over the shorter period of registration available to them.

Building on this, the PgDip then also requires successful completion of an additional set of 4 standard taught modules and a further 2 self-study 'Advanced' modules.

For the MSc, students are also required to successfully complete a thesis.

Each standard taught module consists of a one week course of lectures, tutorials and practical work, followed by directed study coursework, involving private study equivalent to a further week of full-time work, allowing time for more independent learning and reflection.

A limited number of these standard taught modules are approved for delivery by non-residential distance e-learning using the on-line Cranfield Moodle Virtual Learning Environment (VLE). A 10-week block

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

period for part time students to complete such on-line modules is typically offered once in each standard academic term.

The two-week self-study Advanced modules are 'mini-projects' with unique topics agreed individually for each student, which build on material covered in the standard modules and offer students the opportunity to explore selected topics in more depth. Depending on the nature of the topic selected, and excepting the 'Networked and Distributed Simulation Exercise' for the DSM Course, advanced modules typically may not involve any additional classroom attendance. A 10-week block period for part time students to complete Advanced Modules is typically offered once in each standard academic term

7. Course Level Assessment Strategy[4]

Within the AMOR Programme, the DSM and MOR Courses have a common structure and operate under common regulations, with a common core teaching team and with some shared taught modules. Students on both courses are typically (but not exclusively) mid-career personnel, who are already in employment in the military, public service or industry and who have a strong focus on Defence.

The two courses typically address slightly different student needs however and this is reflected in some differences in assessment between them, particularly where they have unique (ie non-shared) modules.

All DSM and MOR taught modules are also available as both Short Courses and as Short Courses for Credit. Students in these modes of study are not registered for formal Postgraduate Awards, but rather are attending isolated individual modules in standalone mode as Career Professional Development activities. Because of this standalone use of the modules, the assessments for any one module cannot depend on, or be linked to, attendance at other related modules, but must be limited to the content of that single module specifically.

Assessments cannot therefore explicitly encompass integration across several modules.
Further, many AMOR modules are also shared with other CDS Postgraduate programs (eg SEDC, MESE, DSP) which again reinforces the need for assessments to be limited to module specific content, as students from other programs may not have access to other AMOR modules.

Both AMOR Courses (DSM and MOR) are typically specialist niche areas with relatively small cohorts, mainly studying in part-time mode, which means that no elective options are available. Both courses have a fixed path of compulsory modules.

DSM students are often MOD personnel employed as technical Subject Matter Experts (SME) whose responsibilities are primarily in aspects such as procurement, acquisition, requirements, management, coordination and coherence. They are typically not developers or operators. Hence their coursework assessments relate primarily to their 'big-picture' need to understand a broad range of relevant issues.

Although few of them will normally develop or utilise the techniques, tools and methods directly, the coursework often employs those in order for the students to better understand what their contractors/vendors/subordinates will be doing, to enable them to communicate more effectively with those personnel as intelligent/educated customers.

In contrast, the MOR student body is smaller and yet more diverse. Their primary focus is on developing skills in the application of different approaches and techniques to problem-solving, analysis and decision-support in a defence context. For MOR it is perhaps more likely that the students themselves will directly use these technique in their real-world jobs.

Although the precise mix varies between the courses, both DSM and MOR employ assessments that are typically a mix of practical work and research-based assignments.

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[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

As both courses have a high proportion of part-time students (currently approaching 100% at the time of writing), assessed coursework must be able to be carried out away from facilities at CDS.

As coursework often involves access to suitable computer systems and specialist software (some of which is not generally academically available outside CDS at the Defence Academy), equipment pools are therefore maintained to allow students to borrow suitable systems to use at their remote stations. This includes laptops and peripherals (such as network switches, joysticks, steering wheels and VR systems), and also the necessary software tools and applications. Remote access to facilities in the SSEL is also offered.

Many of the taught AMOR modules have a high proportion of hands-on computer-based lab work and practical exercises, which allows the academic staff to provide immediate formative feedback, both individually and collectively at the time. With class sizes being typically small, this also often informally encourages student peer discussion (especially where group, collaborative effort is required) and allows taught theory to be quickly supported by, and related to, real world practical examples.

AMOR Advanced Modules require self-study work on individual, self-suggested topics. Although the formal summative assessment is through a written submission, students must also present their work to both staff and other students prior to the summative submission. This not only develops presentation skills, but also provides an opportunity for formative feedback from both teaching staff and peers. Advanced Modules are deliberately designed to foster independent study and research skills prior to MSc research project thesis work.

Group work occurs in one residential Advanced Module (NDSE) for DSM, which is the capstone of the taught phase of the year for full-time students, giving them an opportunity to apply and integrate learning from across their studies. While its formal summative assessment is based on individual written submissions, the 10-day nature of the exercise provides many opportunities for staff formative feedback and peer-learning. As with other Advanced Modules a student post-activity presentation is also required (NB a group presentation in this specific case) which, although not assessed, provides opportunities for further formative feedback.

Although part-time students have more freedom than full-time students, in terms of the order in which they attend/study modules, some prerequisites are stated which ensures that a logical progression is followed. Thus for example, Advanced Modules in a topic may not be taken until the base taught module in that area has been attended.

AMOR offers a limited amount of VLE-based distance learning, intended primarily to provide study flexibility for part-time students. Two taught modules on each Course are offered that way, with the modules each being made available once per academic term in a scheduled 10-week block.

The DSM Course in particular is currently adapting to better meet MOD's needs, at their explicit request. The main effort is to change focus away from teaching that is perceived as being 'too traditional and academic' to become more representative and inclusive of the contemporary issues that the MOD technical SME encounter. As these changes continue, this is likely to lead to an increase in case-based assessment based on real-world examples.

Course modules

The following modules outline all parts of the programme leading to **MSc**.. Other awards associated with the course include some or all of these modules.

Module Number	Related Award	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or [illegible]	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	DSM MOR	R-AMOR-INTRO	Introductory Studies A & B	Dr J D Salt	*30*	*0*	0	*Y*	A:07/09/20 B:11/01/21	07/09/20 11/01/21	11/09/20 15/01/21	N/A	AO	N/A				N/A	N/A
2	DSM	R-AMOR-FMS	Foundations of Modelling & Simulation A & B	Mr J M Hoggard	32	0	10	*Y*	A:14/09/20 B:18/01/21	14/09/20 18/01/21	18/09/20 22/01/21	40	ICW	100				A FT: 12/10/20 A PT: 26/10/20 B PT: 01/03/21	A FT: 25/01/21 A PT: 26/07/21 B PT: 26/07/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%. This will be at the Board of Examiners discretion.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Related Award	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	MOR	R-AMOR-IORT	Introduction to Operational Research Techniques*	Mr J D Smith	30	0	10	Y	14/09/20	14/09/20	18/09/20	50	EX	100				11/12/20	08/04/21
4	DSM	R-AMOR-MSAT	Modelling & Simulation Acquisition and Techniques	Mr J R Searle	32	0	10	Y	28/09/20	28/09/20	02/10/20	40	ICW	100				FT: 26/10/20 PT: 09/11/20	FT: 25/01/21 PT: 26/07/21
5	MOR	R-AMOR-DCS	Discrete & Continuous Simulation	Dr K R McNaught	30	0	10	Y	28/09/20	28/09/20	02/10/20	40	ICW	100				FT: 26/10/20 PT: 09/11/20	FT: 25/01/21 PT: 26/07/21
6	DSM	R-AMOR-RTG	Real Time Graphics A Real Time Graphics B, C and D **	Mr J M Hoggard	32	0	10	Y	A:12/10/20 B:12/10/20 C:18/01/21 D:24/05/21	12/10/20 12/10/20 18/01/21 24/05/21	16/10/20 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 9/11/20 A PT: 23/11/20 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 25/01/21 A PT: 26/07/21 B, C, D: Next 10-week VLE module block.
7	MOR	R-AMOR-DA	Decision Analysis A and B	Dr K R McNaught	30	0	10	Y	A:12/10/20	12/10/20	16/10/20	50	ICW	100				A FT: 9/11/20 A PT:	A FT 25/01/21 A PT:

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Related Award	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or [illegible]%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
									B:08/02/21	08/02/21	12/02/21							23/11/20 B PT: 22/03/21	26/07/21 B PT: 26/07/21
8	DSM MOR	R-AMOR-WGC	War Gaming & Combat Modelling A War Gaming & Combat Modelling B, C and D **	Mr J D Smith	30	0	10	Y	A:26/10/20 B:12/10/20 C:18/01/21 D:24/05/21	26/10/20 12/10/20 18/01/21 24/05/21	30/10/20 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 23/11/20 A PT: 07/12/20 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 25/01/21 A PT: 26/07/21 B, C, D: Next 10-week VLE module block.
9	MOR	R-AMOR-SAT	Statistical Analysis & Trials*	Dr T J Ringrose	30	0	10	Y	11/01/21	11/01/21	15/01/21	40	EX	100				08/04/21	04/06/21
10	DSM	R-AMOR-EATS	Experimentation, Analysis and Trials for Simulation	Mr J D Smith	30	0	10	N	04/01/21	04/01/21	08/01/21	40	ICW	100				FT: 01/02/21 PT: 15/02/21	FT: 26/04/21 PT: 26/07/21
11	DSM	R-AMOR-SEVS	Synthetic Environments & Virtual Simulation	Mr J M Hoggard	32	0	10		25/01/21	25/01/21	29/01/21	40	ICW	100				FT: 22/02/21 PT: 08/03/21	FT: 26/04/21 PT: 26/07/21
12	DSM MOR	R-AMOR-WSAP	Weapon System	Mr J D Smith	30	0	10	Y	08/02/21	08/02/21	12/02/21	40	ICW	100				FT: 08/03/21 PT:	FT: 26/04/21 PT:

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Related Award	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or [illegible]	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
			Performance Assessment															22/03/21	26/07/21
13	MOR	R-AMOR-IS	Intelligent Systems	Dr V V S S Sastry	30	0	10	Y	25/01/21	25/01/21	29/01/21	40	ICW	100				FT: 22/02/21 PT: 08/03/21	FT: 26/04/21 PT: 26/07/21
14	DSM	R-AMOR-NDS	Networked & Distributed Simulation	Mr J R Searle	32	0	10	Y	22/02/21	22/02/21	26/02/21	40	ICW	100				FT: 22/03/21 PT: 05/04/21	FT: 26/04/21 PT: 26/07/21
15	MOR	R-AMOR-LM	Logistics Modelling A Logistics Modelling B, C & D**	Dr J D Salt	30	0	10	Y	A:22/02/21 B:12/10/20 C:18/01/21 D:24/05/21	22/02/21 12/10/20 18/01/21 24/05/21	26/02/21 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 22/03/21 A PT: 05/04/21 B: 21/12/20 C: 22/03/21 D: 02/08/21	A FT: 26/04/21 A PT: 26/07/21 B, C, D: Next 10-week VLE module block.

*This module is assessed by examination; it also has an element of coursework which is formative only (i.e. it is not summatively assessed), but submission is still mandatory.

**Subject to approval by the Course Director, this module may be available for non-residential, on-line distance learning study using the Cranfield Moodle Virtual Learning Environment (VLE). A 10-week block period for part time students to complete such on-line modules is typically offered once in each standard academic term and relates to occurrences B, D and D.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

ADVANCED MODULES AND PROJECT

Module Number	Module code	Related Award	Title	Module Leader	Contact hours	Total hours delivered by Visiting Lecturers	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part assessment			Submission dates	
									Module Start Date (eg Pre-course task)	' Residential' Start Date	' Residential' End Date	Minimum Mark - 40% or 50%	Type of Assessment	Weighting within module (%) of Independent assessments	Weighting within module of multi-part assessments (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment	Assessment Submission and/or exam date	Assessment / Exam Retake date
16	R-AMOR-AD1	DSM MOR	Advanced Module #1 A (FT) Advanced Modules #1 B, C & D (PT)	Mr J R Searle	5	0	10	Y	A FT: 09/11/20 B:12/10/20 C:18/01/21 D:24/05/21	09/11/20 12/10/20 18/01/21 24/05/21	20/11/20 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 23/11/20 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 26/07/21 B, C, D : Next 10-week VLE module block.
17	R-AMOR-AD2	DSM MOR	Advanced Module #2 A (FT) Advanced Modules #2 B, C & D (PT)	Mr J R Searle	5	0	10	Y	A FT: 07/12/20 B:12/10/20 C:18/01/21 D:24/05/21	07/12/20 12/10/20 18/01/21 24/05/21	18/12/20 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 21/12/20 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 26/07/21 B, C, D: Next 10-week VLE module block.
18	R-AMOR-AD3	DSM MOR	Advanced Module #3 A (FT) Advanced Modules #3 B, C & D (PT)	Mr J R Searle	5	0	10	Y	A FT: 08/03/21 B:12/10/20 C:18/01/21 D:24/05/21	08/03/21 12/10/20 18/01/21 24/05/21	19/03/21 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 22/03/21 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 26/07/21 B, C, D: Next 10-week VLE module block.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

19	R-AMOR-NDSE	DSM	Networked & Distributed Simulation Exercise (DSM Advanced Module #4)	Mr J R Searle	10	0	10	N	12/04/21	12/04/21	23/04/21	40	ICW	100				26/04/21	26/07/21
20	R-AMOR-AD4	MOR	Advanced Module #4 A (FT) Advanced Modules #4 B, C & D (PT)	Mr J R Searle	5	0	10	N	A FT: 12/04/21 B:12/10/20 C:18/01/21 D:24/05/21	 12/04/21 12/10/20 18/01/21 24/05/21	 23/04/21 18/12/20 19/03/21 30/07/21	40	ICW	100				A FT: 26/04/21 B:21/12/20 C:22/03/21 D:02/08/21	A FT: 26/07/21 B, C, D: Next 10-week VLE module block.
21	R-AMR-THESIS	DSM MOR	MSc Research Project	Mr J R Searle	N/A	N/A	80	Y	A FT: 04/01/21 A PT: 04/01/21 B PT: 03/08/20 C PT: 05/04/21	 04/01/21 03/08/20 05/04/21	 31/08/21 04/02/22 03/09/21 03/05/22	50	THESIS	100				FT: 31/08/21 PT: 04/02/2022 B: 03/09/21 C:03/05/22	By arrange-ment By arrange-ment

Most Advanced Modules (except NDSE) comprise self-study, mini-project coursework, equivalent to 10 days effort for a full-time residential student (Occurrence A). For each part-time student the equivalent work will normally be conducted non-residentially over a block period of 10 weeks which is typically offered once in each standard academic term (Occurrences B, C and D). NDSE for the DSM Course however typically requires group-based self-study work and is therefore normally undertaken residentially at Shrivenham Campus alongside the full-time students.

Advanced Module Topics will typically be proposed individually by students to follow-on from previous studies in one or more standard taught modules as pre-requisites. Topics require the approval of the relevant Module Manager(s) and Course Director. NDSE is an exception to this, where the topic will be provided and students will work as a group.

Part-time students requiring to re-take Advanced Modules will complete the activity in the next scheduled 10 week block.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
R-AMOR-FMS	Foundations of Modelling & Simulation	AMOR	MESE SEDC share teaching in their R-SEDC-SSE module Defence and Security Programme
R-AMOR-NDS	Networked and Distributed Simulation	AMOR	SEDC (as NDS)
R-AMOR-DA	Decision Analysis	AMOR	SEDC share teaching in their R-SEDC- DAMS module.
R-AMOR-IS	Intelligent Systems	AMOR	Defence and Security Programme
R-AMOR-WGC	War Gaming and Combat Modelling	AMOR	Defence and Security Programme
R-AMOR-RTG	Real Time Graphics	AMOR	Defence and Security Programme
R-AMOR-IORT	Introduction to Operational Research Techniques	AMOR	Defence and Security Programme
R-AMOR-LM	Logistics Modelling	AMOR	Defence and Security Programme
R-AMOR-SAT	Statistical Analysis and Trials	AMOR	Defence and Security Programme

8. How are the ILOs assessed?

The following assessment types are utilised:

With some exceptions for the MOR course (discussed below), most standard taught modules are assessed 100% by written individual coursework assignments. The coursework is normally issued at the beginning of the taught module. Full-time students are normally required to submit the coursework approximately one week after the end of the module. Part-time students are normally required to submit the coursework approximately 5 weeks after the end of the module. It is felt that this mode of assessment best suits the practical and applied nature of the disciplines involved.

Two of the standard taught modules in the MOR course are assessed 100% by formal examinations – with one being an open book and open notes exam, while the other is a closed book exam. For these modules, the requirement to submit coursework will therefore be formative (but still compulsory), not summative. Past examination papers are made available.

Advanced modules (including NDSE for DSM) are 100% assessed by written individual coursework, which may include an optional viva. An individual presentation is also normally required, although this is a formative part of the learning experience and does not contribute to the summative assessment.

The MSc research project is assessed by a written thesis and may include an optional viva.

This approach has been adopted in order that the individual elements of the courses can be assessed by the most appropriate method and that students can demonstrate their understanding in a number of different ways.

Assessment and ILO Mapping

DEFENCE SIMULATION AND MODELLING

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3
2. FMS	ICW	ICW	ICW
4. MSAT	ICW	ICW	ICW
6. RTG	ICW	ICW	ICW
8. WGC	ICW	ICW	ICW
10. SEVS	ICW	ICW	ICW
11. EATS	ICW	ICW	ICW
12.WSAP	ICW		ICW
14. NDS	ICW	ICW	ICW
16. AM#1	ICW	ICW	ICW
17. AM#2	ICW	ICW	ICW
19. NDSE	ICW	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 4.	ILO 5.	ILO 6.	ILO 7	ILO 8.	ILO 9.
2. FMS	ICW	ICW	ICW	ICW	ICW	ICW
4. MSAT	ICW	ICW	ICW			
6. RTG	ICW	ICW	ICW	ICW		ICW
8. WGC	ICW	ICW	ICW	ICW		
10. SEVS	ICW	ICW	ICW	ICW		ICW

Award ILOs / Module No.	ILO 4.	ILO 5.	ILO 6.	ILO 7	ILO 8.	ILO 9.
11. EATS	ICW	ICW	ICW	ICW	ICW	
12. WSAP	ICW	ICW		ICW		
14. NDS	ICW	ICW	ICW	ICW	ICW	ICW
16. AM#1	ICW	ICW	ICW	ICW	ICW	ICW
17. AM#2	ICW	ICW	ICW	ICW	ICW	ICW
18. AM#3	ICW	ICW	ICW	ICW	ICW	ICW
19. NDSE	ICW	ICW	ICW	ICW	ICW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 10.
21 THESIS	THESIS

MILITARY OPERATIONAL RESEARCH

D. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3	ILO 4.	ILO 5
3. IORT	EX		EX	EX	EX
5. DCS		ICW	ICW		
7. DA	ICW	ICW	ICW		
8. WGC	ICW	ICW			
9. SAT	EX	EX	EX	EX	
12. WSAP		ICW		ICW	
13. IS			ICW		
15. LM			ICW	ICW	ICW
16. ADV#1	ICW	ICW	ICW	ICW	ICW
17. ADV#2	ICW	ICW	ICW	ICW	ICW
18. ADV#3	ICW	ICW	ICW	ICW	ICW

E. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 6.		ILO 7.	ILO 8.	ILO 9	ILO 10.	ILO 11.	ILO 12.
3. IORT	EX				EX	EX		

5. DCS				ICW	ICW			
7. DA				ICW	ICW	ICW		
8. WGC			ICW		ICW	ICW	ICW	
9. SAT			EX		EX	EX		
12. WSAP	ICW			ICW			ICW	
13. IS					ICW			
15. LM						ICW		
16. ADV#1			ICW	ICW	ICW	ICW	ICW	ICW
17. ADV#2			ICW	ICW	ICW	ICW	ICW	ICW
19. ADV#3			ICW	ICW	ICW	ICW	ICW	ICW
20. ADV#4			ICW	ICW	ICW	ICW	ICW	ICW

F. MSc
In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessment:

Award ILOs / Module No.	ILO 13.
21 THESIS	THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A	N/A		

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Students on this course are generally either sponsored by their existing employer as preparation for specific roles in Training, Analysis, Acquisition and Experimentation in the Military, Defence Organisations or Defence Industry, or else are seeking employment in those areas.

COURSE SPECIFICATION

Cranfield University: Course Specifications
Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Astronautics and Space Engineering with variants in: MSc in Astronautics and Space Engineering (extended thesis) MSc in Astronautics and Space Engineering (Spacemaster) – *full-time option only*
Course code	MSASEFTC, MSASEPTC, MSASMFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Autonomous and Cyber-physical Systems
Course Director	Dr Jenny Kingston
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	NA
Is the Degree apprenticeship integrated or non-integrated?	NA

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Mastership offered as an open and/or closed course?	NA
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	One year full-time, -three years part-time
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Autonomous and Cyber-physical Systems where the research interests include:

- The design and development of both space and aeronautical systems.

Cranfield University interacts with the following institutions and in the following ways:

- The Erasmus Mundus (Spacemaster) variants of the course are two year programmes taught jointly with other European institutions. The SpaceMaster involves prior learning and teaching for the first year from Lulea Technical University (Sweden).

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by Royal Aeronautical Society (RAeS) until the October 2021 intake, as suitable further learning towards CEng registration.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Equip students from backgrounds in engineering or physical science with the knowledge, understanding and skills required to enable them to contribute to the European space industry or to space-related research.
- Develop students' specialist technical skills and to give students an awareness of space system engineering so that their specialist skills can be most effectively applied.
- Develop the transferable skills of students for a professional career in the space industry or research.

This programme is intended for the following range of students:

- New graduates seeking to pursue a career in the space industry.

- Practitioners in the sector, particularly at junior and middle management levels, who are seeking to expand their knowledge and skills in space systems engineering in order to further develop their careers.
- Practitioners who are not employed in the sector, who are seeking a career in the space industry.
- Both practitioners and new graduates seeking to pursue doctoral research in the area of spacecraft engineering.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. MSc

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Demonstrate a systematic knowledge, understanding and critical evaluation of the key principles of the main spacecraft disciplines (propulsion, orbits, communications, structure, data handling, etc.) and be competent to analyse performance quantitatively.
ILO 2. Demonstrate a critical judgement of their specialist subject area(s) at a level appropriate to new recruits to the space industry such that they are able to contribute directly without significant further training.
ILO 3. Demonstrate a systematic knowledge of the organisation of the space industry and typical space projects, within the wider economic, legal, social, ethical and environmental context.
ILO 4. Be able to apply their knowledge and understanding practically to the design and analysis of space systems.
ILO 5. Write a technical report to communicate their work clearly to others.
ILO 6. Give an oral presentation to describe the execution and results of a technical project.
ILO 7. Plan, execute and manage a small research project.
ILO 8. Work effectively as a member of a team on a technical project.
ILO 9. Undertake independent study and research.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Assessed modules comprising lectures and workshops.
- Attendance-only modules which are not directly assessed but build overall breadth and depth of space engineering knowledge, and which can be applied within the project work.
- Lectures and workshops delivered by industry practitioners, demonstrating the application of theory to various examples and case studies.
- Industry visits to demonstrate industry practice and facilities.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. MSc

The accumulation of 200 credits (or more) through the assessment of taught modules and the successful completion of the Thesis as detailed below:

Astronautics and Space Engineering (standard course)

Description	Credits
COMPULSORY MODULES:	
Modules: 1 to 3 Group Design Project: 11 Individual Research Project:12	30 60 90
ELECTIVE MODULES:	
2 modules chosen from: 4-10	20
OPTIONAL MODULES:	
Any modules chosen from: 14-26	0
TOTAL:	200

Astronautics and Space Engineering (extended thesis option)

Description	Credits
COMPULSORY MODULES:	
Modules: 1 to 3 Extended Individual Research Project: 13	30 150
ELECTIVE MODULES:	
2 modules chosen from: 4-10	20
OPTIONAL MODULES:	
Any modules chosen from: 14-26	0
TOTAL:	200

Astronautics and Space Engineering (Spacemaster variant)

Description	Credits
COMPULSORY MODULES:	
Accredited prior learning at Julius Maximilian University Wurzburg and Lulea Technical University Module: 3 Individual Research Project: 13	120 10 90
ELECTIVE MODULES:	
2 modules chosen from: 4-10	20
OPTIONAL MODULES	
Any modules chosen from: 14-26	0
TOTAL:	240

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[3] [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are normally expected to complete the course within 11 calendar months.

Part-time students usually register for the course in October and are normally expected to complete the course within 3 years

The majority of lecture modules take place between October and March and run in parallel with the Group Design Project which concludes by early May. The Individual Research Project Component runs from

[3] For students who were registered before 1 August 2015, the requirement to obtain a minimum mark for a taught assessment will not apply for taught assessment taken before 31 August 2015 (unless the assessment was designated as a "key assessment" under the previous Assessment Rules).

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

January through to the end of the programme in September. An Extended Thesis variant of the course offers a longer more in-depth Individual Research Project Component that runs from November to the end of the programme instead of participation in the Group Design Project. This is generally aimed at students who have already had significant group project experience (for example in prior work in industry).

This course is also offered on a part-time basis. Students would instead complete the extended thesis variant of the course over a 2 to 5 year period, firstly completing the taught element of the programme before starting the individual research project.

7. Course Level Assessment Strategy[5]

Summative assessments have been chosen to align with the stated ILOs for each course element, and also to provide a range of assessment types. These assessments cover key communication skills (written, oral, and team-working), and include elements where assessed work is performed both with (group project) and without (examination) peer collaboration, to assure robustness of the evaluation of an individual student's performance.

The range of assessment types allows for diversity within the cohort, and provision is made for part-time students in terms of additional time allocated to assignments and thesis. Appropriate provision is also made on a case-by-case basis for students with a Learning Support Agreement.

A large proportion of the summative assessments (assignments, oral presentations and reports/theses) include provision of formative feedback for enhancing learning. For example, feedback provided on the Group Design Project reports is targeted to enhance skills development for the subsequent thesis work. Formative industry feedback is also provided on the Group Design Project (at the Industry Day) and at the final IRP poster presentation.

Taught modules, including attendance-only modules) in general include elements of formative assessment, and these are described in the Module Descriptors.

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to t. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers [7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments [10] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
1	N-ASE-AMA	Astrodynamics and Mission Analysis	Dr Joan Pau Sanchez	20	0	10	N	09/11/20	09/11/20	20/11/20	40	EX	100				14-18/12/20	06/21
2	N-ASE-SSE	Space Systems Engineering	Dr Jenny Kingston	26	0	10	N	08/10/20	08/10/20	23/11/20	40	EX	100				04-08/01/21	06/21
3	N-ASE-SP	Space Propulsion	Dr Jenny Kingston	22	22	10	N	12/10/20	12/10/20	04/12/20	40	EX	100				04-08/01/21	06/21

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[9] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[10] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[11] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[12] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments (%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
4	N-ASE-SCO4	Space Communications	Dr Saba Al-Rubaye	22	0	10	N	11/11/20	11/11/20	19/11/20	40	EX	100				14-18/12/20	06/20	
5	N-ASE-GNCSS	Guidance Navigation and Control of Space Systems	Dr Leonard Felicetti	36	0	10	N	25/01/21	25/01/21	12/02/21	40	ICW	100				12/03/21	At the next available opportunity which may not be until the course runs the following year	
6	N-AVD-FEA-B20	Finite Element Analysis	Ioannis Giannopoulos	22	22	10	Y	07/12/20	07/12/20	11/12/20	40	EX	100				04-08/01/21	06/21	
7	N-AVD-FRP	Design and Analysis of Composite Structures	Dr Shijun Guo	20	0	10	Y	30/11/20	30/11/20	11/12/20	40	EX	100				04-08/01/21	06/21	
8	N-ASE-SADC	Spacecraft Attitude Dynamics and Control	Dr Leonard Felicetti	22	22	10	N	01/02/21	01/02/21	05/02/21	40	EX	100				06-09/04/21	06/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments (%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
9	N-ASE-GPS	Aerospace Navigation and Sensors	Dr Stephen Hobbs	24	0	10	Y	15/02/21	15/02/21	26/02/21	40	ICW	100				19/03/21	06/21
10	N-ASE-ATD	Mathematics and Programming for Astrodynamics and Trajectory Design	Dr Joan Pau Sanchez	20	0	10	N	11/01/21	11/01/21	15/01/21	40	IPRAC	100				12/02/21	06/21
11	N-ASE-GP	Group Design Project	Dr Jenny Kingston	40 - 60	0	60	N	06/10/20	06/10/20	30/04/21	50			100	GPROJ IPRES GCW	90 5 5	04/04/21 23/04/21 30/04/21	
12	N-ASE-THESIS	Individual Research Project	Dr Jenny Kingston	20	0	90	N	29/03/21	29/03/21	18/08/21	50	THESIS	100				18/08/21	
13	N-ASE-EIRP	Extended Individual Research Project	Dr Jenny Kingston	40	0	150	N	23/11/21	23/11/21	18/08/21	50	THESIS	100				18/08/21	
14	N-ASE-LRE	Launch and Re-entry Aerodynamics	Dr Simon Prince	10	0	0	N	01/03/21	01/03/21	05/03/21	n/a	AO	n/a				n/a	n/a
15	N-ASE-ELS	Environmental Control and Life	Prof David Cullen	5	0	0	N	18/01/21	18/01/21	22/01/21	n/a	AO	n/a				n/a	n/a

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments (%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
		Support Systems																
16	N-ASD-MDS	Modelling of Dynamics Systems	Dr James Whidborne	13	0	0	Y	26/10/20	26/10/20	30/10/20	n/a	AO	n/a				n/a	n/a
17	N-ASE-ODH	On Board Data Handling and Software Development	Dr Stephen Hobbs	10	0	0	N	25/01/21	25/01/21	29/01/21	n/a	AO	n/a				n/a	n/a
18	N-ASE-SE	Space Environment	Dr Jenny Kingston	10	0	0	N	15/02/21	15/02/21	19/02/21	n/a	AO	n/a				n/a	n/a
19	N-ASE-PEI	Payload Engineering and Instrumentation	Dr Stephen Hobbs	15	0	0	N	02/11/20	02/11/20	06/11/20	n/a	AO	n/a				n/a	n/a
20	N-ASE-EOE	Earth Observation and the Environment	Dr Stephen Hobbs	10	0	0	N	18/01/21	18/01/21	22/01/21	n/a	AO	n/a				n/a	n/a
21	N-ASE-RS	Research Skills	Dr Stephen Hobbs	6	0	0	N	17/02/21	17/02/21	19/02/21	n/a	AO	n/a				n/a	n/a
22	N-ASE-SM	Structural Mechanics	Dr Jason Brown	20	0	0	N	19/10/20	19/10/20	30/10/20	n/a	AO	n/a				n/a	n/a

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments (%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
23	N-ASE-ISP	Impact Dynamics and Spacecraft Protection	Dr Jason Brown	15	0	0	N	02/11/20	02/11/20	06/11/20	n/a	AO	n/a				n/a	n/a
24	N-AVD-SD	Structural Dynamics	Dr Shijun Guo	10	0	0	Y	08/03/21	08/03/21	12/03/21	n/a	AO	n/a				n/a	n/a
25	N-ASE-CAD	Introduction to Computer Aided Design (CAD)	Dr Jafar Jamshidi	10	0	0	N	11/01/21	11/01/21	15/01/21	n/a	AO	n/a				n/a	n/a
26	N-ASE-TDS	Thermal Analysis and Design Software	Dr Jenny Kingston	10	0	0	N	01/03/21	01/03/21	05/03/21	n/a	AO	n/a				n/a	n/a

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-ASE-GPS	Aerospace Navigation and Sensors	Astronautics and Space Engineering	Aerospace Dynamics
N-AVD-FEA-B19	Finite Elements Analysis	Aerospace Vehicle Dynamics	Aerospace Vehicle Dynamics
N-AVD-FRP	Design and Analysis of Composite Structures	Aerospace Vehicle Dynamics	Aerospace Vehicle Dynamics
N-ASD-MDS	Modelling of Dynamic Systems	Aerospace Dynamics	Aerospace Dynamics
N-AVD-SD	Structural Dynamics	Aerospace Vehicle Dynamics	Aerospace Vehicle Dynamics

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. In the standard course, students can expect to have 6 written examinations, 3-4 pieces of assessment by submitted work and 2 elements of formative or summative assessment by presentation or viva.

