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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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE: MSc in Advanced Lightweight Structures and Impact

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Date of first publication/latest revision: March 2016

1. What is the course?

Course information

Course Title	MSc in Advanced Lightweight Structures and Impact
Course code	MSALSFTC, PDALSFTC, PCALSFTC
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time
Location 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
Teaching Institution	Cranfield University
Admissions body	Cranfield University
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 (PSRB)

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 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:	
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 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
    - o 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);
    - o 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);
    - o 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 October and are expected to complete the course within twelve 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.

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[1] 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).

[2] 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%).

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment			Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[6] (%) of Independent assessments		Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-ALS-INWK	Induction Week (ALSI Course)	Dr Hessam Ghasemnejad	16		0	N		Sept 2016	Sept 2016	N/A	AO	N/A					N/A	
2	N-ALS-ACAS	Advanced Composite Analysis and Simulation	Dr Hessam Ghasemnejad	20		10	N		03/10/16	07/10/16	40	ICW	100					18/11/16	20/01/17
3	N-ALS-ICM	Introduction to Continuum Mechanics	Dr Iman Dayyani	20		10	N		24/10/16	28/10/16	40	EX	100					09/01/17	June 2017
4	N-ALS-TS	Thin-walled Structures	Dr Yigeng Xu	20		10	N		07/11/16	11/11/16	40	EX	100					13/01/17	June 2017

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar			Independent Assessment		Multi-part Assessment			Submission dates	
5	N-ALS-FEM	Finite Element Methods	Dr Iman Dayyani	30		10	N		21/11/16	25/11/16	40	EX	100				20/03/17	June 2017
6	N-ALS-MCS2	Materials Characterisation for Simulation	Dr Mehdi Yasaee	20		10	N		05/12/16	09/12/16	40	ICW	100				20/01/17	20/03/17
7	N-AVD-SS	Structural Stability	Dr Wenli Liu	20		10	Y		23/01/17	03/02/17	40	EX	100				24/04/17	June 2017
8	N-ALS-CRASH	Crashworthiness	Dr Hessam Ghasemnejad	30		10	N		06/02/17	10/02/17	40	ICW	100				24/03/17	24/05/17
9	N-ALS-SIC	Simulation for Impact and Crashworthiness	Dr Mehdi Yasaee	20		10	N		20/02/17	24/02/17	40	ICW	100				07/04/17	07/06/17
10	N-ALS-GA	Group Design Project	Dr Mehdi Yasaee	20		40	N		13/03/17	26/05/17				100 GPROJ	GPRES GCW	20 80	31/05/17	N/A
11	N-ALS-THES	Individual Research Project	Dr Hessam Ghasemnejad	20		80	N		29/05/17	25/08/17				100 THESIS	IPRES THESIS	20 80	15/09/17	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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-AVD-SS	Structural Stability	Aerospace Vehicle Design	Aerospace Vehicle Design

7. 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.

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			

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

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.

COURSE TITLE:	MSc in Advanced Materials

Date of first publication/latest revision: June 2016

1. What is the course?

Course information

Course Title	MSc in Advanced Materials
Course code	MSADMFTC, MSADMPTC, PDADMFTC, PDADMPTC, PCADMFTC, PCADMPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Surface Engineering & Nanotechnology Institute
Course Director	Dr David Ayre
Awarding Body	Cranfield University