This approach has been adopted in order to ensure all students achieve the intended learning outcomes of the programme.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. MSc

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	ILO 9.
1	EX	EX		EX					
2	EX	EX	EX	EX					
3	EX	EX		EX					
4	EX	EX		EX					
5	ICW	ICW		ICW					
6	EX	EX		EX					
7	ICW	ICW		ICW					
8	EX	EX		EX					
9	ICW	ICW		ICW					
10	ICW	ICW		ICW					

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	ILO 9.
11	IPRAC	IPRAC		IPRAC					
12	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	IPRES		GPROJ IPRES GCW	
13	THESIS	THESIS		THESIS	THESIS		THESIS		THESIS
14	THESIS	THESIS		THESIS	THESIS		THESIS		THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A	N/A	N/A	N/A
		N/A	N/A

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The vast majority of our graduates are recruited by both the space industry and space-related academic groups. The positions cover a wide range of engineering disciplines all with the requirement for the broad space systems understanding that the course provides.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Automotive Engineering
Course code	MSAEGFTC, PDAEGFTC, PCAEGFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PGDip, PGCert
Mode of delivery	Full-Time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering Centre
Course Director	Dr Glenn Sherwood
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Admissions body	Cranfield University
Entry requirements	Standard University entry requirements, IELTS 6.5
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Transport Systems Theme, Advanced Vehicle Engineering Centre where the research interests include:

- Vehicle Electrification
- Novel Engine Technology
- Vehicle Braking Systems

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This Automotive Engineering course is accredited formally by the Institution of Mechanical Engineers (IMechE until October 2021.

2. What are the aims of the course?

Cranfield University offers this Automotive programme in order to:

- Meet employer demand for post graduate engineers who have strong applied analytical skills in all areas of vehicle system and component design to meet the challenging market and legislative demands for vehicle safety, Performance and sustainability.
- Provide a primary training and dissemination route for Cranfield University's increasing research portfolio in the area of low carbon vehicle technologies and design methods.
- Supply to the automotive industry (and associated supply chain) high calibre post graduate engineers with the technical qualities, transferable skills and independent learning ability to make them effective in organisations that design and develop automotive products.

Postgraduate Diploma (PGDip) and Postgraduate Certificate (PGCert) exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- EU or international students with a 1st class or 2nd class UK honours degree (or equivalent) in an engineering related discipline.
- Qualifying Double Degree students from the EU.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Evaluate how the automotive design process is led by legislation.
ILO 2. Differentiate between the vehicle systems and subcomponents and appraise the interdependency.
ILO 3. Evaluate how automotive global emissions are impacted by powertrain and body design.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Critically evaluate the ride quality, dynamics and control of vehicles through modelling techniques.
ILO 5. Evaluate and design fundamental vehicle concepts including the interdependency between structure, powertrain, suspension and braking systems including legislative requirements.
ILO 6. Identify the impact of design and processes during engine operations that affect the production of emissions and how these are abated to meet legislative requirements.
ILO 7. Appraise and evaluate the structure of different vehicle types and assess the impact of different materials and load path faults during vehicle design.
ILO 8. Appraise the role of a team manager and identify the steps in problem solving during the automotive design process.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Critically evaluate and assess the results of independently scholarly research.
ILO 10. Plan and implement a programme of individual research with effective written and oral communication of results.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Provision of lectures from academics from selected UK Universities to support the programme in areas outside the technical expertise of Cranfield University.
- Provision of lectures from leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Black Board.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.
- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, WAVE/AVL BOOST and CAE/CATIA.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages.
- Provision of a Personal Development Programme integrated throughout the Taught Modules and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning and project management).

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
ELECTIVE MODULES:	
60 credits from the following taught modules: 1, 2, 3, 4, 5, 6, 7	60
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4, 5, 6, 7 Module 8	80 40
ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4, 5, 6, 7 Module 8 Module 9	80 40 80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months. This programme is not offered on a part-time basis.

The taught modules are preceded by an introductory, non-assessed, study skills module. The taught modules are delivered in a modular format and will typically last for one week. Throughout terms one and two, sufficient non-structured learning and teaching time is scheduled to facilitate independent learning, the completion of assessed work and for personal reflection.

Within the first term, all students participating on the automotive programme will attend the combined (core) automotive modules. Students will attend specialist modules for Automotive Engineering in the first and second term. From term two and for the duration of the 3rd term, students will complete the Group Design Project and have the opportunity to undertake their individual Research Project. There are no elective elements within the individual courses.

7. Course Level Assessment Strategy[4]

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

The assessment strategy encompasses individual as well as group work. There is a blend of assignments and examinations across the assessed modules, although it is important to note that each module has one form of assessment. The modules contribute 80 credits (40%). Where the group design project is concerned, assessment comprises group report and presentation. This equates to 40 credits in total (20%). Finally the remaining 80 credits (40%) are assigned to the individual research project. Here the distribution is 80% for the technical report and 20% for the thesis viva. The combination of these forms of assessment with their various weightings determine the award of the Master's degree. In addition there are exit routes of Postgraduate Diploma (PgD) and Postgraduate Certificate (PgC) should the student not attain the MSc award. Students will be supported in their learning and personal development by:

- Provision of lectures from academics from selected UK Universities to support the programme in areas outside the technical expertise of Cranfield University.
- Provision of lectures from leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Black Board.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.
- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, WAVE/AVL BOOST and CAE/CATIA.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages.
- Provision of a Personal Development Programme integrated throughout the Taught Modules and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning and project management).

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
0		N-AEG-IND	Automotive Engineering Induction	Dr Glenn Sherwood	18		N/A	N	30/09/20	30/09/20	02/10/20	N/A	N/A						
1		N-APE-VDP	Vehicle Design Powertrain and Performance (shared teaching with AM and CAVE)	Dr Marko Tirovic	60		20	N	05/10/20	05/10/20	04/12/20	50	EX	100				11/12/20	Sept 2021

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
2		N-AP-AE02	Engine Design and Performance	Dr Glenn Sherwood	30		10	N	08/02/2021	08/02/2021	12/02/21	50	GCW	100				19/02/21	Sept 2021
3		N-AP-AE03	Automotive Control and Simulation	Dr Daniel Auger	30		10	Y	19/10/20	19/10/20	23/10/20	50	ICW	100				30/10/20	Sept 2021
4		NEW N-AP-VSC	Vehicle Structures	Dr Marzio Grasso	30		10	N	11/01/2021	11/01/2021	22/01/2021	50	ICW	100				25/01/21	Sept 2021
5		NEW N-APE-VMAN	Vehicle Manufacturing	Dr Tim Rose	30		10	N	25/01/2021	25/01/2021	29/01/2021	50	ICW	100				05/02/21	Sept 2021
6		N-AP-AE05	Vehicle Dynamics	Dr Efstathios Velenis	30		10	Y	16/11/20	16/11/20	25/11/20	50	EX	100				04/01/21	Sept 2021
7		N-AP-AM05	Vehicle Electrification and Hybridisation	Dr Efstathios Siampis	30		10	Y	02/11/20	02/11/20	10/11/20	50	ICW	100				13/11/20	Sept 2021
8		N-AP-AE11	Automotive Engineering Design Project	Dr Tim Rose	60		40	N	22/02/2021	22/02/2021	30/04/2021	50	ICW GRP GPRES	20 64 16				30/04/21 23/04/21 26/04/21	Sept 2021

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9		N-AP-AE13	Individual Research Project	Dr Abbas Fotouhi	10		80	Y	01/10/2020	03/05/21	04/09/21	50 50	THESIS OR	80 20				23/08/21 31/08/21-02/09/21	Next opportunity

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-APE-VDP	Vehicle Design Powertrain and Performance (shared teaching Automotive Mechatronics and CAVE, part of week 1 only)	Automotive Engineering	
N-AP-AE03	Automotive Control and Simulation	Automotive Engineering	Automotive Mechatronics
N-AP-AE05	Vehicle Dynamics	Automotive Engineering	Automotive Mechatronics
N-AP-AM05	Vehicle Electrification and Hybridisation	Automotive Mechatronics	Automotive Engineering
N-AP-AE13	Individual Research Project	Automotive Engineering	Automotive Mechatronics CAVE

8. How are the ILOs assessed?

The following assessment types are utilised:

- In Term 1 modules 1 and 5 are assed via written examinations that will be set early in term 2. Conversely, modules 3 and 6will be assessed via an individual assignment. It is noteworthy that these assignments will be aligned to the respective ILOs and may include elements of computer based analysis, model development and simulation.

- Modules in the second term (2, 4) are assessed by assignment that has a computer based analysis. Written Examinations are scheduled for the end of Term 2 / early Term 3. As with the core modules, the nature of the summative assignments in all cases will be constructively aligned to the respective module ILOs and may include an element of written work, oral presentation, numerical analysis and experimentation.

- Module 7 represents an extended open-ended Group Project Activity and is assessed via a combination of written and presentation

- The individual Research Project is assessed via a written thesis and oral examination.

This approach has been adopted because:

The Automotive Engineering course has been running since 1960 and is constantly updated to reflect current industry practice. The experience of the course teaching team feel that this is the most appropriate blend of assessments to fulfil the ILO's.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO1	ILO2	ILO3
1	EX	EX	EX
2	GCW	GCW	GCW
3	ICW	ICW	
4	ICW	ICW	ICW
5	ICW	ICW	
6	EX	EX	
7	ICW	ICW	ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO4	ILO5	ILO6	ILO7	ILO8
1		EX			
2			GCW		
3				ICW	
4		ICW		ICW	
5				ICW	
6	EX				
7		ICW			
8		GCW			GCW GPRES

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO9	ILO10
9	THESIS	THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The following patterns have emerged with regard to the future career paths for those graduates who have successfully studied automotive engineering:

- Continued higher education – PhD Research, both within Cranfield University or within other high ranking UK/EU Universities
- Employment within internationally leading vehicle manufacturers, including:
    - Toyota Europe (Belgium)
    - PSA (France)
    - Jaguar Cars / Land Rover (UK)
    - Bentley Motors (UK)
    - Ford (UK)
- Employment within internationally leading engineering consultancies and system suppliers to the automotive industry, including:
    - AVL (UK and Europe)
    - Ricardo Consulting Engineers (UK)
    - TRW (UK)
    - Bosch (Germany)

Graduands will typically take-up a graduate / senior engineering roles, within the respective product development or research departments of the employing organisations and which are often linked to an accelerated promotion scheme.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Automotive Mechatronics
Course code	MSAMCFTC, PDAMCFTC, PCAMCFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PGDip, PGCert
Mode of delivery	Full-Time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering Centre
Course Director	Dr Efstathios Velenis
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements IELTS 6.5
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Transport Systems Theme, Advanced Vehicle Engineering Centre where the research interests include:

- Vehicle Electrification
- Connected and Autonomous VehiclesAdvanced Control
- Multi-domain Modelling
- Vehicle Dynamics
- Novel Engine Technology
- Vehicle Braking Systems

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the IET and IMechE.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Meet employer demand for post graduate engineers who have strong applied analytical skills in all areas of vehicle system and component design to meet the challenging market and legislative demands for vehicle safety, Performance and sustainability.
- Provide a primary training and dissemination route for Cranfield University's increasing research portfolio in the area of low carbon vehicle technologies and design methods.
- Supply to the automotive industry (and associated supply chain) high calibre post graduate engineers with the technical qualities, transferable skills and independent learning ability to make them effective in organisations that design and develop automotive products.

Postgraduate Diploma (PGDip) and Postgraduate Certificate (PGCert) exit routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- EU or international students with a 1st class or 2nd class UK honours degree (or equivalent) in an engineering related discipline.
- Qualifying Double Degree students from the EU.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge)

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Analyse key engineering subjects as applied to automotive mechatronics.
ILO 2. Judge the technologies which underpin automotive mechatronics.
ILO 3. Rate engineering related disciplines in the context of automotive mechatronics.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Formulate managerial skills for a group project.
ILO 5. Evaluate one or more automotive mechatronics applications.
ILO 6. Assess their personal development with reference to individual contribution and peer assessment in a team working context.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 7. Appraise an area or areas of automotive mechatronics through individual research.
ILO 8. Synthesise their individual research in the form of a thesis report and poster.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- Provision of lectures from academics from selected UK Universities to support the programme in areas outside the technical expertise of Cranfield University.
- Provision of lectures from leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Black Board.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.
- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, WAVE/AVL BOOST and CAE/CATIA.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages.
- Provision of a Personal Development Programme integrated throughout the Taught Modules and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning and project management).

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate
The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
ELECTIVE MODULES:	
60 credits from the following taught modules: 1, 2, 3, 4, 5, 6, 7, 8	60
TOTAL:	60

B. Postgraduate Diploma
The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1,2,3,4,5,6,7,8 Module 9	80 40
ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc
In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1,2,3,4,5,6,7,8 Module 9 Module 10	80 40 80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;

- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months. This programme is not offered on a part-time basis.

The taught modules are preceded by an introductory, non-assessed, study skills module. The taught modules are delivered in a modular format and will typically last for one week. Throughout terms one and two, sufficient non-structured learning and teaching time is scheduled to facilitate independent learning, the completion of assessed work and for personal reflection.

Within the first term, all students participating on the automotive programme will attend the combined (core) automotive modules. Students will attend specialist modules for Automotive Mechatronics in the first and second term. From term two and for the duration of the 3rd term, students will complete the Group Design Project and have the opportunity to undertake their individual Research Project. There are no elective elements within the individual courses.

7. Course Level Assessment Strategy[4]

The assessment strategy encompasses individual as well as group work. There is a blend of assignments and examinations across the assessed modules, although it is important to note that each module has one form of assessment. The modules contribute 80 credits (40%). Where the group design project is concerned, assessment comprises group report and presentation, and an individual contribution component. This equates to 40 credits in total (20%). Finally the remaining 80 credits (40%) are assigned to the individual research project. Here the distribution is 80% for the technical report and 20% for the thesis viva. The combination of these forms of assessment with their various weightings determine the

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

award of the Master's degree. In addition there are exit routes of Postgraduate Diploma (PgD) and Postgraduate Certificate (PgC) should the student not attain the MSc award. Students will be supported in their learning and personal development by:

- Provision of lectures from academics from selected UK Universities to support the programme in areas outside the technical expertise of Cranfield University.
- Provision of lectures from leading industry experts and practitioners highlighting the practical implementation and constraints associated with the theoretical principles introduced on the programme.
- All course material is available via the web-based learning environment Black Board.
- The course is timetabled as a series of modules thereby allowing diligent students to effectively manage the assessment requirements of the course.
- The provision of non-assessed study-skills training covering areas such as; academic report writing, presentation skills, research skills and working with University facilities (IT, library, Student Support Services).
- The extensive use of tutorial sessions and computer aided engineering exercises employing software packages commonly utilised in industry, including Matlab, WAVE/AVL BOOST and CAE/CATIA.
- The opportunity to complete an individual Research Project, which may be sponsored by industry and using industry scale laboratory facilities and software packages.
- Provision of a Personal Development Programme integrated throughout the Taught Modules and an individual Research Project that encourages the development of transferable skills (such as oral and written communication skills, independent learning and project management).

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
0		N-AMC-IND	Automotive Mechatronics Induction	Dr Stefano Longo	18		0	N	28/09/20	30/09/20	02/10/20	N/A	N/A					N/A	
1		N-AP-AE03	Automotive Control and Simulation	Dr Daniel Auger	30		10	Y	19/10/20	19/10/20	23/10/20	50	ICW	100				30/10/20	Sept 2021
2		N-AP-AE05	Vehicle Dynamics	Dr Efstathios Velenis	30		10	Y	16/11/20	16/11/20	25/11/20	50	EX	100				04/01/21	Sept 2021
3		N-AP-AM06	Vehicle Powertrain	Dr Marko Tirovic	30		10	N	05/10/20	05/10/20	09/10/20	50	EX	100				11/12/20	Sept 2021

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
			and Performance (shared teaching with AE module VDPP)																
4		N-AP-AM01	Mechatronics Modelling for Vehicle Systems	Dr Stefano Longo	30		10	Y	30/11/20	30/11/20	04/12/20	50	EX	100				June2021	Sept 2021
5		N-AP-AM02	Advanced Control and Optimisation	Dr Daniel Auger	30		10	Y	11/01/21	11/01/21	15/01/21	50	ICW	100				22/01/21	Sept 2021
6		N-AP-AM03	Vehicle Control Applications	Dr Abbas Fotouhi	30		10	Y	08/02/2021	08/02/2021	15/02/21	50	EX	100				June2021	Sept 2021
7		N-AP-AM04	Embedded Vehicle Control Systems	Dr Stefano Longo	30		10	Y	25/01/21	25/01/21	29/01/21	50	ICW	100				05/02/21	Sept 2021
8		N-AP-AM05	Vehicle Electrification and Hybridisation	Dr Efstathios Siampis	30		10	Y	02/11/20	02/11/20	10/11/20	50	ICW	100				13/11/20	Sept 2021

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9		N-AP-AE12	Automotive Mechatronics Group Project	Dr Efstathios Velenis	60		40	N	01/03/2021	01/03/2021	30/04/2021	50	IPROJ GPROJ GPRES	20 64 16				30/04/21 23/04/21 26/04/21	Sept 2021
10		N-AP-AE13	Individual Research Project	Dr Abbas Fotouhi	10		80	Y	01/10/2020	03/05/21	04/09/21	50 50	THESIS OR	80 20				23/08/21 31/08/21-02/09/21	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-AP-AM06	Vehicle Powertrain and Performance (shared teaching with N-APE-VDP AE, part of week 1, and N-CAV-FORVE, part of week)	Automotive Mechatronics	
N-AP-AM03	Vehicle Control Applications	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AM01	Mechatronics Modelling for Vehicle Systems	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AM02	Advanced Control and Optimisation	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AM04	Embedded Vehicle Control Systems	Automotive Mechatronics	Advanced Motorsport Mechatronics Jaguar Land Rover TAS Scheme (not running this year)
N-AP-AE03	Automotive Control and Simulation	Automotive Engineering	Automotive Engineering, Automotive Mechatronics
N-AP-AE05	Vehicle Dynamics	Automotive Engineering	Automotive Engineering, Automotive Mechatronics
N-AP-AM05	Vehicle Electrification and Hybridisation	Automotive Mechatronics	Automotive Engineering, Automotive Mechatronics
N-AP-AE13	Individual Research Project	Automotive Engineering	Automotive Engineering, Automotive Mechatronics CAVE

8. How are the ILOs assessed?

The following assessment types are utilised:

- In Term 1 modules 2 and 3 are assed via written examinations that will be set early in term 2. Conversely, modules 1 and 8 will be assessed via an individual assignment. It is noteworthy that these assignments will be aligned to the respective ILOs and may include elements of computer based analysis, model development and simulation.

- The specialised modules starting in term one and through to the second term ( ) are assessed by assignment that has a computer based analysis and (6-9) are all assessed using a combination of written assignment and examination. Written Examinations are scheduled for the end of Term 2 / early Term 3. As with the core modules, the nature of the summative assignments in all cases will be constructively aligned to the respective module ILOs and may include an element of written work, oral presentation, numerical analysis and experimentation.

- Module 8 , represents an extended open-ended Group Project Activity and is assessed via a combination of written and presentation

- The individual Research Project is assessed via a written thesis and oral examination.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8
1	ICW	ICW	ICW					
2	EX	EX	EX					
3	EX	EX	EX					
4	EX	EX	EX					
5	ICW	ICW	ICW					
6	EX	EX	EX					
7	ICW	ICW	ICW					
8	ICW	ICW	ICW					

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8
9				ICW	ICW	ICW		

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO7	ILO8
10	THESIS	THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

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- Employment within internationally leading vehicle manufacturers, including:
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    - PSA (France)
    - Jaguar Cars / Land Rover (UK)
    - Bentley Motors (UK)
    - Ford (UK)
- Employment within internationally leading engineering consultancies and system suppliers to the automotive industry, including:
    - AVL (UK and Europe)
    - Ricardo Consulting Engineers (UK)
    - TRW (UK)
    - Bosch (Germany)

Graduands will typically take-up a graduate / senior engineering roles, within the respective product development or research departments of the employing organisations and which are often linked to an accelerated promotion scheme.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Autonomous Vehicle Dynamics and Control
Course code	MSAVCFTC, PDAVCFTC, PCAVCFTC
Academic Year	2020/2021
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert (PDAVCFTC, PCAVCFTC only as exit routes)
Mode of delivery	Full-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Autonomous and Cyber-Physical Systems
Course Director	Dr Argyrios Zolotas
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Astronautics and Cyber-Physical Systems where the research interests include:

- Autonomous Systems
- Dynamics and Control for Autonomous Systems
- Sensor Fusion
- Artificial Intelligence for Autonomous Systems
- Decision-making in Autonomous Systems
- Guidance and Navigation for Autonomous Systems
- Autonomous Systems Design and Operation

Teaching and/or assessment is conducted at the Cranfield Campus.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by Royal Aeronautical Society (RAeS) until the October 2021 intake, as suitable further learning towards CEng registration

2. What are the aims of the course?

The global market for aerial, ground, and marine Autonomous Vehicles has grown rapidly due to the advent of drones and driverless cars. Defence, Aerospace, Automotive, and Marine Industries seek graduates conversant in key aspects of Autonomy including: dynamics & control, guidance & navigation, decision making, sensor fusion, artificial intelligence, communication & and networking. These durable and transferrable skills are the bedrock of this unique MSc course whose content has been based on advice from the Industrial Advisory Board, comprising the relevant Industrial representatives from Big Primes to Small and Medium-sized Enterprises.

The Autonomous Vehicle Dynamics and Control MSc is a unique course for graduates in engineering, physics, or mathematics wishing to acquire durable and transferrable skills in Autonomous Vehicles in order to pursue career opportunities in Defence, Aerospace, Automotive, and Marine Industries. Successful graduates of our MSc course become conversant in key aspects of Autonomy which advantageously differentiates them in today's competitive employment market

The taught part of the Autonomous Vehicle Dynamics and Control MSc course comprises eight ten-credit modules, followed by a forty-credit group project. The ten-credit modules are:

1) Introduction to Unmanned Aircraft Systems (UAS)
2) UAS Dynamics and Control

3) UAS Modelling & Simulation
4) Sensor Fusion
5) Artificial Intelligence for Autonomous Systems
6) Guidance & Navigation Systems for UAS
7) Autonomous Vehicle Control Systems
8) Logic and Automated Reasoning

The linchpin of the taught part is the group project in which the students design, build and fly an unmanned aerial vehicle, thus integrating and applying the knowledge acquired in modules 1–8.

The taught part of the course is followed by Individual Research Projects (IRPs) and the topic of each of the IRPs is provided by one of the member of the Industrial Advisory Board. The real-world relevance of the IRP topics is another unique feature of our MSc course and is another effective differentiator in the job market.

Postgraduate Certificate and Postgraduate Diploma are exit routes only.

This programme is intended for the following range of students:

- Engineers wishing to apply their skills into new areas.
- Qualified engineers working with autonomous systems.
- Recent STEM graduates wishing to extend their knowledge and skills in the above areas.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge)

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Distinguish the primary engineering challenges of Unmanned Aircraft Systems (UAS) analysis and design.
ILO 2. Formulate, analyse and simulate dynamic models of an air vehicle.
ILO 3. Analyse and design control systems for the autonomous operation of an air vehicle.
ILO 4. Relate sensor fusion and Artificial Intelligence in the context of autonomously operating vehicles.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Appraise and utilise fundamental guidance and navigation techniques for UAS.
ILO 6. Examine and relate advanced control systems and their applications to UAS.
ILO 7. Design, build and fly an unmanned aerial vehicle by working in a group environment.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Exhibit independent learning by planning, conducting and critically evaluating an individual programme of extended research into some aspect of UAS.
ILO 9. Communicate effectively, verbally or in writing, to suit a range of audiences.

4. How is the course taught?

The course is delivered through a combination of lectures, tutorials and hands-on lab sessions and also a group project in which the students design, build and fly an unmanned aerial vehicle, thus integrating and applying the knowledge acquired in all the other modules.

The course uses the Blackboard learning environment with all materials delivered in electronic form. In addition to standard learning support facilities (library facilities, IT provision, etc), the course utilises a number of specialised facilities, namely:

- Indoor flight area for small UAS.
- Indoor lab for small / medium UAS development.
- Controlled use of the Cranfield airport for flying UAS.
- Individual Research Projects are proposed by industrial partners.

The topic of each of Individual Research Projects (IRPs) is provided by one of the member of the Industrial Advisory Board (IAB). Progress on the IRPs is monitored by Interim Project Reviews which also serve to improve individual communication skills. After the final thesis viva, students are given an opportunity to prepare posters summarising their IRPs and present them to the IAB.

Students who produce high-quality IRP work are encouraged (and mentored) to write a conference / journal paper for peer-review publication.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Any 6 modules from Modules 1-8	60
ELECTIVE MODULES:	
N/A	0
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules: 1-8 Group Project: 9	80 40

ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Modules: 1-8 Group Project: 9 Individual Research project: 10	80 40 80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Only full-time version of the course is offered and full-time students register for the course in October and are expected to complete the course within 12 calendar months.

7. Course Level Assessment Strategy[4]

To meet the course and module learning outcomes, a range of different types of summative assessments is followed, namely: exams, written assignments and oral presentations. Furthermore, in each module, you will have the chance to get formative assessment (feedback on your work that does not count towards your final mark).

Normally, information on formative assessment will be provided by the relevant module leader. Feedback on written assignments will be given through our virtual learning environment where you will be able to access comments and marks on your work. Feedback on exams is normally provided via a feedback session by the relevant module leader. Feedback on oral presentations is normally provided in class or via written comments after the presentation.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment		Submission dates			
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
0	N-AVC-IN	Induction	Dr Argyrios Zolotas	10		0	N	01/10/20	01/10/20	02/10/20	N/A	AO						
1	N-AVC-IUAS	Introduction to Unmanned Aircraft Systems	Dr Saba Al-Rubaye	28		10	N	05/10/20	05/10/20	16/10/20	40	ICW	100				06/11/20	Next Available date within the academic year

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment		Submission dates			
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
2	N-AVC-UASFD	UAS Dynamics & Control	Dr Argyrios Zolotas	28		10	N	19/10/20	19/10/20	30/10/20	40	ICW	100				20/11/20	Next Available date within the academic year
3	N-AVC-UASMS	UAS Modelling and Simulation	Dr Dmitry Ignatyev	28		10	N	02/11/20	02/11/20	13/11/20	40	ICW	100				04/12/20	Next Available date within the academic year
4	N-AVC-SF	Sensor Fusion	Prof Hyo-Sang Shin	28		10	N	23/11/20	23/11/20	04/12/20	40	IC W	100				08/01/21	Next Available Date within the academic year
5	N-AVC-AIAS	Artificial Intelligence for Autonomous Systems	Dr Ivan Petrunin	28		10	N	04/01/21	04/01/21	15/01/21	40	ICW	100				05/02/21	Next Available Date within the academic year
6	N-AVC-GNS	Guidance and Navigation for UAS	Dr Minguk Seo	28		10	N	18//01/21	18/01/21	29/02/21	40	ICW	100				19/02/21	Next Available date within the academic year
7	N-AVC-AVCS	Autonomous Vehicle Control Systems	Dr Argyrios Zolotas	28		10	N	07/12/20	07/12/20	18/12/20	40	ICW	100				22/01/21	Next Available date within the academic year
8	N-AVC-LAR	Logic and Automated Reasoning	Dr Marta Ceccaroni	28		10	N	01/02/21	01/02/21	12/02/21	40	ICW	100				FT 05/03/21 PT 19/03/21	Next Available date within the academic year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment		Submission dates			
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	N-AVC-GDP	Autonomous Systems Group Design Project	Prof Hyo-Sang Shin	60		40	N	16/11/20	16/11/20	02/04/21	50			100	GPRES GPROJ	20 80	29/03/21 02/04/21	Next Available date within the academic year
10	N-AVC-THESIS	Individual Research Project	Prof Antonios Tsourdos/ Dr Argyrios Zolotas	20		80	N	05/04/21	05/04/21	01/09/21	50			100	OR THESIS	15 85	31/08/21 18/08/21	R&R within 1 year of Exam Board

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-AVC-LAR	Logic and Automated Reasoning	Autonomous Vehicle Dynamics and Control	Applied Artificial Intelligence

8. How are the ILOs assessed?

The following assessment types are utilised:

For the taught course part of the programme, the ratio between examination and assessed coursework is approximately 1:3.

The examinations will generally take a traditional form and enable the students to demonstrate their fundamental knowledge and understanding and to apply the knowledge in a critical way to problems. This ensures that successful students have achieved the learning outcomes, in particular ILOs 1 to 4.

Written coursework assignments take the form of technical reports, laboratory reports and traditional style essays. Such assignments will demonstrate skills in information retrieval, literature citation, critical evaluation and written presentation skills to suit a variety of formats and audiences. Problem solving activities will also be incorporated in such assignments. This will ensure that successful students have achieved the ILOs 1 to 5.

Where appropriate as part of the learning process, some modules will include an element of group work, but this ill not form part of the formal assessment procedure.

The research project is examined for the MSc by thesis (85%) and by Presentation (15%). For the Postgraduate Diploma it is examined 100% thesis, however, the candidate will be expected to give a presentation but will not be formally assessed. Within the project, other learning outcomes will be demonstrated to have been achieved.

In all instances, assessment will be based on the demonstration of appropriate knowledge, an appropriate mode of presentation, interpretation within the correct context, critical discussion and the use and citation of appropriate sources of information.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. MSc

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9
Module 0									
Module 1	ICW								
Module 2	ICW	ICW	ICW						

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9
Module 3	ICW	ICW	ICW						
Module 4	ICW	ICW	ICW						
Module 5	ICW			ICW					
Module 6	ICW			ICW					
Module 7	ICW			ICW	ICW				
Module 8	ICW			ICW		ICW			
Module 9							GPROJ GPRES	GPROJ GPRES	GPROJ GPRES
Module 10								THESIS	OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The knowledge and skills the graduates gain following the successful completion of the course enables them to work in a broad range of industries and a few graduates pursue academic careers through PhD Programmes.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: 3 December 2020

1. What is the course?

Course information

Course Title	MSc in Aviation Safety Management, Risk and Regulation
Course code	MSASRPTC MSc in Aviation Safety Management, Risk and Regulation MSASRPAC Apprenticeship in Aviation Safety Management, Risk and Regulation PDASRPTC PgDip in Aviation Safety Management, Risk and Regulation PCASRPTC PgCert in Aviation Safety Management, Risk and Regulation
Academic Year	2020-2021
Valid entry routes	MSc, PGDip, PGCert
Additional exit routes	PGCert, PGDip
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield, UK CAA, Gatwick
School(s)	SATM
Theme	Transport Systems
Centre	Cranfield Safety and Accident Investigation Centre
Course Director	Dr David Barry
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Risk and Safety Management Professional
Is the Degree apprenticeship integrated or non-integrated?	Non-integrated

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Mastership offered as an open and/or closed course?	Open course
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	
Registration Period(s) available	3 years (MSc), 2 years (PGDip), two years (PGCert)
Course Start Month(s)	January

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Transport Systems Theme, Centre for Safety and Accident Investigation where the research interests include:

Aviation Safety Management
Accident Investigation
Aircraft Maintenance
Risk Analysis
Safety Leadership
Human Factors

Cranfield University interacts with the following institutions and in the following ways:

Civil Aviation Authority - through the provision of lecturing staff as part of each module

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Cranfield University offers this course in order to provide a spectrum of technical knowledge in the context of safety, risk and regulation in aviation. This is a background that staff at many levels in today's aerospace industry must possess. A detailed knowledge of safety issues before and during operations, design, modification, repair helps all aspects of business operation and enables a better balance to be struck between cost and safety. Specifically, the course aims to:

- Provide a globally unique course that relates the regulatory background of all aspects of safety in the operations, production and maintenance of aircraft.
- Promote excellence in risk and safety management via a M level course that forms part of a high technology Mastership programme in safety, risk and regulation.
- Promote safety management and performance-based regulatory practice within UK and world-wide industry and government agencies.

A Postgraduate Diploma (PgDip) entry route is provided for students who wish to access only part of the course provided. It is also suggested that the latter qualification may be more appropriate for staff who have no need for a separate research project.

There is also a Postgraduate Certificate (PGCert) entry route for those who wish to access a specific part of the course - two taught modules and short group project.

This programme is intended for the following range of students:

- Staff from airlines, Air Navigation Service Providers, airports, manufacturers and other parts of the aviation sector, both operations and engineering.
- Licensed engineers in aviation industry
- Staff in regulatory authorities with responsibility for all aspects of aviation safety

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically assess the principles and practice of risk management, including the application of safety management systems.
ILO 2. Evaluate the various approaches to regulatory practice and be able to assess the effectiveness of different oversight strategies used in aviation system.
ILO 3. Analyse, evaluate and formulate safety information to generate safety intelligence and communicate with different audiences.
ILO 4. Develop transferable communication skills through teamwork, written assignments and presentations to enhance their ability to influence the industry in safety regulation.

B. Postgraduate Diploma

In addition to the intended learning outcomes above, a diligent student would also be expected to:

ILO 5. Evaluate the influence of sociotechnical risk factors on the wider aviation system including human factors and management and be able to propose mitigation strategies.
ILO 6. Apply and appraise techniques for safety assurance in new and existing areas of emerging technologies and threats and develop where necessary.

C. MSc

In addition to the intended learning outcomes above, a diligent student would also be expected to:

ILO 7. Undertake independent research on a topic relevant to safety, risk and regulation in the aviation sector.

4. How is the course taught?

Students will be supported in their learning and personal development in various ways, which will include formative assessment for all modules. Delivery will be via on-line learning and use of a virtual learning environment. Most modules will be taught live on-line, supplemented with recorded material for students to work through when convenient. The course will be taught by a mixture of:

- Lectures from Cranfield, UK CAA and external speakers with relevant expertise for each module
- Problem-based learning may be used where appropriate
- Access to library resources
- Use of class exercises (including group work) to help develop knowledge and techniques in the field.

- Conducting individual research project in a commercial organisation to provide "real-life" environment

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where one credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2 Managing Current Safety Issues	50 10
ELECTIVE MODULES:	
N/A	
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4 Managing Current Safety Issues Managing Emerging Safety Issues	80 10 30
ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4 Managing Current Safety Issues Managing Emerging Safety Issues IRP	80 10 30 80
ELECTIVE MODULES:	
N/A	

TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Part-time students register for the course in January and are expected to complete the course within three years.

Each module is made up of a series of components which may comprise face-to-face teaching, remote learning and or live digital delivery. The modules will therefore be a mixture of contact time interspersed by periods of self-directed learning and on-line group work. Modules 1, 2 and Group Project 1 should be taken in Year 1. Module 1 is 30 credits and will be between three and four months. Module 2 (20 credits) is three months in duration, and the Group Project 1 - Managing Current Safety Issues - between four and five months.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

Modules 3, 4 and Group Project 2 should normally be taken in Year 2. Module 3 is a 10 credit, one-week module that requires attendance at Cranfield and Module 4 (20 credits) is 3 months. Group Project 2 - Managing Emerging Safety Issues - is spread over six months. In Year 3, each student will conduct their own Individual Research Project, which will be supervised by an appropriate member of staff. During this period there will be supervision meetings and training in research methods as required.

This MSc course differs from the normal system of 10 credit modules. The reasoning behind making three taught modules greater than the normal 10 credits was to offer a greater range and depth of understanding the subjects, making the modules more immersive. All modules (except M3 – existing module) are based on new and limited existing material. Module 5 (10 credits) and module 6 (30 credits) are both research modules.

The structure strongly promotes group work, with projects in both of the first two years. This provides an invaluable experience for the students not only on the MSc route but also on PGDip and PGCert exit routes. All students will experience working on group projects to develop their communication, team work and project management skills. This is one of the reasons that makes this MSc course appealing to a wide audience.

In summary, what makes this course **innovative, different, unique and flexible**:

- **(Innovative + Different)** Taught modules and group project modules have a variability of credits enabling more flexibility and enhanced depth of knowledge
- **(Innovative + Different)** Two group projects, each in the second half of each academic year (gives opportunity to students on PGDip and PGCert to gain experience in group projects)
- **(Flexible)** Delivered via a variety of modes: on-site face-to-face teaching, online live streaming of classes and pre-recorded material - this gives part-time students more flexibility and ability to time manage themselves
- **(Unique)** Developed and delivered in partnership with the UK Civil Aviation Authority
- **(Flexible)** Clear structure of the course providing part-time students with easy-to-follow structure of the course and modules – clarity on which module to take when. This addresses one of the identified challenges on some of the current MSc courses where student can pick and choose which module to take when, but no advice is available on the preferred order of the modules which could benefit the overall outcome of their study

The course is intended to explain the background theory to safety and risk in aviation, with a particular focus on regulation. The University's aviation operations will be used as a *Living Laboratory* providing case studies and real-life examples to supplement teaching. This will likely involve the Remote Tower facility, National Flying Laboratory, Accident Investigation Centre and Boeing 737. Using these facilities in teaching is something that the Safety and Accident Investigation Centre has a great deal of experience with and serve to enhance the learning experience. The new course is related to other MSc courses as shown in the figure on page 7.

7. Course Level Assessment Strategy[4]

The ILOs of the course have been developed in consultation with the teaching team and potential industry recipients of the course. The process has also been informed by the Apprenticeship Standard for *Risk and Safety Management Professional.* The latter contains a large number of aspects relating to Knowledge, Skills and Behaviours, many of which may also be met by the MSc. Each module will consist of an initial part of declarative knowledge but will also facilitate the development of functioning knowledge for each student. Each and every module (except Module 0) will feature formative feedback as well as summative assessment, which will be diverse in nature and appropriate to the learning outcomes.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

The ILOs of each module are linked to the teaching activities in order to meet the assessment. ILOs 1 and 2 cover the fundamentals of risk, safety management and regulation, and the assessment types are diverse in order to give some variety. Both Modules 1 and 2 feature individual coursework in order to test the ability to construct a written argument and meet the requirements of the course. Presentation skills are also assessed as these are vital in the communication of safety and risk in society. ILO3 is covered throughout the course. The first Group Project (MCSI) will also assess the ability to work within a team environment.

ILOs 4 and 5 will look more deeply into sociotechnical risk factors in aviation as well as techniques for safety assurance. ILO 4 is assessed by a blend of individual coursework and a Reflective Portfolio in Module 4 and via Group work in the second Group project (MESI). The latter is also used to assess ILO5 in addition to the module in Aircraft Accident Investigation and Response (Module 3).

The research aspect of the course is described by ILO6 and assessed by the IRP. A large part of this comprises a written thesis which will address some aspect of safety, risk management and regulation. As oral presentation skills are also vital, the viva will also be assessed to meet ILO6.

Figure 1 shows the interconnection between other related courses in the Centres for Safety & Accident Investigation and Air Transport. MSc in Aviation Safety Management, Risk and Regulation has some common themes with other safety-related and transport industry courses, and some of these are shown. However, the course is unique in its presentation of the role of the regulatory authority and how regulation permeates all aspects within the industry. This includes many aspects of risk and safety management, which makes an excellent fit with the Apprenticeship standard.

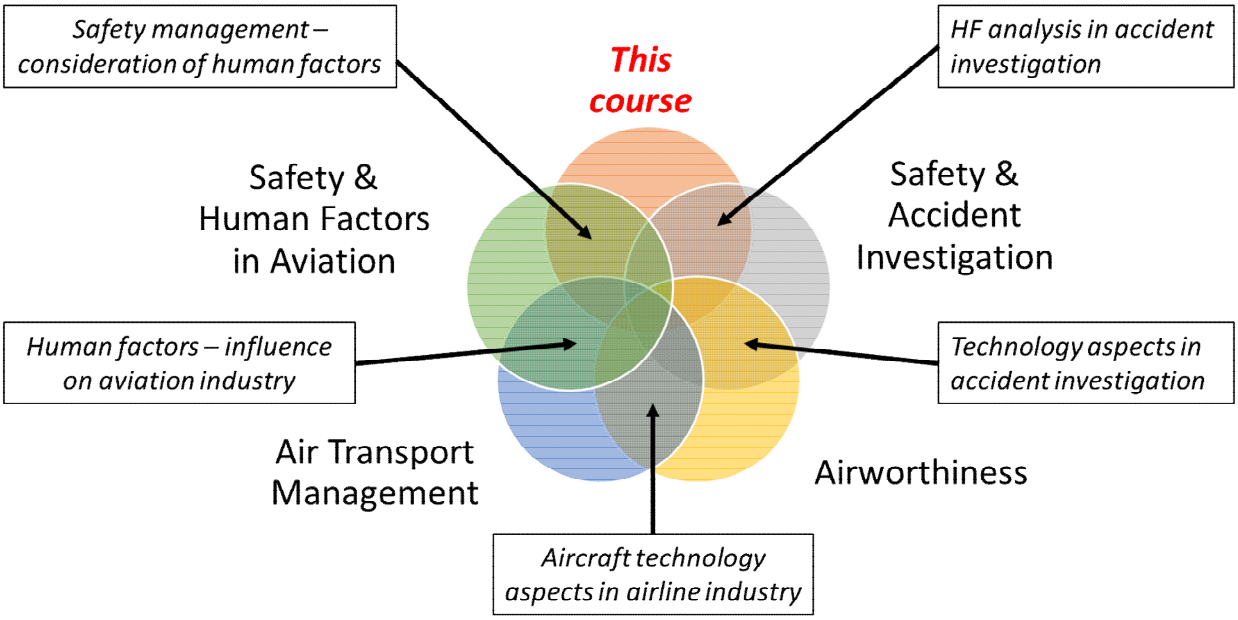

Figure 1 – Connections between related MSc courses within Transport Theme

Course modules

The following modules outline all parts of the programme leading to **MSc**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
M0	N-ASR-IND [NEW]	ASMRR Induction	Dr D Barry	10	0	0	N	11/01/21	11/01/21	11/01/21	N/A	AO					N/A	
M1	N-ASR-ASRM [NEW]	Advanced Safety and Risk Management	Dr D Barry	100		30	N	11/01/21	11/01/21	09/02/21	50% 50%	ICW IPRES	80% 20%				12/04/21 12/04/21	At the next available opportunity which may not be until the course

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																		runs the following year
M2	N-ASR-ALRA [NEW]	Aviation Legislation & Regulatory Approach	C Turkoglu	50		20	N	06/05/21	06/05/21	26/05/21	50% 50%	ICW IPRES	70% 30%				26/07/21 07//06/21 – 11/06/21	At the next available opportunity which may not be until the course runs the following year
M3	N-HFS-AAI	Aircraft Accident Investigation and Response	Dr L Dunn	30		10	Y	25/04/22	25/04/22	29/04/22	50%	ICW	100%				27/06/22	At the next available opportunity which may not be until the course runs the following year
M4	N-ASR-RRSS [NEW]	Responding to Risk in Sociotechnical Systems	Dr J Nixon / Dr C Pilbeam	50		20	N	26/01/22	26/01/22	30/03/22	50% 50%	ICW RP	80% 20%				31/05/22 TBC	At the next available opportunity which may not

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
																		be until the course runs the following year
MCSI (GP1)	N-ASR-MCSI [NEW]	Managing Current Safety Issues	C Turkoglu Prof G Braithwaite	20	0	10	N	01/09/21	01/09/21	31/12/21	50% 50%	GCW GPRES	80% 20%				21/02/22 11/02/22	At the next available opportunity which may not be until the course runs the following year
MESI (GP2)	N-ASR-MESI [NEW]	Managing Emerging Safety Issues	C Turkoglu Prof G Braithwaite	40	0	30	N	02/05/22	02/05/22	30/11/22	50% 50% 50%	GCW ICW GPRES	50% 30% 20%				16/01/23 23/01/23 30/01/23	At the next available opportunity which may not be until the course runs the following year
IRP	N-ASR-THESIS [NEW]	Individual Research Project	Prof G Braithwaite	40	0	80	N	02/01/23	02/01/23	29/12/23	50% 50%	THESIS OR	90% 10%				TBC TBC	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-HFS-AAI	Aircraft Accident Investigation and Response	Safety & Human Factors in Aviation	Airworthiness Forensic Engineering and Science Military Aerospace and Airworthiness Aviation Safety Management, Risk and Regulation

8. How are the ILOs assessed?

The whole MSc is expected to be completed in three years and the complete apprenticeship within 3.5 years (3-6 months following completion of the MSc). The PGCert is expected to be completed in one year and PGDip in two years.

Each module has summative individual assessment which needs to be completed within 8 weeks after the end of the corresponding module. Marks and formal feedback are expected to be available to the students within 4 weeks from the submission deadline.

The following assessment types are used:

- Individual course work
- Reflective portfolio
- Group presentation
- Individual presentation
- Group report
- Thesis for Individual research project
- Oral examination

This approach has been adopted because:

The MSc in Aviation Safety Management, Risk and Regulation has **three** distinct but interrelated elements: the Taught Modules, Group Projects and Thesis (Individual Research Project). Modules are assessed by a variety of methods, including written assignments, presentations, reflective portfolio and (in the case of the thesis) an oral examination, or viva.

The post-Module assessments are set to be challenging and to require the student to study the module topic areas in more depth, in particular the links between risk, safety management and regulatory practice. The objectives of the assignments are for the students to:

- Acquire the skill to efficiently search literature
- Apply skills and knowledge to assess the regulatory aspects within operations and engineering
- Develop the power to critically analyse data
- Compile succinct and informative reports to a high standard
- Formulate responses to specific questions against a time limit

Students are subject to two forms of assessment with regard to the group projects. Firstly, they must submit group coursework and secondly, their group project oral presentation is also assessed. In the latter form of assessment, each presentation is judged on how well their presentation is organised, the quality of their individual presentations and visual aids and how well they are able to answer questions from the audience. Both forms of assessment have an equal weighting with regard to the module mark.

The thesis is assessed using a combination of their written work and an oral poster presentation. The oral presentations are judged on the basis of the quality of the presentation in terms of content and visual aids, how well the key findings and other important elements of the research has been communicated and how well the student has responded to questions from the audience

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs. (Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / **Module No.**	ILO1	ILO2	ILO3	ILO4
M1	ICW IPRES	ICW	ICW IPRES	IPRES
M2	ICW IPRES	ICW IPRES	ICW IPRES	IPRES
Managing Current Safety Issues	GCW GPRES	GCW	GPRES	GCW GPRES

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / **Module No.**	ILO5	ILO6
M3 – N-HFS-AAI		ICW
M4	ICW RP	
Managing Emerging Safety Issues	GCW ICW GPRES	GCW ICW GPRES

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / **Module No.**	ILO7
IRP	THESIS OR

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Most students will already be in full-time employment at the time of attending the course. However the MSc prepares them for a higher level of responsibility in a variety of areas. The course has a unique blend of subjects covering the varied topics within risk and safety management, which will have a huge benefit for people within all aviation sectors. It is therefore entirely possible that the course will enable people to take on additional responsibility and/or transition to other areas within aviation.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	Business and Strategic Leadership *(AON Cohort 1 Occurrence H)*
Course code	MSBSLPTC, PDBSLPTC, PCBSLPTC, MSBSLPAC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Management
Theme	Leadership and Management
Centre	CED
Course Director	Neil Turner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Level 7 Senior Leaders
Is the Degree apprenticeship integrated or non-integrated?	Integrated
Is the Mastership offered as an open and/or closed course?	Closed
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	MSc - part-time - maximum of 5 years PG Certificate – 3 years PG Diploma – 4 years
Course Start Month(s)	October 2020

Institutions delivering the course

This course is delivered by the Centre for Customised Executive Development, School of Management. The research interests include: management, leadership and change management.

This is offered as a closed corporate programme and Cranfield interacts with the client in the following ways:

- Delivery locations are jointly agreed with the client but have to meet Cranfield's requirements
- Core modules are set but in consultation with the client the course can be customised to suit a specific industry or client need through the agreeing pre-scribed electives which the students have to take.
- Students will undertake their research and/or project work off campus, in their own work place.
- Teaching and assessing is provided by Cranfield faculty and Cranfield RTS Associates

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Diploma (PgDip) and MSc entry levels. Exit routes are provided for students at the end of the certificate and diploma for those who wish to access only parts of the course provided.
The aims of the Certificate are:

- To develop participants' knowledge and awareness of business functions and disciplines relevant to being able to analyse a business in preparedness for strategic change.
- To enable participants to develop appropriate knowledge and skills to lead and or participate in the start of a change initiative in their organisation.

In addition, the aims of the Diploma are:

- To enable participants to gain a systematic understanding and apply their knowledge relating to strategy, change, and leadership in order they can critique the relevance of this understanding to their business context.
- To enable participants to lead both the formulation and implementation of a change programme demonstrating their ability to work effectively as individuals and as part of a team, resolving problems and communicating clearly.

In addition, the aims of the MSc are:

- To develop the participants capabilities to conduct independent research into an aspect of change management, strategy or leadership in a business context.
- To advance the participants understanding of strategic change to enable them to effectively critique and contribute to the development of their organisation.

This programme is intended for the following range of students:

- For those who have been in management positions in their client organisation or related network for at least 2 years and have relevant experience in organisations for a minimum of 5 years.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Business and Strategic Leadership

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Systematically assess and describe the strategic context of the business and be able to critically comment on the fit between business and functional strategies including finance, organisational structure, culture and values.

ILO 2. Critically evaluate a business's need and readiness for change.

ILO 3. Develop and apply the personal qualities and skills necessary to assess, influence and manage change; and to operate as an effective team member.

ILO 4. Demonstrate the ability to integrate knowledge and apply multi-disciplinary approaches to solve real-life business problems and to justify and communicate findings and recommendations with stakeholders in a professional manner.

B. Postgraduate Diploma in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select, justify, apply and adapt theories, and diagnostic techniques relevant to change, strategy and leadership.

ILO 6. Develop and demonstrate leadership and advocacy qualities in designing and implementing a cross functional strategic change initiative within a business.

ILO 7. Communicate clearly in a leadership role in an organisation change management context and to engage with key stakeholder concerns.

ILO 8. Develop team working skills in themselves and support others to improve the overall performance of a team.

C. MSc in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate the ability to identify appropriate management frameworks for an issue or situation under consideration and apply tools and techniques accurately.

ILO 10. Display practical capabilities in self-directed research, data gathering, data analysis and interpretation, report writing and presentation skills.

ILO 11. Produce a high quality thesis and critically evaluate the interpretations of the data and to effectively communicate the results.

4. How is the course taught?

The course is taught with a mixture of lectures, case studies, experiential exercises primarily. The method of teaching includes face to face, use of webinars and webcasts.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate Business and Strategic Leadership

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-5	50
ELECTIVE MODULES[3]:	
One element from 11-19	10
TOTAL:	60

B. Postgraduate Diploma Business and Strategic Leadership

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-10	100
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	120

C. MSc Business and Strategic Leadership

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
1-10 20 21	100 AO 80
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

[3] The Client agrees which elective modules will be offered to the students during contract negotiations.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

As this is a corporate (closed) course elective modules, exact dates and venues have to be agreed with the client.

Given the applied nature of the programme modules take place roughly every 2 to 3 months, exact dates have to be agreed with the organisation. There is no set pattern for the delivery location but at least one module is run at Cranfield and the University aim to facilitate requests for visits to organisations of interest to the client.

7. Course Level Assessment Strategy[5]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The initial modules introduce students to the rigour of academic writing, and assessments are in the form of essays and reports. These will be of varying lengths, recognising that writing articles of a short length can actually be more challenging and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor and the requirements for each will be discussed by the module leader. Some modules will include a number of

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

formative tasks including group discussions, case studies, and oral presentations. Formative feedback is given verbally within the classroom following discussions and presentations, and written feedback given for submitted assignments.

Students have opportunities to develop their communication skills, as they are required to give both group and individual presentations. The ability to work effectively in groups is a highly desirable skill and this is developed throughout the course, specifically through the two group projects. The taught components precede the research project, so assessment can be used to develop skills required for the thesis phase. The two group projects help develop skills in reviewing literature, developing appropriate research methods, collecting and analysing data, and drawing appropriate conclusions. This builds the skills necessary for the individual thesis, where students are generally expected to be more self-directed in their learning, whilst being guided by an academic supervisor. The 10,000-word thesis is expected to be both academically rigorous and beneficial to their organisation in terms of addressing a specific business issue.

Course modules – AON Cohort 1 – Occurrence H

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
Year 1																			
1		MXS/PD1 H20	Personal Development 1	Emma Parry /Jane Trinder	16	15	10	Y		19/10/20	22/10/20	40	ICW	100				02/09/21	
2		MXS/FAC H20	Finance and Accounting	Keith Parker	16	15	10	Y		10/02/21	12/02/21	40	ICW	100				22/03/21	
3		MXS/SMG H20	Strategic Management 1	Imran Zawwa	16		10	Y		07/12/20	10/12/20	40			100 MULTI	GPRES ICW	80 20	25/01/21	

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[9] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[10] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[11] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[12] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
4		MXS/OBV H20	Organisational Behaviour	Emma Parry /Jane Trinder	16	15	10	Y		23/03/21	25/03/21	40	ICW	100				10/05/21	
5		MXS/GP1 H20	Group Project Challenge and Action Learning 1	Jane Trinder / various supervisors	16	15	10	Y		19/10/20	22/10/20	40			100 MULTI	GCW GPRES ICW	60 20 20	12/07/21 19/07/21 23/07/21	
6		MXS/PD2 H21	Personal Development 2	Emma Parry /Jane Trinder	16	15	10	Y		13/09/21	15/09/21	40	ICW	100				09/05/22	
7		MXS/CMG H21	Change Management	David Denyer/Jane Trinder	16	15	10	Y		17/01/22	19/01/22	40	ICW	100				07/03/22	
8		MXS/LDS H21	Leadership	David Denyer/Kim Turnbull James	16		10	Y		16/05/22	18/05/22	40	ICW	100				27/06/22	
9		MXS/GP2 H21	Group Project Challenge and Action Learning 2	Jane Trinder + various supervisors	16	15	10	Y		13/09/21	15/09/21	40			100 MULTI	GCW GPRES ICW	60 20 20	06/06/22 13/06/22 16/06/22	
10		MXS/SM2 H21	Strategic Management 2	Imran Zawwa /Cliff Bowman	16		10	Y		15/11/21	17/11/21	40			100 MULTI	GPRES ICW	80 20	04/01/22	
11		M-T/LCS Occ H	Leading Corporate Sustainability	Rosina Watson	16		10	Y		Not running		40	ICW	100					

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
12		MXM/MKT Occ H	Strategic Marketing	Emma Macdonald	16		10	Y		Not running		40	ICW	100					
13		MXM/SOM Occ H	Strategic Operations Management	Abdelkader Aoufi	16		10	Y		14/03/22	16/03/22	40	ICW	100				03/05/22	
14		M-M/DVSC Occ H	Driving Value through the Supply Chain	Mike Bernon	16		10	Y		Not running		40	ICW	100					
15		M-M/SHR Occ H	Strategic Human Resource Management in the 21st Century	Frank Horwitz	16		10	Y		Not running		40	ICW	100					
16		MXM/ECBS Occ H	Economics and Business Strategy	Catarina Figueira	16		10	Y		Not running		40	GCW	100					
17		M-M/LSO Occ H	Leading Sales and Customer Management Organisations	Javier Marcos	16		10	Y		Not running		40	ICW	100					
18		M-M/-MSI Occ H	Managing Strategic Innovation	Imran Zawwa	16		10	Y		Not running		40	ICW	100					
19		MXS-CCC Occ H	Customer Centric	Stan Maklan	16		10	Y		14/06/21	16/06/21	40	GCW	100				06/09/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
20		MXS/RMSH20	Research Methods	David Denyer/Jane Trinder	16	15	0	Y		19/10/20	27/06/22	N/A	AO					N/A	
21		MXS/THSH21	Thesis	Various supervisors	0		80	Y		27/06/22	17/04/23	50	THESIS	100				17/04/23	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
MXM/MKT	Strategic Marketing	Executive MBA	Business and Strategic Leadership
MXM/SOM	Strategic Operations Management	Executive MBA	Business and Strategic Leadership
M-M/DVSC	Driving Value through the Supply Chain	FT MBA	Executive MBA; Business and Strategic Leadership
M-M/SHR	Strategic Human Resource Management in the 21st Century	MBA	Executive MBA; Business and Strategic Leadership
M-M/MSI	Managing Strategic Innovation	MBA	Executive MBA; Business and Strategic Leadership
MXM/ECBS	Economics and Business Strategy	Executive MBA	Business and Strategic Leadership
M-M/LSO	Leading Sales and Customer Management Organisations	MBA	Executive MBA; Business and Strategic Leadership
M-T/LCS	Leading Corporate Sustainability	MiM	MCS, BSL, ELSCM

8. How are the ILOs assessed?

The following assessment types are utilised:

Taught module assessment on the course is predominantly through assignment. Assignments are set by individual module co-ordinators for the certificate and diploma subjects. The thesis is based 100% on the written submission which falls within the University guidelines that an MSc thesis should be >30% of the overall assessment weighting. This weighting will also impress on students the importance of the written thesis and reinforce their understanding that a poor thesis (R&R or failing) cannot be compensated for by an exceptional presentation.

The use of assignments as opposed to exams which require the application of knowledge to their own organisation produces more tangible benefits inside the organisation, and helps to ensure they have moved from knowledge accumulation to learning. The move to splitting assessments for personal development and the group project is to support the need to learn throughout these subjects and ensure application of learning to themselves or the group theme.

Assessment and ILO Mapping

	PgCert				PgDip				MSc		
Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
1			X				X	X			
2	X				X						
3	X	X			X						
4	X	X	X		X			X			

	PgCert				PgDip				MSc		
Award ILOs Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
5		X	X	X	X	X	X	X	X	X	
6		X	X			X		X			
7	X	X	X	X	X	X					
8		X			X	X	X				
9			X	X	X	X	X	X	X	X	
10	X	X			X	X			X		
11	X				X		X				
12	X				X						
13	X				X						
14	X				X						
15	X				X				X		
16	X				X						
17	X			X	X						
18									X	X	
19	X	X		X	X		X		X	X	
20									X	X	
21									X	X	X

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality

Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

This is a closed corporate course with all participants directly sponsored onto the programme by their organisation. These participants have been selected for capability and leadership development and on completing the course can expect to be promoted to significant and/or senior roles.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2019

1. What is the course?

Course information

Course Title	Business and Strategic Leadership *(Barclays Cohort 1 Occurrence G)*
Course code	MSBSLPTC, PDBSLPTC, PCBSLPTC, MSBSLPAC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Management
Theme	Leadership and Management
Centre	CED
Course Director	Neil Turner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Level 7 Senior Leaders
Is the Degree apprenticeship integrated or non-integrated?	Integrated
Is the Mastership offered as an open and/or closed course?	Closed
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	MSc - part-time - maximum of 5 years PG Certificate – 3 years PG Diploma – 4 years
Course Start Month(s)	October 2018

Institutions delivering the course

This course is delivered by the Centre for Customised Executive Development, School of Management. The research interests include: management, leadership and change management.

This is offered as a closed corporate programme and Cranfield interacts with the client in the following ways:

- Delivery locations are jointly agreed with the client but have to meet Cranfield's requirements
- Core modules are set but in consultation with the client the course can be customised to suit a specific industry or client need through the agreeing pre-scribed electives which the students have to take.
- Students will undertake their research and/or project work off campus, in their own work place.
- Teaching and assessing is provided by Cranfield faculty and Cranfield RTS Associates

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Diploma (PgDip) and MSc entry levels. Exit routes are provided for students at the end of the certificate and diploma for those who wish to access only parts of the course provided.
The aims of the Certificate are:

- To develop participants' knowledge and awareness of business functions and disciplines relevant to being able to analyse a business in preparedness for strategic change.
- To enable participants to develop appropriate knowledge and skills to lead and or participate in the start of a change initiative in their organisation.

In addition, the aims of the Diploma are:

- To enable participants to gain a systematic understanding and apply their knowledge relating to strategy, change, and leadership in order they can critique the relevance of this understanding to their business context.
- To enable participants to lead both the formulation and implementation of a change programme demonstrating their ability to work effectively as individuals and as part of a team, resolving problems and communicating clearly.

In addition, the aims of the MSc are:

- To develop the participants capabilities to conduct independent research into an aspect of change management, strategy or leadership in a business context.

- To advance the participants understanding of strategic change to enable them to effectively critique and contribute to the development of their organisation.

This programme is intended for the following range of students:

- For those who have been in management positions in their client organisation or related network for at least 2 years and have relevant experience in organisations for a minimum of 5 years.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Business and Strategic Leadership

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Systematically assess and describe the strategic context of the business and be able to critically comment on the fit between business and functional strategies including finance, organisational structure, culture and values.

ILO 2. Critically evaluate a business's need and readiness for change.

ILO 3. Develop and apply the personal qualities and skills necessary to assess, influence and manage change; and to operate as an effective team member.

ILO 4. Demonstrate the ability to integrate knowledge and apply multi-disciplinary approaches to solve real-life business problems and to justify and communicate findings and recommendations with stakeholders in a professional manner.

B. Postgraduate Diploma in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select, justify, apply and adapt theories, and diagnostic techniques relevant to change, strategy and leadership.

ILO 6. Develop and demonstrate leadership and advocacy qualities in designing and implementing a cross functional strategic change initiative within a business.

ILO 7. Communicate clearly in a leadership role in an organisation change management context and to engage with key stakeholder concerns.

ILO 8. Develop team working skills in themselves and support others to improve the overall performance of a team.

C. MSc in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate the ability to identify appropriate management frameworks for an issue or situation under consideration and apply tools and techniques accurately.

ILO 10. Display practical capabilities in self-directed research, data gathering, data analysis and interpretation, report writing and presentation skills.

ILO 11. Produce a high quality thesis and critically evaluate the interpretations of the data and to effectively communicate the results.

4. How is the course taught?

The course is taught with a mixture of lectures, case studies, experiential exercises primarily. The method of teaching includes face to face, use of webinars and webcasts.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate Business and Strategic Leadership

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-5	50
ELECTIVE MODULES[3]:	
One element from 11-19	10
TOTAL:	60

B. Postgraduate Diploma Business and Strategic Leadership

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-10	100
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	120

C. MSc Business and Strategic Leadership

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
1-10 20 21	100 AO 80
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

[3] The Client agrees which elective modules will be offered to the students during contract negotiations.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

As this is a corporate (closed) course elective modules, exact dates and venues have to be agreed with the client.

Given the applied nature of the programme modules take place roughly every 2 to 3 months, exact dates have to be agreed with the organisation. There is no set pattern for the delivery location but at least one module is run at Cranfield and the University aim to facilitate requests for visits to organisations of interest to the client.

7. Course Level Assessment Strategy[5]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The initial modules introduce students to the rigour of academic writing, and assessments are in the form of essays and reports. These will be of varying lengths, recognising that writing articles of a short length can actually be more challenging and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor and the requirements for each will be discussed by the module leader. Some modules will include a number of

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

formative tasks including group discussions, case studies, and oral presentations. Formative feedback is given verbally within the classroom following discussions and presentations, and written feedback given for submitted assignments.

Students have opportunities to develop their communication skills, as they are required to give both group and individual presentations. The ability to work effectively in groups is a highly desirable skill and this is developed throughout the course, specifically through the two group projects. The taught components precede the research project, so assessment can be used to develop skills required for the thesis phase. The two group projects help develop skills in reviewing literature, developing appropriate research methods, collecting and analysing data, and drawing appropriate conclusions. This builds the skills necessary for the individual thesis, where students are generally expected to be more self-directed in their learning, whilst being guided by an academic supervisor. The 10,000-word thesis is expected to be both academically rigorous and beneficial to their organisation in terms of addressing a specific business issue.

Course modules – Barclays Cohort 1

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
1		MXS/PD1 Occ G	Personal Development 1	Emma Parry /Jane Trinder	16	15	10	Y		09/10/18	11/10/18	40	ICW	100				29/07/19	
2		MXS/FAC Occ G	Finance and Accounting	Keith Parker	16	15	10	Y		20/03/19	22/03/19	40	ICW	100				07/05/19	
3		MXS/SMG Occ G	Strategic Management 1	Imran Zawwa	16		10	Y		17/12/18	19/12/18	40			100 MUTLI	GCW ICW	80 20	11/02/19	
4		MXS/OBV Occ G	Organisational Behaviour	Emma Parry /Jane Trinder	16	15	10	Y		22/05/19	24/05/19	40	ICW	100				01/07/19	

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[9] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[10] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[11] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[12] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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5		MXS/GP1 Occ G	Group Project Challenge and Action Learning 1	Jane Trinder / various supervisors	16	15	10	Y		09/10/18	11/10/18	40			100 MULTI	GCW GPRES ICW	60 20 20	07/09/19 18/09/19 20/09/19	
6		MXS/PD2 Occ G	Personal Development 2	Emma Parry /Jane Trinder	16	15	10	Y		23/09/19	21/05/20	40	ICW	100				06/07/20	
7		MXS/CMG Occ G	Change Management	David Denyer/Jane Trinder	16	15	10	Y		23/07/19	25/07/19	40	ICW	100				16/09/19	
8		MXS/LDS Occ G	Leadership	David Denyer/Kim Turnbull James	16		10	Y		19/05/20	21/05/20	40	ICW	100				27/07/20	
9		MXS/GP2 Occ G	Group Project Challenge and Action Learning 2	Jane Trinder + various supervisors	16	15	10	Y		23/09/19	25/09/19	40			100 MULTI	GCW GPRES ICW	60 20 20	05/10/20 05/10/20 15/10/20	
10		MXS/SM2 Occ G	Strategic Management 2	Imran Zawwa /Cliff Bowman	16		10	Y		20/11/19	22/11/19	40			100 MULTI	GPRES ICW	80 20	13/01/20 13/01/20	
11		M-T/LCS Occ G	Leading Corporate Sustainability	Rosina Watson	16		10	Y		Not running	40	ICW	100						
12		MXM/MKT Occ G	Strategic Marketing	Emma Macdonald	16		10	Y		Not running	40	GPR ES ICW	50 50						

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13		MXM/SOM Occ G	Strategic Operations Management	Abdelkader Aoufi	16		10	Y		Not running	40	ICW	100						
14		M-M/DVSC Occ G	Driving Value through the Supply Chain	Mike Bernon	16		10	Y		Not running	40	ICW	100						
15		M-M/SHR Occ G	Strategic Human Resource Management in the 21st Century	Frank Horwitz	16		10	Y		Not running	40	ICW	100						
16		MXM/ECBS Occ G	Economics and Business Strategy	Catarina Figueira	16		10	Y		Not running	40	GCW	100						
17		M-M/LSO Occ G	Leading Sales and Customer Management Organisations	Javier Marcos	16		10	Y		Not running	40	ICW	100						
18		M-M/-MSI Occ G	Managing Strategic Innovation	Imran Zawwar	16		10	Y		21/01/20	23/01/20	40	ICW	100				09/03/20	
19		MXS-CCC Occ G	Customer Centric	Stan Maklan	16		10	Y		24/03/20	26/03/20	40	GCW	100				15/06/20	
20		MXS/RMS Occ G	Research Methods	David Denyer/Jane Trinder	16	15	0	Y		09/10/18	06/07/20	N/A	AO						

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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21		MXS/THS Occ G	Thesis	Various supervisors	0		80	Y		06/07/20	30/04/21	50	THESIS	100				30/04/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
MXM/MKT	Strategic Marketing	Executive MBA	Business and Strategic Leadership
MXM/SOM	Strategic Operations Management	Executive MBA	Business and Strategic Leadership
M-M/DVSC	Driving Value through the Supply Chain	FT MBA	Executive MBA; Business and Strategic Leadership
M-M/SHR	Strategic Human Resource Management in the 21st Century	MBA	Executive MBA; Business and Strategic Leadership
M-M/MSI	Managing Strategic Innovation	MBA	Executive MBA; Business and Strategic Leadership
MXM/ECBS	Economics and Business Strategy	Executive MBA	Business and Strategic Leadership
M-M/LSO	Leading Sales and Customer Management Organisations	MBA	Executive MBA; Business and Strategic Leadership
M-T/LCS	Leading Corporate Sustainability	MiM	MCS, BSL, ELSCM

8. How are the ILOs assessed?

The following assessment types are utilised:

Taught module assessment on the course is predominantly through assignment. Assignments are set by individual module co-ordinators for the certificate and diploma subjects. The thesis is based 100% on the written submission which falls within the University guidelines that an MSc thesis should be >30% of the overall assessment weighting. This weighting will also impress on students the importance of the written thesis and reinforce their understanding that a poor thesis (R&R or failing) cannot be compensated for by an exceptional presentation.

The use of assignments as opposed to exams which require the application of knowledge to their own organisation produces more tangible benefits inside the organisation and helps to ensure they have moved from knowledge accumulation to learning. The move to splitting assessments for personal development and the group project is to support the need to learn throughout these subjects and ensure application of learning to themselves or the group theme.

Assessment and ILO Mapping

	PgCert				PgDip				MSc		
Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
1			X				X	X			
2	X				X						
3	X	X			X						
4	X	X	X		X			X			

	PgCert				PgDip				MSc		
Award ILOs Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
5		X	X	X	X	X	X	X	X	X	
6		X	X			X		X			
7	X	X	X	X	X	X					
8		X			X	X	X				
9			X	X	X	X	X	X	X	X	
10	X	X			X	X			X		
11	X				X		X				
12	X				X						
13	X				X						
14	X				X						
15	X				X				X		
16	X				X						
17	X			X	X						
18									X	X	
19	X	X		X	X		X		X	X	
20									X	X	
21									X	X	X

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality

Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

This is a closed corporate course with all participants directly sponsored onto the programme by their organisation. These participants have been selected for capability and leadership development and on completing the course can expect to be promoted to significant and/or senior roles.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	Business and Strategic Leadership *(BBC Cohort 1 Occurrence G)*
Course code	MSBSLPTC, PDBSLPTC, PCBSLPTC, MSBSLPAC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Management
Theme	Leadership and Management
Centre	CED
Course Director	Neil Turner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Level 7 Senior Leaders
Is the Degree apprenticeship integrated or non-integrated?	Non-integrated
Is the Mastership offered as an open and/or closed course?	Closed
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	MSc - part-time - maximum of 5 years
Course Start Month(s)	September 2020

Institutions delivering the course

This course is delivered by the Centre for Customised Executive Development, School of Management. The research interests include: management, leadership and change management.

This is offered as a closed corporate programme and Cranfield interacts with the client in the following ways:

- Delivery locations are jointly agreed with the client but have to meet Cranfield's requirements
- Core modules are set but in consultation with the client the course can be customised to suit a specific industry or client need through the agreeing pre-scribed electives which the students have to take.
- Students will undertake their research and/or project work off campus, in their own work place.
- Teaching and assessing is provided by Cranfield faculty and Cranfield RTS Associates

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Diploma (PgDip) and MSc entry levels. Exit routes are provided for students at the end of the certificate and diploma for those who wish to access only parts of the course provided.
The aims of the Certificate are:

- To develop participants' knowledge and awareness of business functions and disciplines relevant to being able to analyse a business in preparedness for strategic change.
- To enable participants to develop appropriate knowledge and skills to lead and or participate in the start of a change initiative in their organisation.

In addition, the aims of the Diploma are:

- To enable participants to gain a systematic understanding and apply their knowledge relating to strategy, change, and leadership in order they can critique the relevance of this understanding to their business context.
- To enable participants to lead both the formulation and implementation of a change programme demonstrating their ability to work effectively as individuals and as part of a team, resolving problems and communicating clearly.

In addition, the aims of the MSc are:

- To develop the participants capabilities to conduct independent research into an aspect of change management, strategy or leadership in a business context.

- To advance the participants understanding of strategic change to enable them to effectively critique and contribute to the development of their organisation.

This programme is intended for the following range of students:

- For those who have been in management positions in their client organisation or related network for at least 2 years and have relevant experience in organisations for a minimum of 5 years.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Business and Strategic Leadership

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Systematically assess and describe the strategic context of the business and be able to critically comment on the fit between business and functional strategies including finance, organisational structure, culture and values.

ILO 2. Critically evaluate a business's need and readiness for change.

ILO 3. Develop and apply the personal qualities and skills necessary to assess, influence and manage change; and to operate as an effective team member.

ILO 4. Demonstrate the ability to integrate knowledge and apply multi-disciplinary approaches to solve real-life business problems and to justify and communicate findings and recommendations with stakeholders in a professional manner.

B. Postgraduate Diploma in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select, justify, apply and adapt theories, and diagnostic techniques relevant to change, strategy and leadership.

ILO 6. Develop and demonstrate leadership and advocacy qualities in designing and implementing a cross functional strategic change initiative within a business.

ILO 7. Communicate clearly in a leadership role in an organisation change management context and to engage with key stakeholder concerns.

ILO 8. Develop team working skills in themselves and support others to improve the overall performance of a team.

C. MSc in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate the ability to identify appropriate management frameworks for an issue or situation under consideration and apply tools and techniques accurately.

ILO 10. Display practical capabilities in self-directed research, data gathering, data analysis and interpretation, report writing and presentation skills.

ILO 11. Produce a high quality thesis and critically evaluate the interpretations of the data and to effectively communicate the results.

4. How is the course taught?

The course is taught with a mixture of lectures, case studies, experiential exercises primarily. The method of teaching includes face to face, use of webinars and webcasts.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. MSc Business and Strategic Leadership

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
1-9 19 20	100 AO 80
ELECTIVE MODULES:	
Two elements from 10-18 (agreed by client during contract negotiations)	20
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

As this is a corporate (closed) course elective modules, exact dates and venues have to be agreed with the client.

Given the applied nature of the programme modules take place roughly every 2 to 3 months, exact dates have to be agreed with the organisation. There is no set pattern for the delivery location but at least one module is run at Cranfield and the University aim to facilitate requests for visits to organisations of interest to the client.

7. Course Level Assessment Strategy[4]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The initial modules introduce students to the rigour of academic writing, and assessments are in the form of essays and reports. These will be of varying lengths, recognising that writing articles of a short length can actually be more challenging and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor and the requirements for each will be discussed by the module leader. Some modules will include a number of formative tasks including group discussions, case studies, and oral presentations. Formative feedback is given verbally within the classroom following discussions and presentations, and written feedback given for submitted assignments.

Students have opportunities to develop their communication skills, as they are required to give both group and individual presentations. The ability to work effectively in groups is a highly desirable skill and this is developed throughout the course, specifically through the two group projects. The taught components precede the research project, so assessment can be used to develop skills required for the thesis phase. The two group projects help develop skills in reviewing literature, developing appropriate research methods, collecting and analysing data, and drawing appropriate conclusions. This builds the skills necessary for the individual thesis, where students are generally expected to be more self-directed in their learning, whilst being guided by an academic supervisor. The 10,000-word thesis is expected to be both academically rigorous and beneficial to their organisation in terms of addressing a specific business issue.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules – BBC Cohort 1 – Occurrence G

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1		MXS/PD1 G20	Personal Development 1	Emma Parry /Jane Trinder	16	15	10	Y		02/12/20	06/06/21	40	ICW	100				01/07/21	
2		MXS/FAC G20	Finance and Accounting	Keith Parker	16	15	10	Y		18/01/21	20/01/21	40	ICW	100				01/03/21	
3		MXS/SMG G20	Strategic Management 1	Imran Zawwa	16		10	Y		28/09/20	01/10/20	40			100 MULTI	GCW ICW	80 20	09/11/20	
4		MXS/OBV G20	Organisational Behaviour	Emma Parry /Jane Trinder	16	15	10	Y		09/03/21	11/03/21	40	ICW	100				26/04/21	

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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5		MXS/PD2 G21	Personal Development 2	Emma Parry /Jane Trinder	16	15	10	Y		07/09/21	05/05/22	40	ICW	100				16/05/22	
6		MXS/CMG G20	Change Management	David Denyer/Jane Trinder	16	15	10	Y		16/11/20	19/11/20	40	ICW	100				04/01/21	
7		MXS/LDS G21	Leadership	David Denyer/Kim Turnbull James	16		10	Y		03/05/22	05/05/22	40	ICW	100				13/06/22	
8		MXS/GPA G21	Group Project Challenge and Action Learning	Jane Trinder + various supervisors	16	15	20	Y		07/09/21	07/09/21	40			100 MULTI	GCW GPRES ICW	60 20 20	20/06/22 27/06/22 30/06/22	
9		MXS/SM2 G21	Strategic Management 2	Imran Zawwa /Cliff Bowman	16		10	Y		09/11/21	11/11/21	40			100 MULTI	GPRES ICW	80 20	04/01/22	
10		M-T/LCS Occ G	Leading Corporate Sustainability	Rosina Watson	16		10	Y		07/06/21	09/06/21	40	ICW	100				19/07/21	
11		MXM/MKT Occ G	Strategic Marketing	Emma Macdonald	16		10	Y		Not running		40	ICW	100					
12		MXM/SOM Occ G	Strategic Operations Management	Abdelkader Aoufi	16		10	Y		Not running		40	ICW	100					
13		M-M/DVSC Occ G	Driving Value through the Supply Chain	Mike Bernon	16		10	Y		Not running		40	ICW	100					

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													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
14		M-M/SHR Occ G	Strategic Human Resource Management in the 21st Century	Frank Horwitz	16		10	Y		Not running		40	ICW	100					
15		MXM/ECBS Occ G	Economics and Business Strategy	Catarina Figueira	16		10	Y		Not running		40	GCW	100					
16		M-M/LSO Occ G	Leading Sales and Customer Management Organisations	Javier Marcos	16		10	Y		Not running		40	ICW	100					
17		M-M/-MSI Occ G	Managing Strategic Innovation	Imran Zawwa	16		10	Y		12/01/22	14/01/22	40	ICW	100				21/02/22	
18		MXS-CCC Occ G	Customer Centric	Stan Maklan	16		10	Y		Not running		40	GCW	100					
19		MXS/RMS G20	Research Methods	David Denyer/Jane Trinder	16	15	0	Y		28/09/20	13/06/22	N/A	AO					N/A	
20		MXS/THS G21	Thesis	Various supervisors	0		80	Y		13/06/22	27/03/23	50	THESIS	100				27/03/23	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
MXM/MKT	Strategic Marketing	Executive MBA	Business and Strategic Leadership
MXM/SOM	Strategic Operations Management	Executive MBA	Business and Strategic Leadership
M-M/DVSC	Driving Value through the Supply Chain	FT MBA	Executive MBA; Business and Strategic Leadership
M-M/SHR	Strategic Human Resource Management in the 21st Century	MBA	Executive MBA; Business and Strategic Leadership
M-M/MSI	Managing Strategic Innovation	MBA	Executive MBA; Business and Strategic Leadership
MXM/ECBS	Economics and Business Strategy	Executive MBA	Business and Strategic Leadership
M-M/LSO	Leading Sales and Customer Management Organisations	MBA	Executive MBA; Business and Strategic Leadership
M-T/LCS	Leading Corporate Sustainability	MiM	MCS, BSL, ELSCM

8. How are the ILOs assessed?

The following assessment types are utilised:

Taught module assessment on the course is predominantly through assignment. Assignments are set by individual module co-ordinators for the certificate and diploma subjects. The thesis is based 100% on the written submission which falls within the University guidelines that an MSc thesis should be >30% of the overall assessment weighting. This weighting will also impress on students the importance of the written thesis and reinforce their understanding that a poor thesis (R&R or failing) cannot be compensated for by an exceptional presentation.

The use of assignments as opposed to exams which require the application of knowledge to their own organisation produces more tangible benefits inside the organisation, and helps to ensure they have moved from knowledge accumulation to learning. The move to splitting assessments for personal development and the group project is to support the need to learn throughout these subjects and ensure application of learning to themselves or the group theme.

Assessment and ILO Mapping

	PgCert				PgDip				MSc		
Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
1			X				X	X			
2	X				X						
3	X	X			X						
4	X	X	X		X			X			

	PgCert				PgDip				MSc		
Award ILOs Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
5		X	X			X		X			
6	X	X	X	X	X	X					
7		X			X	X	X				
8			X	X	X	X	X	X	X	X	
9	X	X			X	X			X		
10	X				X		X				
11	X				X						
12	X				X						
13	X				X						
14	X				X				X		
15	X				X						
16	X			X	X						
17									X	X	
18	X	X		X	X		X		X	X	
19									X	X	
20									X	X	X

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality

Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

This is a closed corporate course with all participants directly sponsored onto the programme by their organisation. These participants have been selected for capability and leadership development and on completing the course can expect to be promoted to significant and/or senior roles.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: October 2020

1. What is the course?

Course information

Course Title	Business and Strategic Leadership – *(BBC Cohort 2 O, P, Q)*
Course code	MSBSLPAC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Management
Theme	Leadership and Management
Centre	CED
Course Director	Neil Turner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Level 7 Senior Leaders
Is the Degree apprenticeship integrated or non-integrated?	Non-integrated
Is the Mastership offered as an open and/or closed course?	Closed
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	MSc - part-time - maximum of 5 years
Course Start Month(s)	November 2020

Institutions delivering the course

This course is delivered by the Centre for Customised Executive Development, School of Management. The research interests include: management, leadership and change management.

This is offered as a closed corporate programme and Cranfield interacts with the client in the following ways:

- Delivery locations are jointly agreed with the client but have to meet Cranfield's requirements
- Core modules are set but in consultation with the client the course can be customised to suit a specific industry or client need through the agreeing pre-scribed electives which the students have to take.
- Students will undertake their research and/or project work off campus, in their own work place.
- Teaching and assessing is provided by Cranfield faculty and Cranfield RTS Associates

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Diploma (PgDip) and MSc entry levels. Exit routes are provided for students at the end of the certificate and diploma for those who wish to access only parts of the course provided.
The aims of the Certificate are:

- To develop participants' knowledge and awareness of business functions and disciplines relevant to being able to analyse a business in preparedness for strategic change.
- To enable participants to develop appropriate knowledge and skills to lead and or participate in the start of a change initiative in their organisation.

In addition, the aims of the Diploma are:

- To enable participants to gain a systematic understanding and apply their knowledge relating to strategy, change, and leadership in order they can critique the relevance of this understanding to their business context.
- To enable participants to lead both the formulation and implementation of a change programme demonstrating their ability to work effectively as individuals and as part of a team, resolving problems and communicating clearly.

In addition, the aims of the MSc are:

- To develop the participants capabilities to conduct independent research into an aspect of change management, strategy or leadership in a business context.
- To advance the participants understanding of strategic change to enable them to effectively critique and contribute to the development of their organisation.

This programme is intended for the following range of students:

- For those who have been in management positions in their client organisation or related network for at least 2 years and have relevant experience in organisations for a minimum of 5 years.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Business and Strategic Leadership

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Systematically assess and describe the strategic context of the business and be able to critically comment on the fit between business and functional strategies including finance, organisational structure, culture and values.
ILO 2. Critically evaluate a business's need and readiness for change.
ILO 3. Develop and apply the personal qualities and skills necessary to assess, influence and manage change; and to operate as an effective team member.
ILO 4. Demonstrate the ability to integrate knowledge and apply multi-disciplinary approaches to solve real-life business problems and to justify and communicate findings and recommendations with stakeholders in a professional manner.

B. Postgraduate Diploma in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select, justify, apply and adapt theories, and diagnostic techniques relevant to change, strategy and leadership.
ILO 6. Develop and demonstrate leadership and advocacy qualities in designing and implementing a cross functional strategic change initiative within a business.
ILO 7. Communicate clearly in a leadership role in an organisation change management context and to engage with key stakeholder concerns.
ILO 8. Develop team working skills in themselves and support others to improve the overall performance of a team.

C. MSc in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate the ability to identify appropriate management frameworks for an issue or situation under consideration and apply tools and techniques accurately.
ILO 10. Display practical capabilities in self-directed research, data gathering, data analysis and interpretation, report writing and presentation skills.
ILO 11. Produce a high quality thesis and critically evaluate the interpretations of the data and to effectively communicate the results.

4. How is the course taught?

The course is taught with a mixture of lectures, case studies, experiential exercises primarily. The method of teaching includes face to face, use of webinars and webcasts.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8.

Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. MSc Business and Strategic Leadership

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
1-9 19 20	100 AO 80
ELECTIVE MODULES:	
Two elements from 10-18 (agreed by client during contract negotiations)	20
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

As this is a corporate (closed) course elective modules, exact dates and venues have to be agreed with the client.

Given the applied nature of the programme modules take place roughly every 2 to 3 months, exact dates have to be agreed with the organisation. There is no set pattern for the delivery location but at least one module is run at Cranfield and the University aim to facilitate requests for visits to organisations of interest to the client.

7. Course Level Assessment Strategy[4]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The initial modules introduce students to the rigour of academic writing, and assessments are in the form of essays and reports. These will be of varying lengths, recognising that writing articles of a short length can actually be more challenging and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor and the requirements for each will be discussed by the module leader. Some modules will include a number of formative tasks including group discussions, case studies, and oral presentations. Formative feedback is given verbally within the classroom following discussions and presentations, and written feedback given for submitted assignments.

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[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules – BBC Cohort 2 – 3 streams – O, P, Q occurrences

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	STREAM	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	1	MXS/PD1 O20	Personal Development 1	Richard Kwiatkowski	16	15	10	Y		21/01/21	14/06/21	40	ICW	100				04/10/21	
	2	MXS/PD1 P20	Personal Development 1	Richard Kwiatkowski	16	15	10	Y		28/01/21	28/06/21	40	ICW	100				11/10/21	
	3	MXS/PD1 Q20	Personal Development 1	Richard Kwiatkowski	16	15	10	Y		04/02/21	05/07/21	40	ICW	100				18/10/21	
2	1	MXS/FAC O20	Finance and Accounting	Keith Parker	16	15	10	Y		19/04/21	23/04/21	40	ICW	100				07/06/21	

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
	2	MXS/FAC P20	Finance and Accounting	Keith Parker	16	15	10	Y		04/05/21	07/05/21	40	ICW	100				21/06/21	
	3	MXS/FAC Q20	Finance and Accounting	Keith Parker	16	15	10	Y		10/05/21	14/05/21	40	ICW	100				28/06/21	
3	1	MXS/SMG O20	Strategic Management 1	Imran Zawwar	16		10	Y		30/11/20	15/01/21	40			100 MULTI	GCW ICW	80 20	22/02/21	
	2	MXS/SMG P20	Strategic Management 1	Imran Zawwar	16		10	Y		30/11/20	20/01/21	40			100 MULTI	GCW ICW	80 20	01/03/21	
	3	MXS/SMG Q20	Strategic Management 1	Imran Zawwar	16		10	Y		30/11/20	27/01/21	40			100 MULTI	GCW ICW	80 20	15/03/21	
4	1	MXS/OBV O20	Organisational Behaviour	Deirdre Anderson	16	15	10	Y		05/07/21	08/07/21	40	ICW	100				06/09/21	
	2	MXS/OBV P20	Organisational Behaviour	Deirdre Anderson	16	15	10	Y		12/07/21	15/07/21	40	ICW	100				13/09/21	
	3	MXS/OBV Q20	Organisational Behaviour	Deirdre Anderson	16	15	10	Y		19/07/21	22/07/21	40	ICW	100				20/09/21	
5	1	MXS/PD2 O21	Personal Development 2	Emma Parry	16	15	10	Y		TBC	TBC	40	ICW	100				05/09/22	
	2	MXS/PD2 P21	Personal Development 2	Emma Parry	16	15	10	Y		TBC	TBC	40	ICW	100				12/09/22	
	3	MXS/PD2 Q21	Personal Development 2	Emma Parry	16	15	10	Y		TBC	TBC	40	ICW	100				19/09/22	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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6	1	MXS/CMG O20	Change Management	David Denyer	16	15	10	Y		01/03/21	04/03/21	40	ICW	100				19/04/21	
	2	MXS/CMG P20	Change Management	David Denyer	16	15	10	Y		08/03/21	11/03/21	40	ICW	100				26/04/21	
	3	MXS/CMG Q20	Change Management	David Denyer	16	15	10	Y		22/03/21	25/03/21	40	ICW	100				03/05/21	
7	1	MXS/LDS O21	Leadership	Kim Turnbull James	16		10	Y		06/06/22	09/06/22	40	ICW	100				11/07/22	
	2	MXS/LDS P21	Leadership	Kim Turnbull James	16		10	Y		13/06/22	16/03/22	40	ICW	100				18/07/22	
	3	MXS/LDS Q21	Leadership	Kim Turnbull James	16		10	Y		20/06/22	23/06/22	40	ICW	100				25/07/22	
8	1	MXS/GPA O21	Group Project Challenge and Action Learning	Neil Turner	16	15	20	Y		29/11/21	02/12/21	40			100 MULTI	GCW GPRES ICW	60 20 20	03/10/22 10/10/22 24/10/22	
	2	MXS/GPA P21	Group Project Challenge and Action Learning	Neil Turner	16	15	20	Y		06/12/21	09/12/21	40			100 MULTI	GCW GPRES ICW	60 20 20	10/10/22 24/10/22 07/11/22	
	3	MXS/GPA Q21	Group Project Challenge and Action Learning	Neil Turner	16	15	20	Y		13/12/21	16/12/21	40			100 MULTI	GCW GPRES ICW	60 20 20	24/10/22 31/11/22 14/11/22	
9	1	MXS/SM2 O21	Strategic Management 2	Imran Zawwar	16		10	Y		17/01/22	20/01/22	40			100 MULTI	GPRES ICW	80 20	28/02/22 28/02/22	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
	2	MXS/SM2 P21	Strategic Management 2	Imran Zawwar	16		10	Y		24/01/22	27/01/22	40			100 MULTI	GPRES ICW	80 20	07/03/22 07/03/22	
	3	MXS/SM2 Q21	Strategic Management 2	Imran Zawwar	16		10	Y		31/01/22	03/02/22	40			100 MULTI	GPRES ICW	80 20	14/03/22 14/03/22	
10	1	M-T/LCS O21	Leading Corporate Sustainability	Rosina Watson	16		10	Y		13/09/21	16/09/21	40	ICW	100				01/11/21	
	2	M-T/LCS P21	Leading Corporate Sustainability	Rosina Watson	16		10	Y		20/09/21	23/09/21	40	ICW	100				08/11/21	
	3	M-T/LCS Q21	Leading Corporate Sustainability	Rosina Watson	16		10	Y		27/09/21	30/09/21	40	ICW	100				15/11/21	
11	1	M-M/-MSI O21	Managing Strategic Innovation	Imran Zawwar	16		10	Y		07/03/22	10/03/22	40	ICW	100				25/04/22	
	2	M-M/-MSI P21	Managing Strategic Innovation	Imran Zawwar	16		10	Y		14/03/22	17/03/22	40	ICW	100				03/05/22	
	3	M-M/-MSI Q21	Managing Strategic Innovation	Imran Zawwar	16		10	Y		21/03/22	24/03/22	40	ICW	100				09/05/22	
12	1	MXS/RMS O21	Research Methods	Neil Turner	16	15	0	Y		11/07/22	24/10/22	N/A	AO					N/A	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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	2	MXS/RMS P21	Research Methods	Neil Turner	16	15	0	Y		18/07/22	07/11/22	N/A	AO					N/A	
	3	MXS/RMS Q21	Research Methods	Neil Turner	16	15	0	Y		25/07/22	14/11/22	N/A	AO					N/A	
13	1	MXS/THS O21	Thesis	Various supervisors	0		80	Y		24/10/22	30/05/23	50	THESIS	100				30/05/23	
	2	MXS/THS P21	Thesis	Various supervisors	0		80	Y		07/11/22	30/05/23	50	THESIS	100				30/05/23	
	3	MXS/THS Q21	Thesis	Various supervisors	0		80	Y		14/11/22	30/05/23	50	THESIS	100				30/05/23	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
MXM/MKT	Strategic Marketing	Executive MBA	Business and Strategic Leadership
MXM/SOM	Strategic Operations Management	Executive MBA	Business and Strategic Leadership
M-M/DVSC	Driving Value through the Supply Chain	FT MBA	Executive MBA; Business and Strategic Leadership
M-M/SHR	Strategic Human Resource Management in the 21st Century	MBA	Executive MBA; Business and Strategic Leadership
M-M/MSI	Managing Strategic Innovation	MBA	Executive MBA; Business and Strategic Leadership
MXM/ECBS	Economics and Business Strategy	Executive MBA	Business and Strategic Leadership
M-M/LSO	Leading Sales and Customer Management Organisations	MBA	Executive MBA; Business and Strategic Leadership
M-T/LCS	Leading Corporate Sustainability	MiM	MCS, BSL, ELSCM

8. How are the ILOs assessed?

The following assessment types are utilised:

Taught module assessment on the course is predominantly through assignment. Assignments are set by individual module co-ordinators for the certificate and diploma subjects. The thesis is based 100% on the written submission which falls within the University guidelines that an MSc thesis should be >30% of the overall assessment weighting. This weighting will also impress on students the importance of the written thesis and reinforce their understanding that a poor thesis (R&R or failing) cannot be compensated for by an exceptional presentation.

The use of assignments as opposed to exams which require the application of knowledge to their own organisation produces more tangible benefits inside the organisation, and helps to ensure they have moved from knowledge accumulation to learning. The move to splitting assessments for personal development and the group project is to support the need to learn throughout these subjects and ensure application of learning to themselves or the group theme.

Assessment and ILO Mapping

	PgCert				PgDip				MSc		
Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
1			X				X	X			
2	X				X						
3	X	X			X						
4	X	X	X		X			X			

	PgCert				PgDip				MSc		
Award ILOs Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
5		X	X			X		X			
6	X	X	X	X	X	X					
7		X			X	X	X				
8			X	X	X	X	X	X	X	X	
9	X	X			X	X			X		
10	X				X		X				
11	X				X						
12	X				X						
13	X				X						
14	X				X				X		
15	X				X						
16	X			X	X						
17									X	X	
18	X	X		X	X		X		X	X	
19									X	X	
20									X	X	X

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality

Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

This is a closed corporate course with all participants directly sponsored onto the programme by their organisation. These participants have been selected for capability and leadership development and on completing the course can expect to be promoted to significant and/or senior roles.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: December 2019/August 2020

1. What is the course?

Course information

Course Title	Business and Strategic Leadership *(Swissport Cohort 1 Occurrence S)*
Course code	MSBSLPTC, PDBSLPTC, PCBSLPTC, MSBSLPAC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Part-time
Location(s)[1] of Study	Cranfield
School(s)	School of Management
Theme	Leadership and Management
Centre	CED
Course Director	Neil Turner
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	Yes
Apprenticeship Standard the course is mapped to	Level 7 Senior Leaders
Is the Degree apprenticeship integrated or non-integrated?	Integrated
Is the Mastership offered as an open and/or closed course?	Closed
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	MSc - part-time - maximum of 5 years PG Certificate – 3 years PG Diploma – 4 years
Course Start Month(s)	January 2020

Institutions delivering the course

This course is delivered by the Centre for Customised Executive Development, School of Management. The research interests include: management, leadership and change management.

This is offered as a closed corporate programme and Cranfield interacts with the client in the following ways:

- Delivery locations are jointly agreed with the client but have to meet Cranfield's requirements
- Core modules are set but in consultation with the client the course can be customised to suit a specific industry or client need through the agreeing pre-scribed electives which the students have to take.
- Students will undertake their research and/or project work off campus, in their own work place.
- Teaching and assessing is provided by Cranfield faculty and Cranfield RTS Associates

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Diploma (PgDip) and MSc entry levels. Exit routes are provided for students at the end of the certificate and diploma for those who wish to access only parts of the course provided.
The aims of the Certificate are:

- To develop participants' knowledge and awareness of business functions and disciplines relevant to being able to analyse a business in preparedness for strategic change.
- To enable participants to develop appropriate knowledge and skills to lead and or participate in the start of a change initiative in their organisation.

In addition, the aims of the Diploma are:

- To enable participants to gain a systematic understanding and apply their knowledge relating to strategy, change, and leadership in order they can critique the relevance of this understanding to their business context.
- To enable participants to lead both the formulation and implementation of a change programme demonstrating their ability to work effectively as individuals and as part of a team, resolving problems and communicating clearly.

In addition, the aims of the MSc are:

- To develop the participants capabilities to conduct independent research into an aspect of change management, strategy or leadership in a business context.

- To advance the participants understanding of strategic change to enable them to effectively critique and contribute to the development of their organisation.

This programme is intended for the following range of students:

- For those who have been in management positions in their client organisation or related network for at least 2 years and have relevant experience in organisations for a minimum of 5 years.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Business and Strategic Leadership

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Systematically assess and describe the strategic context of the business and be able to critically comment on the fit between business and functional strategies including finance, organisational structure, culture and values.

ILO 2. Critically evaluate a business's need and readiness for change.

ILO 3. Develop and apply the personal qualities and skills necessary to assess, influence and manage change; and to operate as an effective team member.

ILO 4. Demonstrate the ability to integrate knowledge and apply multi-disciplinary approaches to solve real-life business problems and to justify and communicate findings and recommendations with stakeholders in a professional manner.

B. Postgraduate Diploma in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select, justify, apply and adapt theories, and diagnostic techniques relevant to change, strategy and leadership.

ILO 6. Develop and demonstrate leadership and advocacy qualities in designing and implementing a cross functional strategic change initiative within a business.

ILO 7. Communicate clearly in a leadership role in an organisation change management context and to engage with key stakeholder concerns.

ILO 8. Develop team working skills in themselves and support others to improve the overall performance of a team.

C. MSc in Business and Strategic Leadership

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Demonstrate the ability to identify appropriate management frameworks for an issue or situation under consideration and apply tools and techniques accurately.

ILO 10. Display practical capabilities in self-directed research, data gathering, data analysis and interpretation, report writing and presentation skills.

ILO 11. Produce a high quality thesis and critically evaluate the interpretations of the data and to effectively communicate the results.

4. How is the course taught?

The course is taught with a mixture of lectures, case studies, experiential exercises primarily. The method of teaching includes face to face, use of webinars and webcasts.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate Business and Strategic Leadership

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-5	50
ELECTIVE MODULES[3]:	
One element from 11-19	10
TOTAL:	60

B. Postgraduate Diploma Business and Strategic Leadership

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
1-10	100
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	120

C. MSc Business and Strategic Leadership

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
1-10 20 21	100 AO 80
ELECTIVE MODULES:	
Two elements from 11-19	20
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

[3] The Client agrees which elective modules will be offered to the students during contract negotiations.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

As this is a corporate (closed) course elective modules, exact dates and venues have to be agreed with the client.

Given the applied nature of the programme modules take place roughly every 2 to 3 months, exact dates have to be agreed with the organisation. There is no set pattern for the delivery location but at least one module is run at Cranfield and the University aim to facilitate requests for visits to organisations of interest to the client.

7. Course Level Assessment Strategy[5]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The initial modules introduce students to the rigour of academic writing, and assessments are in the form of essays and reports. These will be of varying lengths, recognising that writing articles of a short length can actually be more challenging and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor and the requirements for each will be discussed by the module leader. Some modules will include a number of

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

formative tasks including group discussions, case studies, and oral presentations. Formative feedback is given verbally within the classroom following discussions and presentations, and written feedback given for submitted assignments.

Students have opportunities to develop their communication skills, as they are required to give both group and individual presentations. The ability to work effectively in groups is a highly desirable skill and this is developed throughout the course, specifically through the two group projects. The taught components precede the research project, so assessment can be used to develop skills required for the thesis phase. The two group projects help develop skills in reviewing literature, developing appropriate research methods, collecting and analysing data, and drawing appropriate conclusions. This builds the skills necessary for the individual thesis, where students are generally expected to be more self-directed in their learning, whilst being guided by an academic supervisor. The 10,000-word thesis is expected to be both academically rigorous and beneficial to their organisation in terms of addressing a specific business issue.

Course modules – Swissport – occurrence S

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
1		MXS/PD1 Occ S	Personal Development 1	Emma Parry /Jane Trinder	16	15	10	Y	13/01/20	11/11/20	11/11/20	40	ICW	100				16/11/20	
2		MXS/FAC Occ S	Finance and Accounting	Keith Parker	16	15	10	Y	03/06/20	03/06/20	29/06/20	40	ICW	100				07/09/20	
3		MXS/SMG Occ S	Strategic Management 1	Imran Zawwa	16		10	Y	15/07/20	15/07/20	23/07/20	40			100 MULTI	GCW ICW	80 20	28/09/20	
4		MXS/OBV Occ S	Organisational Behaviour	Emma Parry /Jane Trinder	16	15	10	Y	01/09/20	10/09/20	10/09/20	40	ICW	100				26/10/20	

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[9] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[10] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[11] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[12] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
5		MXS/GP1 Occ S	Group Project Challenge and Action Learning 1	Jane Trinder / various supervisors	16	15	10	Y	13/01/20	13/01/20	15/01/20	40			100 MULTI	GCW GPRES ICW	60 20 20	04/01/21 11/01/21 18/01/21	
6		MXS/PD2 Occ S	Personal Development 2	Emma Parry /Jane Trinder	16	15	10	Y	05/01/21	05/01/21	22/09/21	40	ICW	100				11/10/21	
7		MXS/CMG Occ S	Change Management	David Denyer/Jane Trinder	16	15	10	Y	05/07/21	05/07/21	07/07/21	40	ICW	100				08/09/21	
8		MXS/LDS Occ S	Leadership	David Denyer/Kim Turnbull James	16		10	Y	20/09/21	20/09/21	22/09/21	40	ICW	100				01/11/21	
9		MXS/GP2 Occ S	Group Project Challenge and Action Learning 2	Jane Trinder + various supervisors	16	15	10	Y	05/01/21	05/01/21	22/09/21	40			100 MULTI	GCW GPRES ICW	60 20 20	08/11/21 15/11/21 22/11/21	
10		MXS/SM2 Occ S	Strategic Management 2	Imran Zawwa /Cliff Bowman	16		10	Y	23/03/21	23/03/21	25/03/21	40			100 MULTI	GPRES ICW	80 20	10/06/21	
11		M-T/LCS Occ S	Leading Corporate Sustainability	Rosina Watson	16		10	Y	Not running			40	ICW	100					
12		MXM/MKT Occ S	Strategic Marketing	Emma Macdonald	16		10	Y	Not running			40	ICW	100					

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
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13		MXM/SOM Occ S	Strategic Operations Management	Abdelkader Aoufi	16		10	Y	Not running			40	ICW	100					
14		M-M/DVSC Occ S	Driving Value through the Supply Chain	Mike Bernon	16		10	Y	Not running			40	ICW	100					
15		M-M/SHR Occ S	Strategic Human Resource Management in the 21st Century	Frank Horwitz	16		10	Y	Not running			40	ICW	100					
16		MXM/ECBS Occ S	Economics and Business Strategy	Catarina Figueira	16		10	Y	Not running			40	GCW	100					
17		M-M/LSO Occ S	Leading Sales and Customer Management Organisations	Javier Marcos	16		10	Y	09/11/20	09/11/20	11/11/20	40	ICW	100				21/12/20	
18		M-M/-MSI Occ S	Managing Strategic Innovation	Imran Zawwar	16		10	Y	Not running			40	ICW	100				09/03/20	
19		MXS-CCC Occ S	Customer Centric	Stan Maklan	16		10	Y	11/06/21	11/006/21	13/06/21	40	GCW	100				06/09/21	
20		MXS/RMS Occ S	Research Methods	David Denyer/Jane Trinder	16	15	0	Y	13/01/20	13/01/20	01/11/21	N/A	AO					N/A	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
21		MXS/THS Occ S	Thesis	Various supervisors	0		80	Y	01/11/21	01/11/21	24/07/22	50	THESIS	100				24/07/22	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
MXM/MKT	Strategic Marketing	Executive MBA	Business and Strategic Leadership
MXM/SOM	Strategic Operations Management	Executive MBA	Business and Strategic Leadership
M-M/DVSC	Driving Value through the Supply Chain	FT MBA	Executive MBA; Business and Strategic Leadership
M-M/SHR	Strategic Human Resource Management in the 21st Century	MBA	Executive MBA; Business and Strategic Leadership
M-M/MSI	Managing Strategic Innovation	MBA	Executive MBA; Business and Strategic Leadership
MXM/ECBS	Economics and Business Strategy	Executive MBA	Business and Strategic Leadership
M-M/LSO	Leading Sales and Customer Management Organisations	MBA	Executive MBA; Business and Strategic Leadership
M-T/LCS	Leading Corporate Sustainability	MiM	MCS, BSL, ELSCM

8. How are the ILOs assessed?

The following assessment types are utilised:

Taught module assessment on the course is predominantly through assignment. Assignments are set by individual module co-ordinators for the certificate and diploma subjects. The thesis is based 100% on the written submission which falls within the University guidelines that an MSc thesis should be >30% of the overall assessment weighting. This weighting will also impress on students the importance of the written thesis and reinforce their understanding that a poor thesis (R&R or failing) cannot be compensated for by an exceptional presentation.

The use of assignments as opposed to exams which require the application of knowledge to their own organisation produces more tangible benefits inside the organisation, and helps to ensure they have moved from knowledge accumulation to learning. The move to splitting assessments for personal development and the group project is to support the need to learn throughout these subjects and ensure application of learning to themselves or the group theme.

Assessment and ILO Mapping

	PgCert				PgDip				MSc		
Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
1			X				X	X			
2	X				X						
3	X	X			X						
4	X	X	X		X			X			

	PgCert				PgDip				MSc		
Award ILOs Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11
5		X	X	X	X	X	X	X	X	X	
6		X	X			X		X			
7	X	X	X	X	X	X					
8		X			X	X	X				
9			X	X	X	X	X	X	X	X	
10	X	X			X	X			X		
11	X				X		X				
12	X				X						
13	X				X						
14	X				X						
15	X				X				X		
16	X				X						
17	X			X	X						
18									X	X	
19	X	X		X	X		X		X	X	
20									X	X	
21									X	X	X

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	**Modules Covered**	**Assessment**	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality

Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

This is a closed corporate course with all participants directly sponsored onto the programme by their organisation. These participants have been selected for capability and leadership development and on completing the course can expect to be promoted to significant and/or senior roles.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: May 2020

1. What is the course?

Course information

Course Title	Computational and Software Techniques in Engineering with options in: Computational Engineering Design (CED) Computational Intelligence for Data Analytics (CIDA) Computer and Machine Vision (CMV) Software Engineering for Technical Computing (SETC)
Course code	MSCSTFTC, MSCSTPTC, MSSTBFTC (ESTIA variant), PDCSTFTC, PDCSTPTC, PDSTBFTC, PCCSTFTC, PCCSTPTC, PCSTBFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield and Biarritz, France (in respect of the ESTIA variant)
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Computational Engineering Sciences
Course Director	Dr Irene Moulitsas
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

as an open and/or closed course?	
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - up to three years
Course Start Month(s)	September

Institutions delivering the course

This course is delivered by The School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Computational Engineering Sciences where the research interests include:

- Computer Vision
- Vibroacoustics for Condition Monitoring
- Computational Engineering
- High Performance Computing
- Scientific Computing
- Computational Fluid Dynamics

Cranfield University interacts with the following institutions and in the following ways:

A variant of the course is delivered partly at ESTIA, Institute of Technology, an engineering school based in Biarritz, France. ESTIA (École Supérieure des Technologies Industrielles Avancées) has been sending students to study the Cranfield MSc in Computational and Software Techniques in Engineering since 1989. The ESTIA variant allocates 10 credits for the 'C++ Programming' module as opposed to Attendance Only the Cranfield option. This is balanced by ESTIA students not taking the Management for Technology module. Some modules of the course are delivered on-site by Cranfield staff. Students can elect to undertake an individual project locally.

The course has a strong association with a number of EU academic institutions that regularly supply students onto the MSc through the European Partnership Programme. Students follow the course as part of a double degree arrangement with their home institution whereby the final year of their five year programme is replaced with the MSc here at Cranfield. Successful completion of the MSc allows the student to graduate from both Universities. The strongest of these associations is with ESTIA. They send typically 30 students each year onto the MSc. ESTIA students can only register for the CED and CMV options.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

The university has applied for this course to accredited by the Engineering Council and at the time of publication, a decision has yet to be made. Accreditation is undertaken by one or more of the professional engineering institutions (PEIs) that are licensed by the Engineering Council, to its standards set out in UK-SPEC. A degree may be accredited by more than one PEI, particularly where it spans several engineering disciplines. You can check the accreditation status of this, or any other degree programme, at https://www.engc.org.uk/acad.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Equip graduates with the knowledge, understanding and skills required to enable them to meet the demand of an evolving workplace that requires highly qualified engineers possessing core software engineering skills together with competency in mathematical analysis techniques.
- Develop suitably trained and qualified engineers, scientists and mathematicians enabling them to apply the analytical, computational and software skills to the solution of practical engineering IT problems in industrial, commercial and governmental organisations.

More specifically, for each of the options of this course:

- Computational Engineering Design

Computational engineering design plays a fundamental role in the design and manufacture of a diverse range of products for global industries, including automotive, aerospace, oil, defence and health. This option is ideal for those with engineering and applied mathematical backgrounds, and those with mathematical and computational sciences training, who wish to develop and complement their existing skill sets. You will gain programming techniques and practical skills necessary to develop and employ core CAD and CAE solution software relevant to design and physical simulations in diverse industrial settings.

- Computational Intelligence for Data Analytics

Computationally intelligent data handling algorithms are crucial in a wide range of sectors that require fast and automated decision-making. These industries typically include financial, manufacturing, aerospace, automotive and defence. The option aim is to develop a solid base of computer science skills and focused expertise, necessary to develop fast algorithms capable of dealing with a range of complex problems where intelligent decision-making or future predictions are based on understanding of data collections. You will focus on the enabling technologies aspects of the study area, namely high performance and cloud computing and algorithm development related to machine learning and data analytics.

- Computer and Machine Vision

Computer and Machine Vision (CMV) systems are playing a vital role in today's digital economy. The flow of data from an ever-increasing network of cameras, sensors, devices and autonomous systems require intelligent vision and signal analysis techniques for decision making. This option focuses on aerial and robotic vision-based systems and covers the theory and application of signal processing and CMV algorithms for the analysis, interpretation and processing of data. You will gain programming experience and practical skills in computer vision software and further apply them in fields such as computer vision, robotics, autonomous vehicles, condition monitoring, medical devices, remote sensing and data visualisation.

- Software Engineering for Technical Computing

With today's sophisticated and powerful computer environments, the techniques needed to develop and produce the software to run on these systems are themselves becoming increasingly complex. This option provides a unique insight into the development of computer applications across modern computing environments, from multi-core CPUs to specialist GPUs to cloud computing. The core modules provide the basis of this course and act as a starting point for specialist modules to then be introduced. The various computational technology platforms are covered, giving you both theoretical and hands-on experience of programming.

This programme is intended for the following range of students:

- UK students with an honours degree in Engineering, Computer Science, Mathematics, Physics.
- Mature students with at least 5 years relevant industrial experience.
- Students studying at recognised EU Universities with at least 4 years of relevant academic study.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically evaluate the selection of computer languages, software tools, and technologies

ILO 2. Apply appropriate computer languages, software tools, and technologies to help solve practical problems of a computational nature in engineering solutions.

ILO 3. Create original software solutions to engineering problems using industry standard libraries, packages, and software engineering tools.

ILO 4. Compose written reports and/or prepare and deliver oral presentations to effectively communicate proposals, solutions, technical developments, and results.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Plan and implement assigned projects under time pressure, and undertake self-directed learning when necessary.

ILO 6. Assemble a body of relevant technical literature and discuss and evaluate each work with respect to a technical problem.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO7. Propose, plan, and implement an independent research project on a relevant technical topic, with limited supervision.

ILO 8. Critically evaluate project results, discuss findings, and relate their contribution to other works in the field.

4. How is the course taught?

Students will be supported in their learning and personal development by:

- A comprehensive set of carefully prepared lecture notes that form the basis for the teaching. This is perhaps the most valuable resource and reference point for the student starting a new module. Secondly, many lectures are given in conjunction with some form of programming. Students are encouraged, given time and practical assistance to develop their software skills.
  The library resources and search facilities here at Cranfield. A thorough introduction to these resources and demonstrations of information retrieval skills is provided at the beginning of the course. The library facilities are extensive and there is a good representative selection of, physical and online, books and periodicals relevant to the course. Where an article, book or periodical is not available, it can usually be obtained elsewhere via inter-library loans. Books, software and other resources are purchased by the group when it is necessary for one of the projects.

- A programme of seminars given by external and internal speakers is also provided for the Cranfield based students. These reflect the course, sponsoring companies and associated research carried out in the group enabling the students to get an appreciation of related work going on in industry and other universities.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 7. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Computational Engineering Design option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
60 credits from modules 2a, 3 – 6, 7a, 8, 9	60
ELECTIVE MODULES:	
None	
TOTAL:	60

Computational Engineering Design option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	
60 credits from modules 1b, 2b, 4 – 6. 7b, 8, 9	60
ELECTIVE MODULES:	
None	
TOTAL:	60

Computational Intelligence for Data Analytics option

Description	Credits
COMPULSORY MODULES:	
60 credits from modules 3, 17, 18, 19, 23-26	60
ELECTIVE MODULES:	
None	
TOTAL:	60

Computer and Machine Vision option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
60 credits from modules 2a, 3, 4, 11-15	60
ELECTIVE MODULES:	

None	
TOTAL:	60

Computer and Machine Vision option, based at ESTIA

Description	**Credits**
COMPULSORY MODULES:	
60 credits from modules 1b, 2b, 4, 11 - 15	60
ELECTIVE MODULES:	
None	
TOTAL:	60

Software Engineering for Technical Computing option

Description	**Credits**
COMPULSORY MODULES:	
60 credits from modules 2a, 3, 4 , 17 – 21	60
ELECTIVE MODULES:	
None	
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules and group project as detailed below:

Computational Engineering Design option, based at Cranfield

Description	**Credits**
COMPULSORY MODULES:	
2a, 3 – 6, 7a, 8, 9 Group Project 10	80 40
ELECTIVE MODULES:	
None	
TOTAL:	120

Computational Engineering Design option, based at ESTIA

Description	**Credits**
COMPULSORY MODULES:	
1b, 2b, 4 – 6, 7b, 8, 9 Group Project 10	80 40
ELECTIVE MODULES:	
None	

TOTAL:	120

Computational Intelligence for Data Analytics option

Description	Credits
COMPULSORY MODULES:	
3, 17, 18, 19, 23-26 Group project 27	80 40
ELECTIVE MODULES:	
None	
TOTAL:	120

Computer and Machine Vision option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
2a, 3, 4, 11-15 Group Project 16	80 40
ELECTIVE MODULES:	
None	
TOTAL:	120

Computer and Machine Vision option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	
1b, 2b, 4, 11 - 15 Group Project 16	80 40
ELECTIVE MODULES:	
None	
TOTAL:	120

Software Engineering for Technical Computing option

Description	Credits
COMPULSORY MODULES:	
2a, 3, 4 , 17 – 21 Group Project 22	80 40
ELECTIVE MODULES:	
None	
TOTAL:	120

C. MSc

Students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Computational Engineering Design option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
1a, 2a, 3 – 6, 7a, 8, 9 Group Project 10 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Computational Engineering Design option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	
1b, 2b, 4 – 6, 7b, 8, 9 Group Project 10 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Computational Intelligence for Data Analytics option

Description	Credits
COMPULSORY MODULES:	
1a, 3, 17, 18, 19, 23-26 Group Project 27 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Computer and Machine Vision option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
1a, 2a, 3, 4, 11-15 Group Project 16 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Computer and Machine Vision option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	
1b, 2b, 4, 11 - 15 Group Project 16 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Software Engineering for Technical Computing option

Description	Credits
COMPULSORY MODULES:	
1a, 2a, 3, 4 , 17 – 21 Group Project 22 Individual Research Project 28	80 40 80
ELECTIVE MODULES:	
None	
TOTAL:	200

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[3] [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  a. if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  b. if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will

[3] For students who were registered before 1 August 2015, the requirement to obtain a minimum mark for a taught assessment will not apply for taught assessment taken before 31 August 2015 (unless the assessment was designated as a "key assessment" under the previous Assessment Rules).

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);

c. it is <u>not</u> permissible for you to fail an elective module and then proceed to take a different elective module in its place.

- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in September and are expected to complete the course within 11 calendar months. ESTIA students register for the course in September and are expected to complete the course within 11 calendar months.

This course is also offered on a part-time basis. Students would instead take two to three years to complete the MSc.

Each module is taught over a period of one or two weeks. Practical work forms an important part of the teaching and so a significant amount of time is devoted to hands-on sessions with a software package or development environment. This also facilitates independent learning on the part of the student.

7. Course Level Assessment Strategy[5]

The following assessment types are utilised:

The course uses a range of assessment types that are challenging and enable the students to develop and demonstrate a range of skills. Students can expect to have written examinations, individual and group coursework assessments, individual and group projects, and finally individual and group presentations. This approach has been adopted in order to provide the student with a balanced mix of theory, application and development of soft skills.

Since in this course practical application is key to development of understanding and skills acquisition, in all modules students will engage with an interactive learning activity which incorporates formative feedback. The majority of subjects are assessed by a combination of practical assignment and written report. The reports are of varying lengths, recognising that writing articles to a short length can be more challenging for some.

While the majority of the assignments are assessing individual work, a small number of coursework is carried out in pairs, to allow the students to become comfortable with working effectively in a team, undertaking different roles and responsibilities. As part of the formative assessment of group work, each pair will provide a peer review of their performance and contribution.

When a subject has large theory content, where recalling facts to support judgement is crucial, it is assessed by exam.

Students have opportunities to develop their communication skills, as they are required to give group and individual presentations. Formative feedback from members of staff, as well as peer review feedback amongst students, is given immediately after the resentations.

The group project that follows the taught component will assess the ability to apply the acquired knowledge from the taught modules to create and execute a research programme in a larger, multi-

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

disciplinary team working environment, as well as the ability to evaluate results and present the research outcome.

Further application of the knowledge and its understanding, the ability to assemble a technical literature review and plan and implement a research project, is also assessed through the individual research project. Students are generally expected to be more self-directed in their learning during this research project and guidance will be provided through face to face or electronically enabled (via teleconferencing) contact with the supervision team.

Course modules

The following modules outline all parts of the programme leading to MSc Computational & Software Techniques in Engineering . Other awards associated with the course include some or all of these modules.

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments[10] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
1a		N-CST-CPPAO	C++ Programming (AO)	Dr Irene Moulitsas	32		0	N	29/09/20	29/09/20	16/10/20		AO					N/A	At the next available opportunity which may not be until

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[9] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[10] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[11] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[12] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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																			the course runs the following year
1b		N-CST-CPPI	C++ Programming (Integrated)	Dr Irene Moulitsas	32		10	Y	29/09/20	29/09/20	16/10/20	40	GCW Integrated assessment with N-CST-CMI	100				FT 07/12/20 PT 21/12/20	At the next available opportunity which may not be until the course runs the following year
2a		N-CST-CM	Computational Methods	Dr Irene Moulitsas	32		10	Y	29/09/20	29/09/20	16/10/20	40	GCW	100				FT 07/12/20 PT 21/12/20	At the next available opportunity which may not be until the course runs the following year
2b		N-CST-CMI	Computational Methods (Integrated)	Dr Irene Moulitsas	32		10	N	29/09/20	29/09/20	16/10/20	40	GCW Integrated assess	100				FT 07/12/20 PT 21/12/20	At the next available opportunity which may not be until

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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													Independent Assessment		Multi-part Assessment			Submission dates	
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													ment with N-CST-CPPI						the course runs the following year
3		G-MTI Occ B20	Management for Technology	Dr Richard Adams	27		10	Y	11/01/21	15/01/21	01/21	40	EX	100				0X/21	23/03/18
4		N-CST-VIS	Visualisation *Occ B (ESTIA)*	Dr Peter Sherar	35		10	N	Occ A 08/02/21 ESTIA Occ B– 15/02/21	Occ A 08/02/21 ESTIA Occ B 15/02/21	Occ A 12/02/21 ESTIA Occ B 19/02/21	40 40	ICW ICW	100 100				Occ A FT12/ 04/21 PT 26/04/21 ESTIA Occ B 06/04/21	At the next available opportunity which may not be until the course runs the following year
5		N-CST-CSM04	Geometric Modelling and Design *Occ B ESTIA*	Dr Peter Sherar	35		10	N	18/01/21 12/10/2020	18/01/21 12/10/2020	28/01/21 16/10/2020	40	ICW	100				FT 11/01/21 PT 24/01/21 25/01/21 ESTIA Occ B	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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6		N-CST-DEPD	Digital Engineering and Product Design *Occ B ESTIA*	Dr Peter Sherar	35		10	Y	Occ A 02/11/20 ESTIA Occ B 21/10/20	Occ A 02/11/20 ESTIA OccB 21/10/20	Occ A 12/11/20 ESTIA Occ B 30/10/20	40 40	ICW ICW	100 100				FT Occ A 04/01/21 PT Occ A 18/01/21 ESTIA Occ B 14/12/20	At the next available opportunity which may not be until the course runs the following year
7a		N-CST-CES	Computational Engineering Structures	DrIman Dayyani	35		10	N	23/11/20	23/11/20	04/12/20	40	EX	100				Exam Week 5	At the next available opportunity which may not be until the course runs the following year
7b		N-CST-CESE	Computational Engineering Structures ESTIA	Dr Karl Jenkins	35		10	N	25/01/21	25/01/21	05/02/21	40	ICW	100				ESTIA 29/03/21	At the next available opportunity which may not be until the course runs the following

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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																			year
8		N-CST-CE	Computational Engineering (Fluids) *Occ B (ESTIA)*	Dr Karl Jenkins	35		10	Y	Occ A 0102/21 ESTIA Occ B 08//02/21	Occ A 01/02/21 ESTIA Occ B 08/02/21	Occ A 05/02/21 ESTIA Occ B 12/02/21	40 *40*	ICW *ICW*	100 *100*				Occ A FT 06/04/21 PT 19/04/21 ESTIA Occ B 12/04/21	At the next available opportunity which may not be until the course runs the following year
9		N-CST-COD	Computational Optimisation Design	Dr Tom Teschner	35		10	Y	21/10/20	21/10/20	30/10/20	40	ICW	100				FT 14/12/20 PT 23/12/21	At the next available opportunity which may not be until the course runs the following year
10		N-CST-	Applications of	Dr Karl Jenkins	21		40	N	Occ A 01/03/2	Occ A 01/03/2	Occ A 05/03/2	50						Occ A FT & PT	At the next available

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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		GPCED	Computational Engineering Design (Group Project) *Occ B (ESTIA)*						1 ESTIA Occ B 25/01/21	1 ESTIA Occ B 25/01//21	1 ESTIA Occ B 05/02/21				100 MULTI 100 MULTI	GCW GPRES RP GCW GPRES RP	50 30 20 50 30 20	05/05/21 11/05/21 ESTIA Occ B 17/05/21 21/05/21 21/05/21	opportunity which may not be until the course runs the following year
11		N-CST-SA04	Signal Analysis	Dr Zeeshan Rana	35		10	N	21/10/20	21/10/20	30/10/20	40	ICW	100				FT 13/12/20 PT 04/01/21	At the next available opportunity which may not be until the course runs the following year
12		N-CST-DSP	Digital Signal Processing	Dr Yifan Zhao	35		10	N	09/11/20	09/11//20	13/11/20	40	ICW	100				FT 05/01/21 PT 18/01/21	At the next available opportuni

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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																			ty which may not be until the course runs the following year
13		N-CST-DIP1	Image Processing and Analysis	Dr Yifan Zhao	35		10	N	07/12/20	07/1211/20	17/12/20	40	ICW	100				FT 15/02//21 PT 01/03//21	At the next available opportunity which may not be until the course runs the following year
14		N-CST-DIP2	Computer Vision	Dr Zeeshan Rana	35		10	N	04/01/21	04/01/21	08/01/21	40	ICW	100				FT 08/03/21 PT 22/03/21	At the next available opportunity which may not be until

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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																			the course runs the following year
15		N-CST-ML	Machine Learning	Dr Irene Moulitsas	35		10	N	01/02/21	01/02/21	05/02/21	40	ICW	100				FT 29/03/21 PT 12/04//21	At the next available opportunity which may not be until the course runs the following year
16		N-CST-ADSIP	Applications of Computer Vision (Group Project)	Dr Zeeshan Rana	21		40	N	Occ A *01/03/21*	Occ A 01/03/21	Occ A 05/03/21	50			100 MULTI	GCW GPRES RP	50 30 20	Occ A FT & PT 11/05/21 *05/05/21* *11/05/21*	At the next available opportunity which may not be until the course runs the following year

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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17		N-CST-SSPP	Small-scale Parallel Programming	Dr Salvatore Filippone	35		10	N	05/02/21	15/02//21	19/02//21	40	ICW	100				FT 19/04/21 PT 04/05//21	At the next available opportunity which may not be until the course runs the following year
18		N-CST-CC	Cloud Computing	Dr Jun Li	35		10	N	18/01/21	18/01/21	28/01//21	40	ICW	100				FT 22/02/21 PT 18/03/21	At the next available opportunity which may not be until the course runs the following year
19		N-CST-HPTC	High Performance Technical Computing	Dr Irene Moulitsas	35		10	N	07/12//20	07/12//20	17/12//20	40	ICW	100				FT 08/02//21 PT 22/02/21	At the next available opportunity which

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
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																			may not be until the course runs the following year
20		N-CST-RASD	Requirements Analysis and System Design	Dr Jun Li	35		10	N	26/10/20	26/10/20	02/11//20	40	Integrated Assessment GCW	100				FT 05/01/21 PT 18/01/21	At the next available opportunity which may not be until the course runs the following year
21		N-CST-STQA	Software Testing and Quality Assurance	Dr Jun Li	35		10	N	03/11/20	03/11//20	13/11/20								At the next available opportunity which may not be until the course runs the following

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

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									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments [10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
																			year
22		N-CST-GPHEC	Applications in Practical High-End Computing (Group Project)	Dr Irene Moulitsas	21		40	N	01/03/21	01/03/21	05/03/21	50			100 MULTI	GCW GPRES RP	50 30 20	Occ A FT & PT 11/05/21 *05/05/21*	At the next available opportunity which may not be until the course runs the following year
23		N-CST-AJAP NEW	Advanced Java and Advanced Python	Dr Peter Sherar	35		10	N	20/10/2020	20/10/2020	30/10/2020	40	ICW	100				Occ A FT & PT 13/12/2020 05/01/2021	At the next available opportunity which may not be until the course runs the following year
24		N-CST	Machine Learning and	Dr Peter Sherar	35		10	N	10/11/2020	10/11/2020	20/11/2020	40	GCW	100				Occ A FT & PT	At the next available

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments [10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
		- MLBD NEW	Big Data															11/01/2021 25/01/2021	opportunity which may not be until the course runs the following year
25		N-CST-AI NEW	Artificial Intelligence	Dr Jun Li	35		10	N	01/02/2021	01/02/2021	05/02/2021	40	ICW	100				Occ A FT & PT 29/03/2021 12/04/2021	At the next available opportunity which may not be until the course runs the following year
26		I-MNU-A1048	Internet of Things	Dr Christos Emmanoulidis	35		10	Y	23/11/20	23/11/20	27/11/20	40	ICW	100				Occ A FT & PT 08/02/2021 23/02/2021	At the next available opportunity which may not be until the course

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number		Module code	Title	Module Leader	Contact hours[6]	Total hours delivered by Visiting Lecturers[7]	Credits	Is the module shared? Y/N	Calendar			Assessment							
													Independent Assessment		Multi-part Assessment			Submission dates	
									Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[8] - 40% or 50%	Type of Assessment	Weighting within module[9] (%) of Independent assessments	Weighting within module of multi-part assessments [10](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[11]	Assessment Submission and/or exam date[12]	Assessment / Exam Retake date
																			runs the following year
27		N-CST-GPAPCINEW	Applications in Computational Intelligence (Group Project)	Dr Jun Li	21		40		01/03/2021	01/03/2021	05/03/2021	50			100 MULTI	GCW GPRES RP	50 30 20	Occ A FT & PT 11/05/21 *05/05/21*	At the next available opportunity which may not be until the course runs the following year
28		N-CST-THESIS80	Individual Research Project	Dr Irene Moulitsas	20		80	N	06/04/21	06/04/21	24/08/21	50 50	THESIS IPRES	90 10				FT& PT19/08/2021 PT20/8/20 FT & PT	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
G-MTI	Management for Technology	MSc in Thermal Power	Advanced Mechanical Engineering Advanced Chemical Engineering (General option and Biorefining option) Energy Informatics Energy Systems and Thermal Processes (Cranfield and Muscat) Offshore Engineering (Engineering option and Management option) Process Systems Engineering (Cranfield and Muscat) Renewable Energy Marine Structures (EngD)
N-CST-CPPI	C++ Programming (Integrated)	Computational and Software Techniques in Engineering	Aerospace Computational Engineering
N-CST-CMI	Computational Methods (Integrated)	Computational and Software Techniques in Engineering	Aerospace Computational Engineering
N-CST-CES	Computational Engineering Structures	Computational and Software Techniques in Engineering	Shared teaching with N-ALS-FEM
I-MNU-A1048	Internet of Things	Engineering and Management of Manufacturing Systems	

8. How are the ILOs assessed?

The course uses a range of formative and summative assessment types that are challenging and enable the students to develop and demonstrate a range of skills.

For the taught component students can expect to have written examinations, individual and group coursework assessments, as well as individual and group presentations.

The group project is assessed with a group coursework report, collaborative software development, a group oral and poster presentation, as well as peer review to assess personal contribution to course work.

The individual research project is assessed by a thesis, a technical oral presentation and a poster presentation.

This approach has been adopted in order to provide the student with a balanced mix of theory, practical application to a problem and development of skills to present technical results in a written or oral forms. All tasks are undertaken both on an individual level and through team work to prepare the students to work effectively independently as well as in a team.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. PGCert

The Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / **Module No.**	ILO1	ILO2	ILO3	ILO4
01a	AO	AO	AO	AO
01b	GCW	GCW	GCW	GCW
02a	GCW	GCW	GCW	GCW
02b	GCW	GCW	GCW	GCW
03				EX
04	ICW	ICW	ICW	ICW
05	ICW	ICW	ICW	ICW
06	ICW	ICW	ICW	ICW
07a	EX	EX	EX	EX
07b	ICW	ICW	ICW	ICW
08	ICW	ICW	ICW	ICW
09	ICW	ICW	ICW	ICW
11				ICW
12		ICW	ICW	ICW
13		ICW	ICW	
14	ICW	ICW	ICW	ICW
15	ICW	ICW	ICW	ICW
17	ICW	ICW	ICW	ICW
18	ICW	ICW	ICW	ICW
19	ICW	ICW	ICW	ICW
20	GCW	GCW	GCW	GCW
21	GCW	GCW	GCW	GCW
23	ICW	ICW	ICW	ICW
24	GCW	GCW	GCW	GCW

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4
25	ICW	ICW	ICW	ICW
26	ICW	ICW	ICW	ICW

B. PGDip

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO5	ILO6
10	GCW GPRES RP	GCW GPRES
16	GCW GPRES RP	GCW GPRES
22	GCW GPRES RP	GCW GPRES
27	GCW GPRES RP	GCW GPRES

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO7	ILO8
28	THESIS	THESIS IPRES

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
Two modules with an integrated assessment	C++ Programming (Integrated) 1b Computational Methods (Integrated) 2b	GCW	100

Two modules with a combined assessment	Requirements Analysis and System Design (20) Software Testing and Quality Assurance (21)	GCW	100

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the

Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

This Masters course in 'Computational and Software Techniques in Engineering', with its blend of skills-based and subject-specific material equips students with the generic hands-on skills and up-to-date knowledge adaptable to the wide variety of applications in the general field of computational engineering.

Typically students seek employment in the engineering software market. Enquiries regarding availability of potential employees are received from many quarters, both in the EU and elsewhere. There is considerable demand for personnel with expertise in engineering software development and for those who have strong technical programming skills in industry standard languages and tools. Graduates of the course, in demand by CAD/CAE vendors, commercial engineering software developers, automotive, telecommunications, medical and other industries and research organisations, have been particularly successful in finding long-term employment.

Some students may go on to register for PhD degrees, many, on the basis of their MSc research project. Thesis topics are most often supplied by individual companies on in-company problems with a view to employment after graduation - an approach that is being actively encouraged by a growing number of industries.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: May 2020

1. What is the course?

Course information

Course Title	MSc in Computational Fluid Dynamics
Course code	MSCFDFTC, MSCFDPTC, PDCFDFTC, PCCFDFTC
Academic Year	2020/2021
Valid entry routes	MSc
Additional exit routes	PgDip & PgCert
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Computational Engineering Sciences
Course Director	Dr Zeeshan Rana
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not Applicable
Registration Period(s) available	Full-time MSc - one year, Part-time MSc - three years,
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Aerospace Theme, Computational Engineering Sciences Centre, where the research interests include:

- Fluid dynamics of single phase, multi-phase and multi-species flows.
- Steady and unsteady aerodynamics.
- Transition and turbulence.
- Heat transfer.
- Numerical methods development.
- Scientific and high performance computing.
- Computational fluid dynamics with the applications in aerospace, automotive, environmental, energy, micro and nanotechnology, nuclear, bio-medical, chemical and defence sectors.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is accredited formally by the Institution of Mechanical Engineers (IMechE) until September 2020 and the Royal Aeronautical Society (RAeS) until September 2020.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- Provide a comprehensive training programme in Computational Fluid Dynamics (CFD) which will enhance the skills of the graduate student through a detailed introduction to the fundamentals of CFD together with an insight into the applications of CFD.
- Provide a unique opportunity for cross-disciplinary education and knowledge transfer in the computational fluids engineering via integration of a very broad range of applications into course curriculum.
- Produce graduates capable of solving computational fluid problems in a broad range of engineering areas, delivering high standard of computational expertise to a diverse range of employers.
- Provide a CPD opportunity through the part-time course option for qualified engineers wishing to extend their knowledge of CFD or incorporate CFD into their practice.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) are provided for students who wish to access only parts of the course.

This programme is intended for the following range of students:

- Recent graduates wishing to extend their knowledge and skills in the above areas.

- Qualified engineers wishing to apply their skills in new areas.
- Qualified engineers working with CFD in a particular area wishing to extend their knowledge and enhance their practice by knowledge transfer from different application areas.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Formulate the governing equations of fluid mechanics, evaluate their mathematical properties and differentiate their formulations for steady and unsteady, compressible and incompressible, inviscid and viscous flows.

ILO 2. Construct numerical schemes for model partial differential equations and assess the principles of numerical analysis, stability, approximation accuracy, convergence properties through the computed numerical solution.

ILO 3. Assess different state-of-the-art CFD methods as used in engineering practice and research and development for incompressible and compressible flows.

ILO 4. Evaluate the limitations of methods and techniques for the simulation of turbulent and transitional flows and thus build appropriate modelling frameworks for engineering-scale applications.

ILO 5. Measure the potential sources of, and differentiate between, error and uncertainty in numerical simulations. Manage software and computer tools and set-up error and uncertainty quantification strategies. Systematically and consistently implement the strategies in order to ensure credibility of the CFD simulation process.

ILO 6. Construct grids for practical CFD applications, systematically assess their quality, robustness and efficiency with respect to the CFD solver. Evaluate the CFD results by using various visualisation and post-processing software and gain fruitful insight of the flow properties.

B. Postgraduate Diploma

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 7. Create grids, numerically solve the governing equation on the grid and post process the results using various commercial CFD software packages for practical engineering applications.

ILO 8. Manage the planning, conducting and reporting of a CFD project for practical scientific and engineering fluid flow problems, carry out comprehensive research literature survey and systematically analyse one or more aspects of Computational Fluid Dynamics.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 9. Prepare a framework of research and application, where the challenges associated with a particular topic of research are critically evaluated with novelty arising from the taught material and through the stat-of-the-art approaches found in the literature of the corresponding subject.

4. How is the course taught?

Students will be supported in their learning and personal development by:

The course material is delivered through a combination of lectures, tutorials and hands-on lab sessions. Where possible lectures feature a strong interactive element. In addition, several modules have a guest industrial speaker who specialises in that field in industry.

Assignments should be noted separately in the description of the course teaching methods. The assessment the students are required to complete i.e.8 individual assignments, 1 group project and 1 individual research project (for an MSc) are used not only as means of summative assessment but also as means of formative assessment guiding the students through various aspects of Computational Fluid Dynamics via the application of techniques learned to practical problems.

The learning support builds on the standard mechanisms provided by the University including library facilities, specialised IT provision (Linux workstations) etc. The course uses the Blackboard virtual learning environment with all materials delivered in electronic form and electronic communication tools (e.g. forums) used to enhance the discussion of the course materials.

In addition to standard learning support facilities the course utilises a number of specialised facilities, namely:

- A dedicated HPC (High Performance Computing) cluster used in the taught component and thesis work
- NFLC Jetstream plane used in taught component to illustrate aircraft manoeuvres
- Windtunnel facilities used for demonstrations
- Virtual Reality computer lab for the visualisation of simulation data.

Group project and computer lab sessions are designed to enhance transferable skills related to teamwork and communication (written and verbal). Through the group project the student will develop interpersonal skills, necessary to develop solutions of industrial type problems. The group project will be supported by several activities i.e. lectures dedicated to the applications of CFD science and engineering, specialist computer software demonstrations and training, industrial talks and lectures, presentation of project management with role-playing activities. These activities will relate to a thematic topic of the group project e.g. aerospace, automotive and energy. For students that cannot efficiently performed group activities i.e. part time students; they have the option of taking the project dissertation instead of the group project. The project dissertation is completed individually.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 8. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 3, 4, 7	30
ELECTIVE MODULES:	
30 credits from 1, 2, 5, 6	30

TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-7 Module 9 (Group Project) or Module 11 (Project Dissertation)	80 40
ELECTIVE MODULES:	
N/A	
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-8 Module 9 (Group Project) or Module 11 (Project Dissertation) Module 10 (Individual Research Project)	80 40 80
ELECTIVE MODULES:	
N/A	
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

The course starts with the induction week where the students are introduced to the teaching team, fundamentals of CFD software, programming and HPC.

Full-time students register for the course in October and are expected to complete the course within 12 calendar months. The taught component runs from October until February. Between February and April the group project and related activities take place. The individual research project runs from April/May until end of August.

Part-time students register for the course in October and are expected to complete the course within 3 years selecting the modules to be taken each year in consultation with the Course Director. Part-time students have the option to either take the group project or the project dissertation.

Allocation of group projects is performed in December/January, Individual research project topics are provided in January and allocations is completed within February.

7. Course Level Assessment Strategy[4]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. Majority of the taught modules will be assessing skills and knowledge using Individual Course Works (ICWs). The intention is to examine students' comprehension of theoretical knowledge and their ability in applying practical skills in problem solving.

The group project (GPs) will provide students the opportunity to work within a team of engineers to design and develop solution for a particular problem. It will assess the ability to create and execute a research programme in a team working environment as well as the ability to evaluate results and present the research outcome. Effective project management is key part of the group project. Part- time students who are unable to complete the group project will undertake a project dissertation.

Further knowledge and application will be assessed by the individual research projects (IRPs). It will also assess as well as develop research skills in terms of the ability to assemble a technical literature review and the ability to plan and implement an independent research project.

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Course modules

The following modules outline all parts of the programme leading to **MSc.** Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	N-CFD-IFM	Introduction to Fluid Mechanics and Heat Transfer	Dr Laszlo Konozsy	20		10	N	05/10/20	05/10/20	09/10/20	40	ICW	100				FT 02/12/20 PT 16/12/20	At the next available opportunity which may not be until the course runs the following year
2	N-CFD-NMHPC	Numerical Methods and High Performance Computing	Dr Panagiotis Tsoutsanis	30		20	N	19/10/20	19/10/20	30/10/20	40	ICW	100				FT 27/01/21 PT 10/02/21	At the next available opportunity which may not be until the course runs the following year

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	N-CFD-GG	Grid Generation / CAD	Dr Tom Teschner	20		10	N	02/11/20	02/11/20	06/11/20	40	ICW	100				FT 03/02/21 PT 17/02/21	At the next available opportunity which may not be until the course runs the following year
4	N-CFD-DAPP	Data Analysis and Uncertainty	Dr Zeeshan Rana	20		10	N	16/11/20	16/11/20	20/11/20	40	ICW	100				FT 03/03/21 PT 17/03/21	At the next available opportunity which may not be until the course runs the following year
5	N-CFD-NMCF	Numerical Modelling for Compressible Flows	Dr Panagiotis Tsoutsanis	20		10	Y	18/01/21	18/01/21	22/01/21	40	ICW	100				FT 17/03/21 PT 31/03/21	At the next available opportunity which may not be until the course runs the following year
6	N-CFD-NMIF	Numerical Modelling for Incompressible Flows	Dr Laszlo Konozsy	20		10	Y	04/01/21	04/01/21	08/01/21	40	ICW	100				FT 10/02/21 PT 24/02/21	At the next available opportunity which may not be until the course runs the following year
7	N-CFD-CTM	Turbulence Modelling	Dr Zeeshan Rana	20		10	N	30/11/20	30/11/20	11/12/20	40	ICW	100				FT 10/02/21 PT 24/02/21	At the next available opportunity which may not be until the course runs the following year
8	N-CFD-REDAO	The Role of Experimental Data in CFD	Dr Zeeshan Rana	10		0	N	22/02/21	22/02/21	12/03/21	N/A	AO	N/A				N/A	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	N-CFD-GRPP	Group Project	Dr Zeeshan Rana	20		40	N	01/02/21	01/02/21	16/04/21	50			100 MULTI	GPROJ GPRES	85 15	09/04/21 16/04/21	At the next available opportunity which may not be until the course runs the following year
10	N-CFD-RP	Individual Research Project	Dr Zeeshan Rana	10		80	N	26/04/21	26/04/21	27/08/21	50			100 MULTI	THESIS OR	85 15	27/08/21 06/09/21	
11	N-CFD-D	Project Dissertation (for part time only)	Dr Zeeshan Rana	10		40	N	01/02/21	01/02/21	16/04/21	50			100 MULTI	IPROJ IPRES	85 15	19/05/21 05/05/21	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination ; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-CFD-NMCF	Numerical Modelling for Compressible Flows	Computational Fluid Dynamics	Aerospace Computational Engineering
N-CFD-NMIF	Numerical Modelling for Incompressible Flows	Computational Fluid Dynamics	Aerospace Computational Engineering

8. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students are assessed through 7 individual assignments, 1 group project and 1 individual research project.

This approach has been adopted in order to achieve a careful balance between the delivery of fundamental knowledge and CFD skills which is better assessed through a individual assignment and individual research thesis development of interpersonal skills within a “live” industrial problem and project based learning through the group project.

Majority of the assignments utilised in the course are based on practical CFD problems with emphasis on developing CFD skills and critical evaluation capability.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

The Postgraduate certificate has a total of 60 credits, this is offered as exit route, the student should be able to achieve 60 credits from module 1 to 7.

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6
1	ICW					
2		ICW				
3						ICW
4		ICW			ICW	
5	ICW	ICW	ICW			
6	ICW	ICW	ICW			
7	ICW	ICW	ICW	ICW		

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8
1	ICW							
2		ICW						
3						ICW		
4		ICW			ICW			
5	ICW	ICW	ICW					
6	ICW	ICW	ICW					
7	ICW	ICW	ICW	ICW				
9						GPROJ GPRES	GPROJ GPRES	GPROJ GPRES
11						IPROJ OR	IPROJ OR	IPROJ OR

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9
1	ICW								
2		ICW							
3						ICW			
4		ICW			ICW				
5	ICW	ICW	ICW						
6	ICW	ICW	ICW						
7	ICW	ICW	ICW	ICW					
9						GPROJ GPRES	GPROJ GPRES	GPROJ GPRES	
10						IPROJ OR	IPROJ OR	IPROJ OR	IPROJ OR
11						IPROJ OR	IPROJ OR	IPROJ OR	

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Based on feedback from 2014/15 graduates, 90% of our graduates are in a full-time employment in industry or academia within 6 months of the course completion. Our graduates are employed in a broad range of industries where computational expertise is required. Currently our graduates are employed among others by aerospace, computer hardware, automotive, measurement equipment, mining, process systems and engineering consultancy companies. A proportion of our graduates pursue careers in academia through further PhD studies.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: March 2020

1. What is the course?

Course information

Course Title	MSc in Connected and Autonomous Vehicle Engineering (Automotive)
Course code	MSCAVFTC; PDCAVFTC; PCCAVFTC
Academic Year	2020/21
Valid entry routes	MSc
Additional exit routes	PGDip, PGCert
Mode of delivery	Full-Time
Location(s)[1] of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering
Course Director	Dr Daniel Auger
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 (Masters)
Benchmark Statement(s)	Not applicable
Registration Period(s) available	Full-time MSc - one year
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing's Advanced Vehicle Centre where the research interests include:

Vehicle Electrification
Automated Driving
Advanced Control
Multi-domain Modelling
Novel Engine Technology
Vehicle Braking Systems

Cranfield University interacts with the following institutions and in the following ways:

N/A

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.*

The Advanced Vehicle Engineering Centre will seek to accredit the award of MSc in Connected and Autonomous Vehicle Engineering (Automotive) with the IMechE and/or IET by 2023. The course is not currently accredited by any professional bodies.

The course design has taken into account the Engineering Council's requirements for accredited courses, as indicated in the appendices. The course is not currently accredited by any professional bodies.

2. What are the aims of the course?

Cranfield University offers this course in order to:

1. Meet employer demand for postgraduate engineers who have strong applied analytical skills in areas relevant to connected and autonomous vehicle engineering to meet the challenging market and legislative demands for vehicle safety, performance and sustainability.
2. Provide a primary training and dissemination route for Cranfield University’s increasing research portfolio in the area of connected and autonomous vehicle technologies for road vehicles and civil off-highway applications.
3. Supply to the automotive industry and intelligent mobility sectors (and associated supply chain) high calibre post graduate engineers with the technical qualities, transferable skills and independent learning ability to make them effective in organisations that design and develop automotive products.

This programme is intended for the following range of students:

1. UK, EU or international students with a 1st class or 2nd class UK honours degree (or equivalent) in an engineering related discipline (including most maths or science disciplines).
2. Qualifying Double Degree students from the EU

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Connected & Autonomous Vehicle Engineering (Automotive)

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Evaluate the fundamental characteristics of a road vehicle in the context of connected and autonomous vehicle engineering.

ILO 2. Compose and evaluate business strategies within the context of connected and autonomous vehicle engineering.

ILO 3. Formulate, plan and organise work within a group design project relating to connected and autonomous vehicles.

ILO 4. Select, apply and optimize appropriate technologies to address design and/or business problems within a limited range of disciplines relevant to connected and autonomous vehicle engineering.

B. Postgraduate Diploma in Connected & Autonomous Vehicle Engineering (Automotive

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 5. Select and apply appropriate technologies from the realm of electronic systems engineering to address design and/or business problems in the context of connected and autonomous vehicle engineering.

ILO 6. Select and apply appropriate technologies from the realm of robotics and control to address design problems in the context of connected and autonomous vehicle engineering.

ILO 7. Assess and evaluate human factors, safety, ethics and regulatory challenges associated with connected and autonomous vehicle engineering

C. MSc in Connected & Autonomous Vehicle Engineering (Automotive)

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Propose, plan and implement a time-bound programme of individual advanced research or development to address a technical or operational requirement within the context of CAV engineering.

ILO 9. Apprise an audience of senior decision makers on the findings of a substantial body of work through a brief presentation and responsive discussion in the context of CAV engineering.

4. How is the course taught?

Students will be supported in their learning and personal development by:

Lectures, mixed-mode learning sessions, formative feedback, practicals, assignments (typically embodying problem-based learning), a group design project and an individual research project. Where appropriate, online learning, Virtual Learning Environments and Technology Enhanced Learning are used.

The course draws extensively from across the university, using the knowledge of staff from within three schools: SATM, CDS and SOM.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	N/A
Fundamentals of Road Vehicle Engineering (module 1) Technology Strategy and Business Models (module 10) Group Design Project (module 11)	10 10 20
ELECTIVE MODULES:	
Module 0 20 credits from remaining modules 2-9	0 20
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-10 Group Project (module 11)	100 20
ELECTIVE MODULES:	
Module 0	0
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-10	100
Group Project (module 11)	20
Thesis (module 12)	80
ELECTIVE MODULES:	

Module 0	0
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 12 calendar months.

Subject to teaching room availability, each module is taught over two weeks, with the second week largely free of structured teaching to allow time for more independent learning and reflection and/or assignment work.

7. Course Level Assessment Strategy[4]

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

In all cases, the chosen methods of assessment have been chosen for greatest constructive alignment with the associated intended learning outcomes. For the majority of taught modules, individual coursework allows the greatest 'time on task' and deep learning, but for some, an examination is the best fit. The course contains a group project and an individual research project: these are assessed with individual reports and presentations. (The group project also has a group-assessed element.) Again, this is aligned with the learning outcomes for the modules and the overall course.

Course modules

The following modules outline all parts of the programme leading to **MSc**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
0	N-CAV-IND	Introduction	Daniel Auger	18	0	N		30/09/20	30/09/20	02/10/20	N/A	A/O	N/A					
1	N-CAV-FORVE	Fundamentals of Road Vehicle Engineering	Marko Tirovic	30		10		5/10/20	5/10/20	9/10/20	50	EX	100%				14/12/20	14/9/21
2	N-CAV-PPADM	Path Planning, Autonomy and Decision Making	Hyo-Sang Shin	28		10	N	08/02/21	08/02/21	12/02/21	50	ICW	100%				19/02/21	18/9/21

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%..
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	N-CAV-SPV	Sensors, Perception and Visualisation	Luca Zanotti Fragonara	28		10	N	2/11/20	2/11/20	6/11/20	50	ICW	100%				13/11/20	13/8/21
4	N-CAV-SYS	Systems Engineering	Tim Mackley	30		10	N	19/10/20	19/10/20	23/10/20	50	ICW	100%				30/10/20	29/06/21
5	N-AP-AM04	Embedded Vehicle Control Systems	Stefano Longo	30		10	Y	25/1/21	25/1/21	29/01/21	50	ICW	100%				5/02/21	5/07/21
6	N-CAV-TSO	Transport Systems Optimisation	Abbas Fotouhi	30		10	N	30/11/20	30/11/20	4/12/20	50	EX	100%				4/01/21	21/09/21
7	N-CAV-HF	Human Factors, Human-Computer Interaction and ADAS System	Lisa Dorn	30		10	N	08/03/21	08/03/21	12/03/21	50	ICW	100%				19/03/21	12/07/21
8	N-CAV-NSC	Networked Systems and Cyber Security	Phil Nobles	30		10	N	16/11/20	16/11/20	20/11/20	50	ICW	100%				27/11/20	27/07/21
9	N-CAV-ESR	Ethics, Safety and Regulation	Colin Pilbeam	30		10	N	22/02/21	22/02/21	26/02/21	50	ICW	100%				05/03/21	19/07/21
10	N-CAV-TSBM	Technology Strategy and	Mikko Arevuo	16		10	N	11/01/21	11/01/21	15/01/21	50	GCW	100%				22/01/21	15/09/21

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
		Business Models																	
11	N-CAV-GP	CAVE (Auto) Group Project	Dr Marco Cecotti	35		20	N	22/03/21	22/03/21	30/04/21	50			100%	GPROJ ICW GPRES	40% 40% 20%	30/04/21	07/04/22	
12	N-AP-AE13	Individual Research Project	Abbas Fotouhi	10		80	Y	01/10/2020	03/05/2021	02/09/21	50	THESIS OR	80% 20%				23/08/21 31/08/21-02/09/21	03/09/22	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
N-AP-AM04	Embedded Vehicle Control Systems	MSc in Automotive Mechatronics	MSc in Automotive Mechatronics
N-AP-AE13	Individual Research Project	MSc in Automotive Engineering	MSc in Automotive Mechatronics MSc in Automotive Engineering

8. How are the ILOs assessed?

The following assessment types are utilised:

Individual coursework (assignments), examinations, group coursework, group project work, individual project work.

This approach has been adopted because:

The assessment approaches have been chosen to best suit the type of knowledge and skills they relate to. In many cases, individual coursework and project work allows deep engagement with the subject allowing the full spectrum of module-level ILOs to be assessed. Some ILOs specifically relate to group project work, and group assessment is used accordingly. For a few modules, time-bound examinations felt to be a good way to assess module ILOs.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4
1	EX			
2				EX
3				ICW
4				ICW
5				ICW
6				EX
7				ICW
8				ICW
9				ICW
10		GCW		
11			MULTI	

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO5	ILO6	ILO7
2		EX	
3	ICW	ICW	
4	ICW	ICW	
5	ICW		
6	EX		EX
7			ICW
8	ICW	ICW	
9			ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO8	ILO9
12	THESIS	OR

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

Graduates in this course are likely to be able to undertake roles in industry or commercial sectors such as the following:

Engineering/technical roles relating to the deep technical skills taught on the project. (These could be with traditional automotive OEMs and their supply chain or within the emerging 'intelligent mobility' sector.) Examples of entry level job titles might be 'engineer/technologist', 'senior engineer/technical specialist' or 'technical specialist'. Work would include development of particular technologies in the CAV field or integration of such technologies into CAV systems.

Commercial and technical sales roles relating to connected and autonomous vehicles. Typical jobs titles here might be 'application engineer', 'technical consultant' or 'sales engineer'.

Graduates will be well equipped to progress to senior management and technical roles within the automotive and intelligent mobility sectors.

Graduates will also be well equipped for roles in applied research within universities and similar organisations.

COURSE SPECIFICATION

Cranfield University: Course Specifications
Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision:	20 February 2020

1. What is the course?

Course information

Course Title	Counterterrorism Programme
Course code	**MSc, PgDip, PgCert Counterterrorism;** MSCTMFTC, MSCTMPTC, PDCTMFTC, PDCTMPTC, PCCTMFTC, PCCTMPTC, **MSc, PgDip, PgCert Counterterrorism, Risk Management and Resilience;** MSCRRFTC, MSCRRPTC, PDCRRFTC, PDCRRPTC, PCCRRFTC, PCCRRPTC **Short Course for Credit;** SPCTMPTC
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert, MSc
Mode of delivery	Full-time, Part-time
Location(s)[1] of Study	Cranfield, Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Cranfield Forensic Institute
Course Director	Programme Director: Professor Andrew Silke; Counterterrorism Course Director: Dr Anastasia Filippidou; Counterterrorism, Risk Management and Resilience Course Director: Professor Andrew Silke
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ Level 7 Masters
Benchmark Statement(s)	N/A
Registration Period(s) available	Part-time: 2 years (PgDip and PgCert) or 3 years (MSc) Full-time: 1 year MSc, PgDip and PgCert
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the Cranfield Forensic Institute within Cranfield Defence and Security where the research interests include:

Counterterrorism, risk and resilience, security technology, forensic archaeology and anthropology, ballistics, explosives, forensic and security imagining.

Cranfield University interacts with the following institutions and in the following ways:

- Pool Reinsurance - research project titles.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

This course is not accredited by any external bodies.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- help prepare students for both academic and non-academic careers (including those related to security, policing, military, government policy, and international work), bringing together a unique mix of different subjects, combining modules from soft and hard sciences. The skills students gain will reflect the modules selected.

- provide students with fundamental knowledge, core expertise and advanced, evidence-based methodological tools and approaches necessary to understand, analyse, prevent and mitigate terrorism.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exit routes are provided for

students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

- graduates with relevant first degrees
- other graduates working in relevant professional fields of study, including those connected to policing, criminal justice, military, security, preventing violent extremism, countering violent extremism, intelligence and defence sectors
- practitioners in fields related to counterterrorism, risk management and risk mitigation.

Some elements of the programme are delivered at the UK Defence Academy in Shrivenham, which is a Ministry of Defence (MoD) site. All applicants to courses that are wholly or partially delivered at Shrivenham must complete the UK Government's Baseline Personnel Security Standard (BPSS) prior to registration, or must already hold a security clearance to this level or higher. BPSS clearance applications will be shared during the application process with the MoD, which has ultimate discretion over admission to the Shrivenham site. If a student is not able to access the Shrivenham site they will be unable to select any modules which are based at Shrivenham.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate in Counterterrorism

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically examine and appraise the major theoretical, academic and substantive debates relating to terrorism and counterterrorism.

ILO 2. Develop the analytical skills to critically research, evaluate and assess models and explanations of terrorism, and the range of counterterrorism options to these.

ILO 3. Construct and formulate arguments and analysis and communicate these effectively in a form suitable for specific target audiences.

B. Postgraduate Diploma in Counterterrorism

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Critically evaluate the design and impact of counterterrorism policies and initiatives

ILO 5. Examine and critically assess several case studies of major terrorism and counterterrorism campaigns.

ILO 6. Assemble and evaluate a wide range of evidence from a range of disciplines that impacts on terrorism and counterterrorism and be able to do this working independently or as part of a group.

ILO 7. Systematically engage with and critique the evidence base for understanding terrorism and which underlies counterterrorism initiatives and policies.

C. MSc in Counterterrorism

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Complete a significant piece of independent research on a chosen topic within the area of terrorism or counterterrorism.

ILO 9. Critically evaluate different research methodologies and select appropriate research strategies and materials.

ILO 10. Appraise and identify recommendations for policy, practice and/or future research.

D. Postgraduate Certificate in Counterterrorism, Risk Management and Resilience

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically examine and appraise the major theoretical, academic and substantive debates relating to terrorism and counterterrorism.

ILO 2. Critically research, evaluate and assess risk management and mitigation theory and techniques with regard to terrorism and related threats

ILO 3. Construct and formulate arguments and analysis and communicate these effectively in a form suitable for specific target audiences.

E. Postgraduate Diploma in Counterterrorism, Risk Management and Resilience

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 4. Critically evaluate the design and impact of counterterrorism policies and initiatives

ILO 5. Critically evaluate risk and crisis management tools, processes, and frameworks and relate risk and crisis management frameworks to contemporary resilience strategies.

ILO 6. Assemble and evaluate a wide range of evidence from a range of disciplines that impacts on terrorism and counterterrorism and be able to do this working independently or as part of a group.

ILO 7. Examine and critically analyse mitigation and resilience approaches to a range of terrorist threats, tactics and strategies.

F. MSc in Counterterrorism, Risk Management and Resilience

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Complete a significant piece of independent research on a chosen topic within an area of terrorism, risk management and resilience.

ILO 9. Critically evaluate different research methodologies and select appropriate research strategies and materials.

ILO 10. Appraise and identify recommendations for policy, practice and/or future research.

4. How is the course taught?

Students will be supported in their learning and personal development by:

Teaching methods vary from module to module but include lectures, seminars, tutorials, workshops and individual supervision. The emphasis is on student participation and small group work within a supportive learning environment. Student learning is supported by lecture notes, module handbooks and suggested reading. Direct class contact is supplemented by on-line interactive programme materials, individual reading and preparation for assignments. Learning resources include IT and access to electronic databases.

Our education philosophy is led by the basic principles of:

- research led teaching – through a course team that are active researchers or practitioners
- learning through assessment methods - we view assessment as part of the learning process, with a variety of assessment methods extending the curriculum and transferable skills

The main instrument of teaching and learning in the taught phase modules remains the traditional lecture, incorporating the effective use of visual aids and supported by high quality written material where appropriate. Tutorial sessions centring on a particular subject area or involving more wide-ranging discussions are also an important feature of the course. Additionally, there is a growing move to reduce the amount of teacher-centred learning and allow students to take the initiative in the learning process.

Thus some modules include a requirement for each student to make an oral presentation to the rest of the class on a specific subject that is then assessed by the staff present. Students are required to present their written work in a variety of forms, including the conventional essay as well as laboratory reports and expert witness statements. In the case of MSc students this includes presenting the results of their individual research project in the format of a thesis. The emphasis is always on clear, concise and accurate presentation. This ensures that students are continually encouraged to think about report writing and are given frequent opportunities to improve their techniques as they progress through the course. Some modules employ role play to demonstrate how theory is put into practice, including table top exercises where students work in small groups to risk manage and mitigate a range of different terrorism scenarios.

In addition to the teaching methods outlined, students will be supported in their learning and personal development by:

- Good staff student relations. Staff endeavour to be enthusiastic and helpful. The Programme Director will address any immediate issues of concern that a student or students may have in connection with the course.
- All students are provided with a personal tutor who is available to support the student and advise on academic issues and provide pastoral care. Students are encouraged to meet with their personal tutors at least twice during the taught phase of the course. Additional meetings are scheduled as required.
- After the taught phase pastoral care largely transfers to the student's individual research project supervisor, who they are encouraged to meet with regularly.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate in Counterterrorism

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3	30
ELECTIVE MODULES:	
30 credits from Modules 4-22	30
TOTAL:	**60**

B. Postgraduate Diploma in Counterterrorism

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	

Modules 1-4	40
ELECTIVE MODULES:	
80 credits from Modules 5-22	80
TOTAL:	**120**

C. MSc in Counterterrorism

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Modules 1-4, 23	120
ELECTIVE MODULES:	
80 credits from Modules 5-22	80
TOTAL:	**200**

D. Postgraduate Certificate in Counterterrorism, Risk Management & Resilience

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	**Credits**
COMPULSORY MODULES:	
Modules 1, 2, 8	40
ELECTIVE MODULES:	
20 credits from Modules 3-7, 9-10, 16-17, 21-22	20
TOTAL:	60

E. Postgraduate Diploma in Counterterrorism, Risk Management & Resilience

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

Description	**Credits**
COMPULSORY MODULES:	
Modules 1-4, 8-9	70
ELECTIVE MODULES:	
50 credits from Modules 5-7, 10, 16-17, 21-22	50
TOTAL:	120

F. MSc in Counterterrorism, Risk Management & Resilience

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Modules 1-4, 8-9, 23	150
ELECTIVE MODULES:	
50 credits from Modules 5-7, 10, 16-17, 21-22	50
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
  - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

6. How is the course structured?

Full-time students register for the course in October and are expected to complete the course within 11 calendar months.

Part-time students register for the course in October and are expected to complete the course within 3 years.

Most modules are taught over one week. For some modules this will include sufficient time for parts of the module assessments such as individual or group presentations. Most assessments are completed after the residential element. The examination for Reasoning for Forensic Science and coursework is completed after the residential element of the module. The coursework for Courtroom Skills is submitted before the module with a practical assessment completed during the residential week

Each option within the course is based around a specific set of option-specific, compulsory modules (a "theme"), with a complementary series of associated role- specific modules. Students select modules across the whole programme according to their individual requirements and entry qualifications.

Students would normally commence their individual research project only on successful completion of the taught component of the course. It is expected that the individual research project will normally fall within the scope of the dominant theme established in the taught phase.

Part-time provision of the course works as a variant of the full-time course, but is offered in a more flexible mode of study. Students are able to "jump on and jump off" modules over a longer period and sit classes alongside full-time students. Part-time students are also allowed longer deadlines for the submission of coursework.

An illustrative journey pathway for a part-time student on the MSc Counterterrorism, Risk Management & Resilience could be to take the following modules:

First Year: Module 1 (Oct), Module 2 (Oct), Module 8 (Jan), Module 3 (Mar) (50 credits)

Second Year: Module 4 (Nov), Module 22 (Jan), Module 7 (Mar), Module 5 (April) (40 credits)

Third Year: Module 9 (Nov), Module 6 (Feb) Module 21 (Mar) Module 23 (Apr - Aug) (110 credits)

7. Course Level Assessment Strategy[4]

The course assessment tasks are challenging and are designed to enable students to demonstrate a full range of skills and attributes. Core modules introduce students to foundational theory and central issues (e.g. Understanding Terrorism and Counterterrorism; Applied Counterterrorism; Terrorism Risk Management and Mitigation) and will be assessed through essays, reports, MCQs, presentations and group debate. Reports and essays are of varying lengths, and recognise that writing articles or reports to a short length can be more challenging for some and can develop different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor. Students will write employability relevant reports and assessments to equip them with the skills they require to succeed as a professional working in a counterterrorism-relevant sector and to address specific award ILOs [e.g. MSc Counterterrorism ILOs 3, 4, 5, 6]; and for those working in risk management, mitigation & resilience sectors [e.g. MSc Counterterrorism, Risk Management & Resilience ILOs 2, 3, 5, 7].

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

Students then have opportunities to develop their communication skills, as they are required to give group presentation and individual presentations and participate in group debates. The ability to work effectively in groups is a highly desirable skill which is specifically identified in ILO 6 (MSc Counterterrorism & MSc Counterterrorism, Risk Management & Resilience). Feedback is given immediately after the group presentation and group debates.

Modules are supported by a number of formative tasks including group debates (e.g. Applied Counterterrorism; Chemical, Biological, Radiological and Nuclear (CBRN) Terrorism), MCQs (e.g. Cyberterrorism; Protecting Critical National Infrastructure), and oral presentations (e.g. Understanding Terrorism and Counterterrorism; Strategies, Ideologies and Tactics of Terrorism). Formative feedback is given verbally within the classroom following debates, and oral feedback provided by the tutor and peers for presentations. Students will also engage with interactive learning activity such as MCQs which incorporates formative feedback. For a range of modules (e.g. Understanding Terrorism and Counterterrorism; Applied Counterterrorism; Chemical, Biological, Radiological and Nuclear (CBRN) Terrorism; Strategies, Ideologies and Tactics of Terrorism; Terrorism Risk Management and Mitigation) class presentations and peer review informs performance, students are also generally encouraged to support each other by asking and answering questions via the VLE.

The taught components precede the research project, so assessment can be used to develop skills required for the individual research project. Students are generally expected to be more self-directed in their learning during the research project and guidance will be provided by a staff supervisor. The research project addresses ILOs 8-10 for both courses and takes the form of a Thesis on a subject directly relevant to the major theme of the course.

Course modules

The following modules outline all parts of the programme leading to **MSc**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments (%/100%)[9]	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	R-FP-IS	Introductory Studies	Peter Masters	70	0	0	Y	05/10/20	05/10/20	09/10/20	N/A	AO	N/A	N/A				
2	R-CT-UTC	Understanding Terrorism & Counterterrorism	Andrew Silke	40	0	20	N	26/10/20	26/10/20	30/10/20	50 50			100	IPRES ICW	10 90	30/10/20 FT 30/11/20 PT 14/12/20	Next available opportunity

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
3	R-CT-AC	Applied Counterterrorism	Andrew Silke	25	0	10	N	15/03/21	15/03/21	19/03/21	50	GCW	100				FT 19/04/21 PT 04/05/21	Next available opportunity
4	R-CT-SITT	Strategies, Ideologies & Tactics of Terrorism	Anastasia Filippidou	25	0	10	N	02/11/20	02/11/20	06/11/20	50	ICW	100				FT 07/12/20 PT 21/12/20	Next available opportunity
5	R-CT-PCNI	Protecting Critical National Infrastructure	Andrew Silke	25	0	10	N	26/04/21	26/04/21	30/04/21	40	ICW	100				FT 01/06/21 PT 14/06/21	Next available opportunity
6	R-CT-CT	Cyber Terrorism	Andrew Silke	25	0	10	N	01/02/21	01/02/21	05/02/21	40	ICW	100				FT 08/03/21 PT 22/03/21	Next available opportunity
7	R-CT-CBRN	Chemical. Biological, Radiological and Nuclear (CBRN) Terrorism	Matt Healy	25	0	10	N	01/03/21	01/03/21	05/03/21	40	ICW	100				FT 06/04/21 PT 19/04/21	Next available opportunity
8	R-CT-TRMM	Terrorism Risk Management & Mitigation	Mike Harris	40	0	20	N	18/01/21	18/01/21	22/01/21	50 Compulsory 40 Elective			100	IPRES ICW	10 90	22/01/21 FT 22/02/21 PT 08/03/21	Next available opportunity

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	R-IDS-RR	Risk, Crisis and Resilience	Edith Wilkinson	25	0	10	Y	23/11/20	23/11/20	27/11/20	40	ICW	100				FT 06/01/21 PT 20/01/21	Next available opportunity
10	R-IDS-TCT	Counterterrorism and Intelligence	Anastasia Filippidou	20	0	10	Y	15/02/21	15/02/21	19/02/21	40	ICW	100				FT 22/03/21 PT 06/04/21	Next available opportunity
11	R-IDS-DCR	Diplomacy and Conflict Resolution	Anastasia Filippidou	20	0	10	Y	11/01/21	11/01/21	15/01/21	40	ICW	100				FT 15/02/21 PT 01/03/21	Next available opportunity
12	R-CT-TL	Terrorism and the Law	David Turns	20	0	10	N	12/04/21	16/04/21	23/04/21	40	ICW	100				FT 24/05/21 PT 07/06/21	Next available opportunity
13	R-FP-IEC	Investigation and Evidence Collection	Stephanie Giles	40	0	10	Y	12/10/20	12/10/20	16/10/20	50	ICW	100				FT 16/11/20 PT 30/11/20	Next available opportunity
14	R-FP-RFS	Reasoning for Forensic Science	Peter Zioupos	25	0	10	Y	19/10/20	19/10/20	23/10/20	50	EX	100				W/c 14/12/20	W/c 19/04/21
15	R-FP-AT	Analytical Techniques	Fiona Brock	40	5	20	Y	09/11/20	09/11/20	20/11/20	50	ICW	100				FT 05/01/21 PT 15/01/21	Next available opportunity

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments (%100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
16	R-FP-CS	Courtroom Skills	Peter Zioupos	25	0	10	Y	05/10/20	10/05/21	14/05/21	50 50			100	OR ICW	60 40	ALL 14/05/21 ALL 09/04/21	Next available opportunity
17	R-FP-FEI	Fires, Explosions and their Investigation	Stephen Johnson	28	0	10	Y	01/03/21	01/03/21	05/03/21	40	ICW	100				FT 06/04/21 PT 19/04/21	Next available opportunity
18	R-FP-IFIFB	Introduction to Firearms Investigations & Forensic Ballistics	Kate Hewins	32	0	10	Y	30/11/20	30/11/20	04/12/20	40	ICW	100				FT 13/01/21 PT 27/01/21	Next available opportunity
19	R-FP-FI	Firearms Investigations	Kate Hewins	32	0	10	Y	25/01/21	25/01/21	29/01/21	40	ICW	100				FT 01/03/21 PT 15/03/21	Next available opportunity
20	R-FP-FBI	Forensic Ballistics Investigations	Kate Hewins	32	0	10	Y	22/02/21	22/02/21	26/02/21	40	ICW	100				FT 29/03/21 PT 12/04/21	Next available opportunity
21	R-FP-CEDC	Counter-Improvised Explosive Devices Capability	Mike Harris	28	0	10	Y	22/03/21	22/03/21	26/03/21	50	IPRES	100				28/04/21 hand in date for all 11/05/21 presentation date for all	Next available opportunity

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers[6]	Credits	Is the module shared? Y/N	Calendar			Assessment								
												Independent Assessment		Multi-part Assessment			Submission dates		
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments[9] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
22	R-FP-FEAI	Forensic Exploitation and Intelligence	Stephen Johnson	28	0	10	Y	08/02/21	08/02/21	12/02/21	40	ICW	100				FT 15/03/21 PT 29/03/21	Next available opportunity
23	R-CT-THESIS	Research Project	Edith Wilkinson	50	0	80	N	Part 1 11-12/12/20 Part 2 8-9/03/21	22/04/21	25/0821	50 50			100	OR THESIS	20 80	12-16/07/21 25/08/21	N/A

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
R-FP-IS	Introductory Studies	Forensic Programme	
R-IDS-RR	Risk, Crisis and Resilience	Counterterrorism Programme	Defence and Security Programme
R-IDS-TCT	Counterterrorism and Intelligence	Counterterrorism Programme	Defence and Security Programme
R-FP-IEC	Investigation and Evidence Collection	Forensic Programme	
R-FP-RFS	Reasoning for Forensic Science	Forensic Programme	
R-FP-AT	Analytical Techniques	Forensic Programme	
R-FP-CS	Courtroom Skills	Forensic Programme	
R-FP-FEI	Fires, Explosions and their Investigation	Forensic Programme	Defence and Security Programme
R-FP-IFIFB	Introduction to Firearms Investigations & Forensic Ballistics	Forensic Programme	Defence and Security Programme
R-FP-FI	Firearms Investigations	Forensic Programme	
R-FP-FBI	Forensic Ballistics Investigations	Forensic Programme	
R-FP-CEDC	Counter-Improvised Explosive Devices Capability	Forensic Programme	Explosives Ordnance Engineering MSc
R-FP-FEAI	Forensic Exploitation and Intelligence	Forensic Programme	

8. How are the ILOs assessed?

The following assessment types are utilised:

Essays, exams, reports, oral presentations, and a research project.

All assessments in the Programme comply with guidelines on assessment set out by the University and are designed to assess the learning outcomes of the module. Modes of assessment are varied and innovative. Feedback is detailed and great lengths are taken to ensure that assessment tasks are clarified and clearly understood.

The focus is on best practice and awareness of current research. For some assignments, students are expected to take on a professional role and assessments involve critical evaluation and professional judgement through a balance of report writing (including expert witness statements, analytical reports and critical reviews) oral examinations (individual and group presentations) and written examinations.

To complete the course to the award of a Masters level qualification, students must progress through PgCert and PgDip modules and assessment to the final element of the programme, the research based dissertation. Students must pass this final element of the programme with a minimum mark of 50%.

This approach has been adopted because:

It enables the testing of different aspects of the student's knowledge and ability. Conventional essay work is used to test research skills and analytical ability, and is often based on a critical review of the literature. A wide range of data types and sources are used. While journals, conference papers and specialist textbooks are most frequently used, students are expected to use other sources such as government and industry publications, newspapers, television and internet sites when appropriate. Consequently, students have to demonstrate an awareness of the reliability of the source and the possibility of conflicting interests.

Professional skills are developed through oral presentations and writing analytical reports on case studies and practical work, with a particular emphasis on clear but concise presentation. Students can expect assessed coursework to be returned to them no longer than 20 working days following the deadline for handing in, according to University Regulations. Throughout the course both individual and group presentations and briefings are used to assess communication skills appropriate for a range of target audiences

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate in Counterterrorism

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3
1			
2	IPRES ICW	ICW	ICW IPRES
3	GCW	GCW	
4	ICW		
5		ICW	ICW
6	ICW	ICW	ICW
7	ICW		ICW
8		ICW IPRES	ICW IPRES
9			ICW
10	ICW	ICW	ICW
11	ICW		ICW
12	ICW		ICW
13			ICW
14			EX
15			ICW
16			OR ICW
17		ICW	ICW
18			ICW

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3
19			ICW
20			ICW
21			IPRES
22			ICW

B. Postgraduate Diploma in Counterterrorism

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 4	ILO 5	ILO 6	ILO 7
1				
2	ICW	ICW	ICW IPRES	ICW
3	GCW	GCW	GCW	GCW
4		ICW	ICW	ICW
5		ICW	ICW	
6	ICW			
7	ICW		ICW	ICW
8	ICW		ICW	ICW
9	ICW		ICW	
10			ICW	ICW IPRES
11	ICW	ICW	ICW	
12	ICW		ICW	ICW
13			ICW	ICW
14				
15			ICW	ICW
16			ICW	ICW
17				
18			ICW	ICW
19				ICW
20				ICW
21				IPRES
22			ICW	ICW

C. MSc in Counterterrorism

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 8	ILO 9	ILO 10
23	THESIS	THESIS	THESIS OR

D. Postgraduate Certificate in Counterterrorism, Risk Management and Resilience

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3
1			
2	IPRES ICW		ICW IPRES
3	GCW	GCW	GCW
4	ICW		ICW
5		ICW	ICW
6	ICW	ICW	ICW
7	ICW	ICW	ICW
8		ICW IPRES	ICW IPRES
9		ICW	ICW
10	ICW		ICW
16			OR ICW
17			ICW
21		IPRES	IPRES
22			ICW

E. Postgraduate Diploma in Counterterrorism, Risk Management and Resilience

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 4	ILO 5	ILO 6	ILO 7
1				
2	ICW		ICW IPRES	
3	GCW		GCW	
4			ICW	
5		ICW	ICW	ICW
6	ICW	ICW		ICW
7	ICW	ICW	ICW	ICW
8	ICW	ICW IPRES	ICW IPRES	ICW IPRES
9	ICW	ICW	ICW	ICW
10			ICW	

Award ILOs / Module No.	ILO 4	ILO 5	ILO 6	ILO 7
16			OR ICW	
17				
21		IPRES		IPRES
22			ICW	

F. MSc in Counterterrorism, Risk Management and Resilience

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO 8	ILO 9	ILO 10
23	THESIS	THESIS	THESIS OR

MSc Counterterrorism	**MSc Counterterrorism, Risk Management & Resilience**
Core Modules Introductory Studies Understanding Terrorism & Counterterrorism Applied Counterterrorism Strategies, Ideologies & Tactics of Terrorism Research Project (Thesis)	**Core Modules** Introductory Studies Understanding Terrorism & Counterterrorism Applied Counterterrorism Strategies, Ideologies & Tactics of Terrorism Terrorism Risk Management & Mitigation Risk, Crisis and Resilience Research Project (Thesis)
Elective Modules Protecting Critical National Infrastructure Cyber Terrorism CBRN Terrorism Terrorism Risk Management & Mitigation Risk, Crisis and Resilience Counterterrorism and Intelligence Diplomacy and Conflict Resolution Terrorism and the Law Investigation and Evidence Collection Reasoning for Forensic Science Analytical Techniques Courtroom Skills Fires, Explosions and their Investigation Introduction to Firearms Investigations & Forensic Ballistics Firearms Investigations Forensic Ballistics Investigations Counter-Improvised Explosive Devised Capability Forensic Exploitation and Intelligence	**Elective Modules** Protecting Critical National Infrastructure Cyber Terrorism CBRN Terrorism Counterterrorism and Intelligence Courtroom Skills Fires, Explosions and their Investigation Counter-Improvised Explosive Devised Capability Forensic Exploitation and Intelligence

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The courses should enhance students' post award employment prospects. We have entered an era where terrorism and counterterrorism have become critical issues for modern society. The courses will provide graduates with a rigorous, evidence-based qualification in this important area. This Counterterrorism qualification will assist graduates to start careers in a wide variety of fields, including those related to security, defence, risk management, policing, policy, and international work. Beyond this, the course will help assist the careers of graduates who are already working in these and related fields. The Counterterrorism, Risk Management & Resilience pathway is specifically tailored for students interested in developing a career in the risk management or insurance sectors with a focus on protective security against terrorism and related threats. This pathway should appeal particularly to candidates who are either serving or recently retired from government, military or policing agencies, or those who are already in the risk management or insurance space who want to specialise in counterterrorism risk management and protective security.

COURSE SPECIFICATION

Cranfield University: Course Specifications
Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: July 2020

1. What is the course?

Course information

Course Title	MSc in Defence Cyber Masters Programme
Course code	MSCSOPTR, MSCDIPTR, MSCSOFTR, MSCDIFTR, PDCSOPTR, PDCSOFTR, PDCDIPTR, PDCDIFTR, PCCSOPTR, PCCSOFTR PCCDIPTR, PCCDIFTR, SPCSOPTR, SPCDIPTR
Academic Year	2020/21
Valid entry routes	MSc, PgDip, PgCert Cyber Defence and Information Assurance (CDIA) MSc, PgDip, PgCert Cyberspace Operations (CSOps)
Additional exit routes	PgDip Cyber Defence and Information Assurance PgCert Cyber Defence and Information Assurance PgDip Cyberspace Operations PgCert Cyberspace Operations
Mode of delivery	Part-time and Full-time Flexible learning
Location(s)[1] of Study	Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Centre for Electronic Warfare, Information and Cyber
Course Director	Mr Ross Harris Mr Ian Owens (CDIA) Mr Darren Lawrence (CSOps)
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	YES
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

Is the Mastership offered as an open and/or closed course?	N/A
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	1st or 2nd class honours degree; 3rd class degree with three years relevant experience; pass degree with five years relevant experience; HND/C with seven years relevant experience. Exceptional candidates may be accepted with 10 years relevant experience, where relevant experience is gained in Information Security, Information Operations, information risk or related role. Students whose first language is not English must also attain an IELTS score of 6.5. Owning to security classification, and course purpose, only UK Government sponsored and security-cleared students with a justifiable interest in cyberspace operations will be enrolled on the CSOps named award or the Cyberwarfare in Intelligence and Military Operations module.
UK Qualifications Framework Level	QAA FHEQ level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	A Full time student will have a registration period of 1 year. Part-time MSc - up to five years, PgDip - up to four years, Part-time PgCert - up to three years (For MOD status students the duration may vary, subject to annual review.)
Course Start Month(s)	Full-time & Part-time – September

Institutions delivering the course

This course is delivered by Cranfield Defence and Security where the research interests associated with this course include Cyber and Information Assurance/Security and Information Operations

Cranfield University interacts with the following institutions and in the following ways:

- Guest lecturers are drawn from other academic institutions and the practitioner community
- The course has a notable external advisory panel, chaired by Air Marshal Sir Julian Young, and is supported by the Cabinet office and the Office of Cyber Security and Information Assurance.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

The Cyber Defence & Information Assurance MSc is accredited by the Chartered Instatute of Library & Information Professionals.

2. What are the aims of the course?

Cranfield University offers this programme in order to achieve the following aims related to the two named Masters level awards noted above:

- Cyber Defence and Information Assurance (CDIA) - To develop professionals who can effectively manage and exploit the threats and opportunities of cyberspace at the organisational level.
- Cyberspace Operations (CSOps) - To develop professionals to support manoeuvres in cyberspace, in contested operations and as part of integrated planning.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) entry routes are provided for students who wish to access only parts of the course provided.

This programme is intended for the following range of students:

CDIA

- Government, corporate and critical information infrastructure staff who are one or more of the following:
  - Managers who need to understand information risk and respond to cyber threats
  - Technicians who wish to understand the operational and business context
  - Procurement staff commissioning critical or sensitive projects
  - Policy and planning staff interested in computer network and security operations
  - Personnel interested in social media and associated concepts such as cyber mobilization
  - Those charged with accreditation and assessment of security measures

CSOps

- Military and other Government personnel charged with supporting operations in Cyberspace, in their current or anticipated role. These staff may also carry out one or more of the roles listed above for CDIA.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate common to both named awards

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO 1. Critically assess an organisation's Information Security and Information Assurance policy, strategy and plans, with a view to improvement.
ILO 2. Critically appraise approaches to assessing risk.
ILO 3. Evaluate the opportunities and limitations afforded by emergent security technologies.
ILO 4. Develop security requirements in in various contexts.

ILO 11. Critically evaluate a range of approaches to understanding complex and changing cyber environments.

ILO 13. Analyse and scope a complex cyber problem-space with a view to action and improvement.

ILO 14. Judge ethics and legality at each stage of planning and activity.

ILO 15. Develop problem definition, analysis and problem solving skills to address challenges faced in cyber issues.

ILO 16. Argue coherently and demonstrate knowledge of personal strengths and weaknesses.

B. Postgraduate Certificate ILOs Specific to CSOps

ILO 8. Appraise the main elements and key management issues in the planning and conduct of Cyberspace Operations in the full-spectrum context.

ILO 9. Assess theories of human cognition and behaviour and evaluate their utility in effects planning in the C2 context.

ILO 10. Assess cyber technical approaches that support military effect.

C. Postgraduate Diploma ILOs Common to both awards

ILO 5. Determine effective approaches to managing and exploiting social media and pervasive technologies

ILO 6. Appraise best practice in network defence and security operations management in the context of interdependence and critical infrastructure.

ILO 7. Evaluate the human dimension of security systems, processes and behavioural change programmes and plan for improvement in an organisational context.

ILO 12. Appraise the techniques that can be used to design investigation, problem formulation and structuring, and interpretation of data.

ILO 17. Assess operational impact of proposed interventions.

ILO 18. Assess business impact of proposed interventions.

D. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 19. Independently and confidently be able to apply appropriate theories, tools and/or techniques to a cyber-related situation, or situations, as appropriate to the student's named award

ILO 20. Critically evaluate the published literature and synthesise the identified concepts

ILO 21. Judge appropriate research approaches for conducting research and draw justifiable inferences from the data and analysis generated and present a self-critical discussion of the results with conclusions

ILO 22. Display practical ability in self-directed research to produce a high quality thesis.

4. How is the course taught?

The course is taught through a flexible blend of residential courses, VLE activities and interaction and project based learning.

The dissertation is an 80 credit module for which part time students will have 12 months to complete once they have submitted their dissertation proposal, full time students have until the end of their registration period.

Please note, modules will only be run subject to there being a minimum of six students selecting the module.

Students will be supported in their learning and personal development by:

- Physical and electronic access to resources in the Barrington library
- Collaborative and reflective learning in a cohort of practitioners has proven successful in other courses and it is intended to utilise this approach on this course. In this, students will be encouraged to draw on and share their experiences. Students will be asked to conduct activities that will require them to tackle realistic scenarios and to reflect on how the course literature, teaching and learning shapes their professional practice.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 6. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate in Cyber Defence and Information Assurance

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Foundations of Cyber	10
ELECTIVE MODULES:	
Choose 50 credits from the following modules: Understanding Risk Cyber Attack – Threats and Opportunities Social Technologies Data Led Decision Support & Artificial Intelligence Emerging Technology Monitoring Incident Management Cyber Law Information Operations Cyber Deception The Human Dimension Critical Networks and Cyber-Physical Systems Systems Thinking for Organisational Viability	 10 10 10 10 10 10 10 10 10 10 10 10
TOTAL:	**60**

B. Postgraduate Certificate in Cyberspace Operations

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Foundations of Cyber Cyberwarfare in Intelligence and Military Operations Information Operations	10 10 10
ELECTIVE MODULES:	
Choose 30 credits from any of the other Defence Cyber Masters Programme modules.	30
TOTAL:	**60**

C. Postgraduate Diploma in Cyber Defence and Information Assurance

The accumulation of 120 credits through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Foundations of Cyber	10
ELECTIVE MODULES:	
Choose 110 credits from: Understanding Risk Cyber Attack – Threats and Opportunities Social Technologies Data Led Decision Support & Artificial Intelligence Emerging Technology Monitoring Incident Management Cyber Law Information Operations Cyber Deception The Human Dimension Critical Networks and Cyber-Physical Systems Systems Thinking for Organisational Viability	 10 10 10 10 10 10 10 10 10 10 10 10
TOTAL:	**120**

D. Postgraduate Diploma in Cyberspace Operations

The accumulation of 120 credits through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Foundations of Cyber Cyberwarfare in Intelligence and Military Operations Information Operations Cyber Law Cyber Deception	10 10 10 10 10
ELECTIVE MODULES:	
Choose 70 credits from any of the other Defence Cyber Masters Programme modules.	
TOTAL:	**120**

E. MSc in Cyber Defence and Information Assurance

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	Credits
COMPULSORY MODULES:	
Foundations of Cyber Thesis	10 80
ELECTIVE MODULES:	
Choose 110 credits from: Understanding Risk Cyber Attack – Threats and Opportunities	 10 10

Social Technologies	10
Data Led Decision Support & Artificial Intelligence	10
Emerging Technology Monitoring	10
Incident Management	10
Cyber Law	10
Information Operations	10
Cyber Deception	10
The Human Dimension	10
Critical Networks and Cyber-Physical Systems	10
Systems Thinking for Organisational Viability	10
TOTAL:	**200**

F. MSc in Cyberspace Operations

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Description	**Credits**
COMPULSORY MODULES:	
Foundations of Cyber	10
Cyberwarfare in Intelligence and Military Operations	10
Information Operations	10
Cyber Law	10
Cyber Deception	10
Thesis	80
ELECTIVE MODULES:	
Choose 70 credits from any of the other Defence Cyber Masters Programme modules:	70
TOTAL:	**200**

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that lower award.

Pass Criteria

The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.
In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee); [3]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:

[3] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

- if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
- if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
- it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.

- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

This course is offered on a part-time and full-time basis.

Part Time
Students are required to begin with the Foundations of Cyber module but then are free to undertake the modules as fits their own requirements; noting the compulsory rules which apply. Students are expected to study for no more than 20 credits at any one time. On average students are expected to study 40 to 60 credits per academic year.

Full Time
Students are required to begin with the Foundations of Cyber module and then follow the full time course schedule for the academic year in which they are studying. There are elelective module options that can be selected as fits their own requirements; noting the compulsory rules which apply. Students are expected to study for no more than 20 credits at any one time.

7. Course Level Assessment Strategy[4]

The varied assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. The pre-requisite module, Foundations of Cyber, will introduce students to masters level study, research techniques and academic writing and will be assessed through an essay. Assessments will be of varying lengths, recognising that writing articles to a short length can be more challenging for some and can develop different skills relevant to professional practice. The type of each assessment task is clearly stated within the module descriptor. Students will produce employability relevant policy briefing documents and reports to equip them with the skills they require to succeed in Cyber related roles and to address the specific award ILOs [1-18]. Students have opportunities to develop their communication skills, as they are required to give presentations. Skills development around problem definition, analysis and problem solving has translated into ILO [15]. Feedback is given immediately after any group activity. Modules are supported by a number of formative tasks including group discussion, case studies, oral presentations. Formative feedback is given verbally/written within the classroom/on the Virtual Learning Environment (VLE) following discussions from the module leader and oral feedback provided by the tutor and peers for presentations. Students are generally encouraged to support each other by asking and answering questions via the VLE. The taught components precede the dissertation, so assessment can be used to develop skills required for the individual research project. This is further supported by a dissertation workshop. Students are generally expected to be more self-directed in their learning during this research project and guidance will be provided through

[4] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

materials on the VLE and their supervisor. The research project specifically addresses ILOs 19-22 and takes the form of a Thesis.

Course modules

The following modules outline all parts of the programme leading to an **MSc**. Other awards associated with the course include some or all of these modules.

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
1	R-DEFCY-FMC	Foundations of Cyber	Dr Nikki Williams	30	0	10	Y	07/09/20	07/09/20	11/09/20	40	ICW	100%				21/09/20 FT 05/10/20 PT	AY 21/22
2	R-DEFCY-UR	Understanding Risk	Dr Natalie Clewley	36	0	10	N	07/09/20	N/A	08/01/21 end of online module	40	ICW	100%				11/01/21 FT/PT	AY 21/22
3	R-DEFCY-CA	Cyber Attack – Threats and Opportunities	Dr Duncan Hodges	30	0	10	N	07/09/20 PT 21/09/20 FT	28/09/20	02/10/20	40	ICW	100%				12/10/20 FT 26/10/20 PT	AY 21/22

[5] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[6] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[7] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[8] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[9] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear androgogical reason and where each element forms part of a continuous learning and assessment experience for students.
[10] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[11] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
4	R-DEFCY-ST	Social Technologies	Robert Black	72	0	10	Y	04/01/21 PT 18/01/21 FT	25/01/21	29/01/21	40	ICW	100%				08/02/21 FT 22/02/21 PT	AY 21/22
5	R-SISD-DLDS	Data Led Decision Support & Artificial Intelligence	Adam Zagorecki	30	0	10	Y	25/01/21 PT 08/02/21 FT	15/02/21	19/02/21	40	ICW	100%				01/03/21 FT 15/03/21 PT	AY 21/22
6	R-SISD-ETM	Emerging Technology Monitoring	Ian Owens	7		10	Y	11/01/21	1 Day residential 03/03/21	15/05/21 end of online module	40	ICW	100%				14/05/21 FT/PT	AY 21/22
7	R-DEFCY-IM	Incident Management	Ian Owens	35	0	10	N	09/11/20 PT 23/11/20 FT	30/11/20	04/12/20	40	ICW	100%				14/12/20 FT 06/01/21 PT	AY 21/22
8	R-DEFCY-CN	Critical Networks and Cyber-Physical Systems	Dr Duncan Hodges	30	0	10	N	A 19/10/20 PT 02/11/20 FT B 14 Dec 20 PT	09/11/20 11/01/21	13/11/20 15/01/21	40	ICW	100%				23/11/20 FT 07/12/20 PT 08/02/21 PT	AY 21/22

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
9	R-DEFCY-HD	The Human Dimension	Antoinette Caird-Daley	30	0	10	Y	A 28/09/20 PT 12/12/20 FT B 15/02/21	19/10/20 08/03/21	23/10/20 12/03/21	40	ICW	100%				02/11/20 FT 16/11/20 PT 07/04/21 PT	AY 21/22
10	R-DEFCY-CIMO	Cyberwarfare in Intelligence and Military Operations	Robert Black	72	0	10	N	28/09/20 PT 12/12/20 FT	19/10/20	23/10/20	40	ICW	100%				02/11/20 FT 16/11/20 PT	AY 21/22
11	R-SISD-STOV	Systems Thinking for Organisational Viability	Jeremy Hilton	35	0	10	Y	A 14/09/20 B 08/03/21 PT 22/03/21 FT	05/10/20 29/03/21	09/10/20 02/04/21	40	ICW	100%				02/11/20 PT 14/04/21 FT 28/04/21 PT	AY 21/22 AY 21/22
12	R-DEFCY-IO	Information Operations	Darren Lawrence	72	0	10	N	09/11/20 PT 23/11/20 FT	30/11/20	04/12/20	40	ICW	100%				14/12/20 FT 06/01/21 PT	AY 21/22
13	R-DEFCY-CL	Cyber Law	Rob Black	72	0	10	N	15/02/21 PT 01/03/21 FT	08/03/21	12/03/21	40	ICW	100%				22/03/21 FT 07/04/21 PT	AY 21/22

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Module Number	Module code	Title	Module Leader	Contact hours[5]	Total hours delivered by Visiting Lecturers [6]	Credits	Is the module shared? Y/N	Calendar			Assessment							
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[7] - 40% or 50%	Type of Assessment	Weighting within module[8] (%) of Independent assessments	Weighting within module of multi-part assessments [9](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[10]	Assessment Submission and/or exam date[11]	Assessment / Exam Retake date
14	R-DEFCY-CDE	Cyber Deception	Darren Lawrence	72	0	10	N	05/04/21 PT 19/04/21 FT	26/04/21	30/04/21	40	ICW	100%				10/05/21 FT 24/05/21 PT	AY 21/22
15	R-CYB-THESIS	Thesis Cyber Masters Programme	Antoinette Caird-Daley	48	0	80	N	Workshop Dates:	14/12/20 21/06/21	16/12/20 23/06/21								
								A 17/05/21 B 30/09/20 C 31/03/21			50	Thesis	100%				A 30/07/21 FT B 30/09/21 PT C 31/03/22 PT	Examiners Discretion

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Other course(s)/ programme(s) that use the module**
R-SISD-DLDS	Data Led Decision Support & Artificial Intelligence	Information Capability Management	Defence Cyber Masters Programme Defence and Security Programme
R-SISD-ETM	Emerging Technology Monitoring	Information Capability Management	Defence Cyber Masters Programme Defence and Security Programme
R-DEFCY-FMC	Foundations of Cyber	Defence Cyber Masters Programme	Defence and Security Programme
R-DEFCY-ST	Social Technologies	Defence Cyber Masters Programme	Defence and Security Programme
R-DEFCY-HD	The Human Dimension	Defence Cyber Masters Programme	Defence and Security Programme
R-SISD-STOV	Systems Thinking for Organisational Viability	Information Capability Management	Defence and Security Programme Defence Cyber Masters Programme

8. How are the ILOs assessed?

The following assessment types are utilised:

Formative Assessment:
Throughout the course each student will conduct a number of online activities, case studies and small 'project' like activities. As part of their online activities their contributions will be subject to peer review by fellow students, visiting lecturers and module leaders. A variety of approaches will be utilised for peer to peer collaboration including presentation of information gathering and analysis undertaken, essays, problem solving, analysis of case study scenarios (including: 'dilemma', 'puzzle', 'discussion', 'how to', and historical cases).

Summative Assessment:
Students can expect assessment on a variety of topics within the scope of the course via a piece of submitted coursework for each module. This approach has been adopted in order to present students with a variety of realistic problems that need to be solved using a variety of approaches which provide opportunities to demonstrate their ability to apply skills and knowledge developed on the course, many of which relate to situations that might be found in the workplace. To obtain an MSc, students must complete a dissertation, demonstrating their ability to apply the skills and knowledge gained on the course to a real world problem.

Assessment and ILO Mapping

A. CDIA Postgraduate Certificate

Award / ILOs / Module	CDIA														CSOps Only		
	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 11	ILO 12	ILO 13	ILO 14	ILO 15	ILO 16	ILO 17	ILO 18	ILO 8	ILO 9	ILO 10
FMC	ICW	ICW	ICW	ICW				ICW		ICW	ICW	ICW	ICW					

B. CsOps Postgraduate Certificate

Award / ILOs / Module	CDIA / CSOps														CSOps Only		
	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 11	ILO 12	ILO 13	ILO 14	ILO 15	ILO 16	ILO 17	ILO 18	ILO 8	ILO 9	ILO 10
FMC	ICW	ICW	ICW	ICW				ICW		ICW	ICW	ICW	ICW					
IO					ICW	ICW		ICW		ICW		ICW	ICW	ICW	ICW	ICW	ICW	
CIMO								ICW		ICW		ICW	ICW	ICW	ICW	ICW	ICW	ICW

C. CDIA/CsOps Postgraduate Diploma

Award / ILOs / Module	CDIA / CSOps														CSOps Only		
	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 11	ILO 12	ILO 13	ILO 14	ILO 15	ILO 16	ILO 17	ILO 18	ILO 8	ILO 9	ILO 10
FMC	ICW	ICW	ICW	ICW				ICW		ICW	ICW	ICW	ICW					
THD				ICW		ICW	ICW	ICW		ICW	ICW	ICW	ICW	ICW	ICW			
CATO		ICW	ICW	ICW		ICW	ICW	ICW		ICW		ICW	ICW	ICW	ICW			
IM	ICW		ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW		ICW	ICW	ICW	ICW			
CNCPS				ICW		ICW		ICW		ICW		ICW	ICW	ICW	ICW			
STOV	ICW	ICW		ICW			ICW	ICW	ICW	ICW		ICW	ICW					
DLDS	ICW							ICW	ICW	ICW		ICW	ICW					
ETM			ICW	ICW				ICW		ICW		ICW	ICW					
ST			ICW	ICW	ICW		ICW	ICW		ICW		ICW	ICW					
UR		ICW						ICW		ICW		ICW	ICW					
CD		ICW	ICW				ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW
CL			ICW					ICW		ICW	ICW	ICW	ICW	ICW	ICW	ICW		ICW
IO					ICW	ICW		ICW		ICW		ICW	ICW	ICW	ICW	ICW	ICW	
CIMO								ICW		ICW		ICW	ICW	ICW	ICW	ICW	ICW	ICW

D. CDIA and CsOps MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award / ILOs / Module	ILO 19	ILO 20	ILO 21	ILO 22
DISS	Thesis	Thesis	Thesis	Thesis

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A			

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a

Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. What opportunities are graduates likely to have on completing the course?

The course aims to ensure that graduates are better prepared to tackle the current and emerging demands of cyberspace. Given the rapidly changing nature of the threat and capability landscape this education will allow graduates to recognise emerging threats and respond effectively and proactively. As the course ties together a broad technical and business base, and is supported by a wide range of public and private sector organisations, the qualification will be noteworthy on the CVs of those wishing to move into strategic and operational positions in defence and businesses enabled by the information revolution.

COURSE SPECIFICATION

Cranfield University: Course Specifications

Course specifications outline the content and structure of a course leading to an award of Cranfield University. This version of the course specification has been approved by Education Committee and every effort has been made to ensure the accuracy of the information.

Date of first publication/latest revision: August 2020

1. What is the course?

Course information

Course Title	Cyber-Secure Manufacturing
Course code	MSCMIFTC, MSCMIPTC, PDCMIFTC, PDCMIPTC, PCCMIFTC, PCCMIPTC
Academic Year	20202021
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time / Part-time
Location(s)[1] of Study	Cranfield
School(s)	School of Aerospace, Transport, and Manufacturing
Theme	Manufacturing
Centre	Through-life Engineering Services Institute
Course Director	Dr Hongmei He
Awarding Body	Cranfield University
Is this an AP Contract course?[2]	No
Is this course offered as a Cranfield Mastership?	No
Apprenticeship Standard the course is mapped to	N/A
Is the Degree apprenticeship integrated or non-integrated?	N/A
Is the Mastership offered as an open and/or closed course?	N/A

[1] If any part of this course is delivered at another site, please note which one(s) here
[2] AP Contract courses are provided by Cranfield University to the MoD as part of the Academic Provider contract

20Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University entry requirements
UK Qualifications Framework Level	QAA FHEQ level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	Full-time MSc/PgDip/PgCert - one year Part-time MSc/PgDip – two or three years, Part-time PgCert – two years.
Course Start Month(s)	October (FT and PT)

Institutions delivering the course

This course is delivered by School of Aerospace, Transport, and Manufacturing, Manufacturing Theme, Manufacturing Informatics Centre where the research interests include:

The research of Manufacturing Informatics Centre focuses on new and emerging Information and Communications Technology (ICT) and methodologies for next-generation manufacturing, enabled by IoT technologies. Cybersecurity for manufacturing is one of our main research areas in the Manufacturing theme. Dr Hongmei He, Dr Mohammad Samie, and Dr Christos Emmanouilidis, have been engaging the research of cybersecurity and IoT security, Embedded System Security and working with industry for relevant projects. The course team has long experience in applying research results to underpin the teaching. Hence, our research in cybersecurity will also underpin the new MSc course.

Cranfield University remains fully responsible for the quality of the delivery of the course.

Accreditation by Public, Statutory or Regulatory Bodies (PSRBs)

Accreditation will be sought for IET, IMECHE, BCS and RAES which already accredit other Manufacturing courses. There are also plans to seek accreditation from GCHQ and the Institute of Information Security Professionals.

This course has certified the accreditation of IET and is planned to apply for the accreditation of BCS.

2. What are the aims of the course?

The aim of the course is to develop the next generation of manufacturing engineers who are able to protect manufacturing systems & machines against cyber threats.

The objective is to enable students to use cutting-edge technologies in IoT, Data Analytics, Cloud Computing and Cybersecurity to:

- Identify cyber threats to cyber-physical systems in the manufacturing sector
- Protect manufacturing systems from cyber attacks
- Improve incident response and disaster recovery in manufacturing systems
- Assess the cost of cybersecurity solutions for manufacturing systems

This programme is intended for the following range of students:

- Graduates from computer science, manufacturing and engineering and industry professionals who are able to work at Masters Level
- Especially, professionals from manufacturing and engineering industry or organisation, who want to update their knowledge and skills in cyber security, data analysis, IoT and cloud manufacturing,

may wish to take the part-time study for the MSc course or take some short courses from the MSc courses.

3. What should students expect to achieve in completing the course?

Award intended learning outcomes (ILOs) (skills and knowledge).

A. Postgraduate Certificate (PgCert)

In completing this course, and achieving the associated award, a diligent student should be able to:

ILO1 Analyse traditional and modern manufacturing environments and their operations, and evaluate their engineering challenges with regards to cybersecurity.

ILO2 Analyse hardware and system architectures (e.g. for IoT devices), and create security metrics, including vulnerabilities, threats, risks and solutions to improve the cyber security of manufacturing systems.

ILO3 Evaluate cloud architecture, properties, management services, security challenges and risks associated with different cloud deployment models.

ILO4 Evaluate advanced technologies to retrieve data from cloud and discover new information from big data, and manage data protection in cloud manufacturing.

ILO5 Setup up-to-date technologies and simulations to detect and prevent cyber-attacks, improve incident response and disaster recovery, assess cyber risks.

ILO6 Estimate the cost of cyber security solutions for the protection of machines and equipment in manufacturing systems.

B. Postgraduate Diploma (PgDip)

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO7 Develop models with cutting-edge data mining technologies to identify cyber threats, and evaluate the performance of the technical models for solving data-driven cyber-security issues.

ILO8 Analyse problems in the real world through investigative methods, systems thinking and anticipating futures to adapt to the fast changes of cyber –secure manufacturing environments.

ILO9 Identify research questions, develop project objectives and deliverables, and plan and execute a work programme with reference to key project management processes.

ILO10 Select and justify methodologies to solve real world problems in manufacturing and/or cyber security for manufacturing, and collect & analyse data, review and critically analyse literature, generate conclusions.

C. MSc

In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO11 Undertake and present independent research on a relevant topic, demonstrating the ability to conduct original investigations, test ideas, validate results and reach appropriate conclusions.

4. How is the course taught?

The main forms of teaching for the course are lecturing and lab sessions, plus a number of industry seminars. Each module will be assessed through exam or assignment (see the table of course modules in page 8).

In order to help students understand the new concepts and master new techniques, Enquiry-Based Learning (EBL) activities (e.g. group discussion, group poster, group presentation, case study, etc.) in class is another form of learning activities for selected modules, and the group work will be guided by the module leader.

- Modules will be live on the VLE two weeks prior to the start date of the module to allow pre-reading
- Group discussion will allow students in groups to explore a specific topic or solve a problem with the learned knowledge, technology and/or methodologies, and the evaluation or comments of the group work will be given by another group. This will help students understand the new technologies.
- Group poster: Each group of students is given a topic or real problem to be solved, and the group work will provide a solution through a poster, and the final evaluation/comments of the poster will be given by other groups.
- Group presentation: Each group of students is required to read the latest research paper in relevant area, and a group presentation will be provided. Other groups of students will question on the presentation. This will require students not only understand the latest research methodology, but also identify possible gaps and possible improvement.
- Case study: given a real problem, the lecturer will demonstrate how to use the introduced knowledge, technologies or methodology to solve the real problem through more interaction with students

For full time students, after completing all 8 modules, they will join a group project and complete an individual research project. All group or individual projects are coordinated with the Manufacturing Systems and Management programme. Each project will be supervised by a member of academic staff, also guided by an industry supervisor if it is an industry project.

For part time PgDip/MSc students, the group project (or dissertation (9b)) should be taken after completing the three modules: 01, 05, 06 (see the part-time learning path in page 6), and the individual research project should be taken after completing all the 8 modules.

Support for part-time students

Part-time students will be advised by the course director for scheduling their course study before they start, and during their course study.

The leader(s) of each module will answer PT students' query before and during their module study through meetings, emails, telephone or skype.

Module leader(s) will arrange an accessible tutorial two weeks after the module.

5. What do students need to achieve in order to graduate?

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the elements of the course, as laid out in Section 7. Courses are structured through the accumulation of credit, where 1 credit represents 10 notional learning hours.

In brief, students will normally need to achieve the following in order to be awarded the qualifications:

A. Postgraduate Certificate

The accumulation of 60 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules: 1, 3, 5 and 6	40
ELECTIVE MODULES:	
Select 2 from Modules 2, 4, 7 and 8	 20
Recommended	
Module 0: Induction	0
TOTAL:	60

B. Postgraduate Diploma

The accumulation of 120 credits (or more) through the assessment of taught modules as detailed below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules: 1 - 8 Module 9a Group Project	80 40
Recommended	
Module 0: Induction	0
TOTAL:	120

PART TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 1 – 8	80
ELECTIVE MODULES:	
Group Project (9a) or Dissertation (9b).	40
Recommended	
Module 0: Induction	0
TOTAL:	120

C. MSc

In addition to the requirement for the Postgraduate Diploma outlined above, students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

FULL TIME STUDENTS

Description	Credits
COMPULSORY MODULES:	
Modules 1 - 8 Module 9a: Group Project Module 10: Individual Research Project	80 40 80
Recommended	

Module 0: Induction	0
TOTAL:	200

PART TIME STUDENTS

Description	**Credits**
COMPULSORY MODULES:	
Modules 1 – 8 Individual Research Project (10)	80 80
ELECTIVE MODULES:	
Group Project (9a) or Dissertation (9b).	40
Recommended	
Module 0: Induction	0
TOTAL:	200

If a student does not meet the required standards for the award, the examiners for the programme may decide to offer a lower award associated with the programme, providing that a lower exit award exists and the student meets the requirements of that award.

Pass Criteria
The University operates standard pass criteria which can be found in the Senate Handbook on Assessment Rules.

In order to achieve your award, you are required to achieve:

- An overall average mark of ≥50%;
- An average mark of ≥50% across the taught assessment;
- All assessments need to be completed and the minimum mark attained: no more than one failure to complete an assessment (as defined in Section 2.3) will be permitted throughout the course of your studies (Please note that the board of examiners does not have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[3] [4]
- **For Taught Assessments,** the minimum mark for each individual taught assessment on the first attempt for the significant majority of the taught assessments, noting that:
  - if you fail to attain the minimum mark for **up to 30 learning credits**, you will be permitted to re-take all of those assessments (except for circumstances where a resit award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);
  - if, having failed to attain the minimum mark for 30 learning credits, you fail to obtain the minimum mark for **any additional learning credits** over the course of your studies you will be disqualified from the right to re-take the assessments: this will normally result in intended

[3] For students who were registered before 1 August 2015, the requirement to obtain a minimum mark for a taught assessment will not apply for taught assessment taken before 31 August 2015 (unless the assessment was designated as a "key assessment" under the previous Assessment Rules).

[4] Providing the minimum mark is met, a mark of 40-49% will be automatically compensated if a student's overall average taught assessment mark (including the failed assessment) is greater than 50%. Students are advised, however, that they retain the right to re-take an assessment with a mark of <40% (but should note that a re-take attempt will be capped at 50%), as long as they haven't failed more than 30 credits. At the discretion of the Board of Examiners or by Board of Examiners Chair's Actions a student may be permitted a re-take attempt of modules in the range of 40-49% only if the average mark of their other taught modules would not allow them to qualify for their award (<50%).

award failure. (Please note the board of examiners may at its discretion overrule this limit, but this is not an automatic right);
    - it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.
- **For Substantial pieces of assessment** (corresponding to ≥40 credits, which are not part of the taught assessment average), the pass mark of ≥50% (where they exist);
- **For the thesis,** a mark of ≥50% in order to receive a pass (where it exists).

6. How is the course structured?

Full time MSc/PgDip/PgCert students register for the course in October of each academic year and are expected to complete the course within 12 calendar months.

The course includes 8 taught modules, group project (for PgDip and MSc students) and an individual research project (for MSc students). Part-time students (PgDip and MSc) are encouraged to take the Group Project component and only in exceptional circumstances, and with approval from the Group Project Co-ordinator, will be permitted to replace the Group Project with an individual dissertation.

Each taught module will be taught over one week with further self-study required, and will be assessed by exam or coursework.

The learning path for the part time students is outlined hereafter.

A. Part-time PgCert

Part-time PgCert students have to complete 6 taught modules as required in Section 5.A over a period of 2 years. Induction is strongly recommended and can alternatively be delivered via the VLE. The learning path of PgCert is illustrated in the following table:

Year 1	Year 2
Successful completion of three modules, including two core modules and an optional module: • 01 Industrial Cybersecurity Challenges and Strategies • 03 IoT Security and Systems • A module to be decided with the course director	Successful completion of three modules, including two core modules and one optional module: • 05 Hardware-level Cybersecurity • 06 Cybersecurity of Machine Tool Systems • A module to be decided with the course director.

B. Part-time PgDip

Part time PgDip students have to complete 8 taught modules and a dissertation as required in Section 5.B over a period of 3 years. Induction is strongly recommended and can alternatively be delivered via the VLE. Two scenarios depending on the length of studies:

2 years study plan	3 years study plan
1st year: Successful completion of four modules (three core and one elective) and a Dissertation: • 01 Industrial Cybersecurity Challenges and Strategies • 05 Hardware-level Cyber Security	1st years: Successful completion of three modules: • 01 Industrial Cybersecurity Challenges and Strategies • 03 IoT Security and Systems • A module to be decided with the course director.

• 06 Cybersecurity of Machine Tool Systems • A module to be decided with the course director • Module 9b (Feb– Aug) (PgDip)	2nd year: Successfully completion of the two modules and a Dissertation as below: • 05 Hardware-level Cyber Security • 06 Cybersecurity of Machine Tool Systems • Module 9b (Feb – Aug.) (PgDip)
2nd year: Successful completion of remaining modules as required in Section 5.B for PgDip.	3rd year: Successful completion of the remaining modules as required in Section 5.B for PgDip.

C. Part-time MSc

Part time MSc students have to complete 8 taught modules, Group Project or dissertation and individual research project as required in Section 5.C over a period of 3 years. Induction is strongly recommended and can alternatively be delivered via the VLE. Two scenarios depending on the length of studies:

2 years study plan	3 years study plan
1st year: Successful completion of four modules (three core modules and one elective) and a Dissertation : • 01 Industrial Cybersecurity Challenges and Strategies • 05 Hardware-level Cyber Security • 06 Cybersecurity of Machine Tool Systems • a module to be decided with the course director • Module 09a/b –Group Project/Dissertation (Feb – Aug.) (MSc)	1st years: Successful completion of four modules: • 01 Industrial Cybersecurity Challenges and Strategies • 03 IoT Security and Systems • 05 Hardware-level Cyber Security • A module to be decided with the course director 2nd year: Successful completion of two modules and an individual dissertation: • 04 Secure Cloud-based Manufacturing • 06 Cybersecurity of Machine Tool Systems • Module 09a/b – Group Project/Dissertation (Feb – Aug.) (MSc)
2nd year: Successful completion of remaining modules as required in Section 5.C for MSc. Completion of individual research project (Feb – Aug) (MSc)	3rd year: Successful completion of the remaining modules as required in Section 5.C for MSc. Completion of individual research project (Feb – Aug) (MSc)

7. Course Level Assessment Strategy[5]

The assessment tasks are challenging and enable students to demonstrate a full range of skills and attributes. In the eight compulsory modules, the three modules of “operations management”, “Industrial cybersecurity challenges and strategies” and “data analytics for cyber-attack detection”, The pre-requisite modules, will introduce students core factors of managing operations, modern manufacturing environment

[5] Guidance to aid colleagues writing or updating a course-level assessment strategy for inclusion in the Course Specification can be found as Appendix K in either the Senate Handbook on Setting up a New Taught Course or the Senate Handbook on Managing Taught Courses https://intranet.cranfield.ac.uk/EducationServices/Pages/SenateHandbooksA-Z.aspx

and associated engineering challenges and strategies in cybersecurity, as well as working knowledge of using different data mining techniques to identify cyber threats to a manufacturing system, and they will be assessed through exams, thus demonstrating students have implemented ILOs 1, 4, 7. The requirements of exams have been provided in the module descriptors. The remaining five modules, such as “IoT Security and Systems”, “Secure cloud-based manufacturing”, “Cybersecurity of Machine Tool Systems”, “Hardware-level Cyber Security”, and “Cyber Thinking and Practice in Manufacturing”, will provide students cyber security technology from hardware, machine tool systems, internet of things to cloud. These modules will be assessed through essays and reports, thus developing different skills relevant to professional practice. The length of each assessment task is clearly stated within the module descriptor. Students will write employability relevant policy briefing documents to equip them with the skills they require to succeed in areas of cybersecurity, advanced IoT and cloud, to demonstrate the implementation of specific ILOs 1-8. Students then have opportunities to develop their communication skills through a group project, for which, they are required to give a group presentation and individual presentation. The ability to work effectively in groups is a highly desirable skill which has translated into ILOs 8-10. Feedback is given immediately after the group presentation. Modules [9a,9b] are supported by a number of formative tasks including group discussion, case studies, oral presentations. Formative feedback is given verbally within the classroom following discussions, via a written summary for case studies from the module leader and oral feedback provided by the tutor and peers for presentations. Students will also engage with an interactive learning activity which incorporates formative feedback. For module [9a,9b] peer review informs practice and tutorials guide progress, students are generally encouraged to support each other by asking and answering questions via the VLE. The taught components precede the research project, so assessment can be used to develop skills required for the individual research project (module 10). Students are generally expected to be more self-directed in their learning during this research project and guidance will be provided through their supervisors from academic and/or industry, if the project is sponsored by or has an industry partner. The research project addresses ILOs 8-11, and it is to demonstrate the MSc candidate’s ability to conduct original investigations on a specific problem, which could be an industry project, and to produce appropriate conclusions after reviewing the state of arts in the relevant topic. The student is required to communicate their findings in a Thesis in the style of a scientific paper, and provide an oral presentation based on a poster.

Course modules

The following modules outline all parts of the programme leading to MSc. Other awards associated with the course include some or all of these modules.

Mo	Mod	Title	Module Leader	Contact	Total hour	Credits	Is the	Calendar				Assessment						
												Independent Assessment		Multi-part Assessment			Submission dates	
Module Number	Module code	Title	Module Leader	Contact hours[8]	Total hours delivered by Visiting Lecturers	Credita	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	Module Delivery Start Date	Module Delivery End Date	Minimum Mark[9] - 40% or 50%	Type of Assessment	Weighting within module[10] (%) of Independent assessments	Weighting within module of multi-part assessments	Type of Assessment	Weighting of individual elements of multi-part assessment[12]	Assessment Submission and/or exam date[13]	Assessment / Exam Retake date
0	I-MAN-INWK	Induction	Prof Konstantinos Salonitis	18		0	Y	29/09/20	28/09/20	02/10/20	N/A	AO	N/A	N/A	N/A	N/A	N/A	N/A
1	I-CMI-ICCS	Industrial Cybersecurity Challenges and Strategies	Dr Hongmei He	32	4	10	N	19/10/20	19/10/20	23/10/20	40	EX	100				16/12/20	Manufacturing resit exams will be during week commencing: 17/05/21

[6] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[7] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[8] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[9] A mark of 50% is required to pass the assessment however, where the stated minimum mark is 40%, a mark of 40-49% may be compensated by good performance in other modules providing that the overall average is ≥50%.
[10] For **independent assessments** please record type and weighting of each separate piece of assessment individually. 10 credit modules should be designed to allow assessment through a single independent summative assessment. Deviations will require approval by the School Director of Education
[11] For **multi-part assessments** please record the overall weighting of module which should be 100%. Multipart assessments should only be included in courses where there is a clear andragogical reason and where each element forms part of a continuous learning and assessment experience for students.
[12] Failure to submit an element of a **multi-part assessment** will **not** require remedial action if the absence of the marks for the assignment still results in a pass for the assessment (whether 40 or 50% as appropriate*)*. If, however, the absence of marks fails to meet the minimum mark for the module then **all** elements of the assessment must be re-taken.
[13] Please ensure you include submission dates for both FT and PT students and that you give details of the submission date for each individual element of a multi-part assessment.
Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

2	I-MNU-A1034	Operations Management	Mr John Patsavellas	32	0	10	Y	05/10/20	05/10/20 Stream 1 12/10/20 Stream 2 Occ A	09/10/20 Stream 1 16/10/20 Stream 2	40	EX	100				14/12/20	Manufacturing resit exams will be during week commencing: 17/05/21
3	I-CMI-IOTSS	IoT Security and Systems	Dr Christos Emmanouilidis	32	12	10	N	23/11/20	23/11/20	27/11/20	40	ICW	100				11/01/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
4	I-CMI-SCM	Secure Cloud based Manufacturing	Dr Yifan Zhao	32	6	10	N	30/11/20	30/11/20	04/12/20	40	ICW	100				11/01/2021	Re-assessment date to be set by agreement of the Module Leader as/when required.
5	I-CMI-HCS	Hardware-level Cyber Security	Dr Mohammad Samie	32	2	10	N	09/11/20	09/11/20	13/11/20	40	ICW	100				07/12/20	Re-assessment date to be set by agreement of the Module Leader as/when required.
6	I-CMI-CMTS	Cybersecurity of Machine Tool Systems	Dr Saba Al-Rubaye	33	2	10	N	11/01/21	11/01/21	15/01/21	40	ICW	100				08/02/21	Re-assessment date to be set by agreement of the Module Leader

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

																		as/when required.
7	I-CMI-DACD	Data Analytics for Cyberattack Detection	Dr Hongmei He	32	9	10	N	02/11/20	02/11/20	06/11/20	40	EX	100				18/12/20	Manufacturing resit exams will be during week commencing: 17/05/21
8	I-CMI-CTPM	Cyber Thinking & Practice in Manufacturing	Mr Jeremy Hilton, Mrs Lorraine Dodd	32	0	10	N	25/01/21	25/01/21	29/01/21	40	ICW	100				22/02/21	Re-assessment date to be set by agreement of the Module Leader as/when required.
9a	I-MAT-GRPP	Group Project	Dr David Ayre	20	0	40	Y	01/02/21	01/02/21 Occ A FT	27/04/21 FT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/04/21 04/05/21 04/05/21 04/05/21	
			Dr Supriyo Ganguly						01/02/21 Occ B PT	27/08/21 PT	50	GCW ICW	80 20		GPRES GPROJ ICW Observed behaviour	20 80 50 50	27/08/21 01/09/21 01/09/21 01/09/21	
9b	I-MAT-DISS	Dissertation	Dr Muhammad Khan	20	0	40	Y	08/02/21	08/02/21	31/08/21	50	ICW	100				27/08/21	
10	I-MNU-THESIS	Individual Research Project	Dr Muhammad Khan	20	0	80	Y	08/02/21	Occ A = PT 08/02/21	PT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/21	
								30/04/21	Occ B = FT	FT 27/08/21	50	THESIS OR	90 10				27/08/21 01/09/20	

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

			Dr Muhammad Khan						30/04/21									

Assessment Types: AO – Attendance only; ICW – Individual Coursework; GCW – Group Coursework; IPRES – Individual Presentation; GPRES – Group Presentation; IPRAC – Individual Practical; GPRAC – Group Practical; IPROJ – Individual Project (>20 credits); GPROJ – Group Project (>20 credits); EX – Examination; RP – Reflective Portfolio; OR- Viva Voce examination; THESIS – Thesis; MULTI – Multi-part Assessment

Please list all modules that are used by another existing course.

Module code	**Module title**	**Course that owns the module**	**Course(s)/programme(s) that share the module**
I-MAN-INWK	Induction	Manufacturing Systems and Management Programme	Aerospace Manufacturing, Management and Information Systems, Global Product Development and Management, Engineering and Management of Manufacturing Systems
I-MNU-A1034	Operations Management	Engineering and Management of Manufacturing Systems	Aerospace Manufacturing, Global Product Development and Management, Management and Information Systems, Manufacturing Technology and Management, Engineering Competence
I-MNU-GRPP	Group Project	Advanced Materials	Aerospace Materials, Manufacturing Technology and Management, Aerospace Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Welding Engineering, Metal Additive Manufacturing
I-MAT-DISS	Dissertation for Part Time Students	Advanced Materials	Aerospace Materials, Manufacturing Technology and Management, Aerospace Manufacturing, Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems, Welding Engineering, Metal Additive Manufacturing

I-MNU-THESIS	Individual Research Project	Advanced Materials	Engineering and Management of Manufacturing Systems, Global Product Development and Management, Management and Information Systems. Aerospace Materials, Manufacturing Technology and Management, Welding Engineering, Aerospace Manufacturing, Metal Additive Manufacturing

8. How are the ILOs assessed?

The following assessment types are utilised:
Exam, coursework, group presentation, oral presentation, thesis and group project report or work-based dissertation

This approach has been adopted because:

Question papers are used primarily to assess knowledge, understanding and cognitive skills, such as reasoning, analysing and evaluating, while an assignment is a problem solving task with clear guidelines and structure. The modules are at QAA FHEQ level 7 (Masters), and will be assessed by a combination of question papers and coursework assessments. To assess the ILOs, each module has been assigned different assessment approaches based on the features of modules. For example, the modules of "Modern Manufacturing and Security Challenges", "Operations Management" and "Data Mining Technology for Cyber Threat Identification" will be assessed through exam. The modules "Secure Cloud Manufacturing", "Secure IoT and System Architecture", "Secure Cloud Manufacturing", "Manufacturing System Engineering", "Cybersecurity of Machine Tool Systems" are assessed with coursework, and "Cyber Thinking & Practice in Manufacturing" is assessed through group presentation and individual course work.

Assessment and ILO Mapping

Complete the grid below by inserting in the boxes which assessments from the modules directly assess the Award ILOs.

(Module numbers should correspond with those used in the Course module table above.)

A. Postgraduate Certificate

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8
1	EX							
2	EX							
3		ICW			ICW	ICW		
4			ICW	ICW			ICW	
5	ICW	ICW			ICW			
6		ICW	ICW		ICW	ICW		ICW
7				EX			EX	

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8
8	GPRES ICW			GPRES ICW		GPRES ICW		GPRES ICW

B. Postgraduate Diploma

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO8	ILO9	ILO10
5			
9a	GPROJ GPRES	GPROJ GPRES	GPROJ GPRES
9b	ICW	ICW	ICW

C. MSc

In addition to those outlined above, the Award intended learning outcomes are assessed by the following module assessments:

Award ILOs / Module No.	ILO8	ILO9	ILO10	ILO11
10	THESIS	THESIS	THESIS	OR THESIS

CROSS-MODULAR ASSESSMENT (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)
N/A	N/A	N/A	N/A
		N/A	N/A

9. How will the University assure the quality of the provision?

New course proposals are reviewed by a Course Validation Panel, comprising at least the following membership: normally one subject matter expert external to the School or University, at least 3 academic staff not associated with the proposal. The Panel may include 1 member of professional staff. Panels are supported by an appropriately trained Secretary who provides authoritative guidance on policy and procedure to the Panel. Proposals are reviewed in line with the UK Quality Code for Higher Education. New courses are ultimately approved by the University's Education Committee, on behalf of Senate.

Course changes are approved by the School's Director of Education on behalf of Education Committee and Senate. Significant changes to a course will be referred to a Course Review Panel at the discretion of the Director of Education.

The University has in place regular monitoring procedures for quality assurance including an Annual Reflective Review for each course and an in depth 6 year review of each School's (total) educational provision known as the Senate Review.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guiding principles to meet the Expectations and Core Practices of the UK Quality Code for Higher Education. External examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

Each course has a formally constituted Examination Board, which includes the External Examiner, and which is responsible for ensuring that awards are made within the Regulations of the University and that students are made awards on the basis of meeting the specified Intended Learning Outcomes of a course at the appropriate standard.

Each course has a formally constituted Course Committee which meets at least twice a year to discuss, inter alia, programme design and planning, the student experience (including feedback) and student progress.

Each course has an Industry Advisory Panel (or similar) which meets at least once a year to engage with external stakeholders on curriculum design and currency of course content.

Student feedback both qualitative and quantitative is collected for each module studied. In addition students are invited to participate in the University's annual New Student Survey and Student Satisfaction Survey along with the annual national Postgraduate Taught Student Experience Survey. The results of all feedback are considered by the Course Committee and additionally, in respect of the University and national surveys, issues of quality are considered by and acted on where appropriate by the Education Committee, Senate, School and University Executives.

New Partnership arrangements are considered in two stages:

1. The University Executive is responsible for ensuring appropriate due diligence has been undertaken in respect of the University's legal, financial, reputational and ethical responsibilities.
2. A Partnership Delivery Approval Panel then considers whether the proposal meets the UK Quality Code for Higher Education. The delivery of new partnership provision is ultimately approved by the Universities Education Committee, on behalf of Senate.

Year one partnership reviews are undertaken one year after the initiation of a new partnership involving academic (award bearing) provision. The aim is to provide a supportive framework to assist the Sponsoring School and its new Partner Institution to work collaboratively to ensure that: the learning and teaching provision and associated student experiences are of a high standard; and that those responsible for delivering the provision are undertaking their respective roles and responsibilities in an appropriate way.

As part of the regular monitoring procedures for established collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focused Review which looks at each partnership in depth. Occasional site inspection visits are also made.

10. <u>What opportunities are graduates likely to have on completing the course?</u>

With the capacity and ability, our graduates can undertake the jobs in manufacturing informatics and engineering, cyber security, IoT, Cloud Computing, Big Data Analytics, after the completion of the degree course. For PT students who are already working, such a course could help them change the role in their work, leveraging the knowledge and skills gained on the MSc, to progress in their careers.

Jobs in Manufacturing Digitalisation and Manufacturing Engineering: conducted by labour market analytics and consulting firm Burning Glass[14], in the future, engineering & advanced manufacturing is one

of main job markets that graduates are looking to. On completion of the Master's degree course, our students will be able to protect future manufacturing systems against cyber-attacks.

Jobs in Cybersecurity: With growing concerns about network vulnerability, the demand for cyber security experts is growing at 12 times the overall job market, according to Burning Glass[15]. The Cybersecurity Challenge UK is working with businesses to deliver two pilot schemes – a Cybersecurity mentoring scheme and a series of 'cyber camps', to promote career opportunities in the businesses involved and the wider cybersecurity profession[16]. The cyber security market size is estimated to grow from USD 122.45 Billion in 2016 to USD 202.36 Billion by 2021, at a Compound Annual Growth Rate (CAGR) of 10.6% during the forecast period. 2015 is considered to be the base year while the forecast period is 2016–2021[17].

Jobs in IoT: While today there are just 300,000 developers contributing to the IoT, a new report from VisionMobile (http://www.visionmobile.com/) projects a market requiring 4.5 million developers by 2020, reflecting a 57% compound annual growth rate and a massive market opportunity[18].

Jobs in cloud computing: One of the most evident effects of the shift to Cloud technologies is that there is a growing demand for a more balanced focus between business development and application development. In job markets, positions for Cloud Specialists "will provide design, engineering and expertise of the cloud environment"; Cloud Computing Architect is "seating in a critical role to drive the architect/design and implementation for cloud-based solutions"[19]

Jobs in Big Data Analytics: Data technology and data science has an incredible rise over the past few years. Enterprise in every industry is investing to be more data-driven in how they do business. This movement has enabled the job market for data tech and data science expertise to grow at an exponential pace. "*By 2018, the United States alone could face a shortage of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analysts with the know-how to use the analysis of big data to make effective decisions".*[20]

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[15] The demand for cyber security experts is growing at 12 times the overall job market

[16] http://cybersecuritychallenge.org.uk/education/university-mentoring-and-cyber-camps/

[17] Cyber Security Market by Solutions (IAM, Encryption, DLP, UTM, Antivirus/Antimalware, Firewall, IDS/IPS, Disaster Recovery), Services, Security Type, Deployment Mode, Organization Size, Vertical & Region - Global Forecast to 2021, marketsandmarkets.com, July 2016, Report Code: TC 3485.

[18] MATT ASAY, The Internet Of Things Will Need Millions Of Developers By 2020, 27 Jun, 2014. http://readwrite.com/2014/06/27/internet-of-things-developers-jobs-opportunity.

[19] Andrea Colangelo, How Cloud Computing is changing the job market, February 18, 2014.

[20] Frank Lo, The State of Big Data Recruiting: A closer look into the exploding demand for big data expertise, https://datajobs.com/big-data-jobs-recruiting, 2016.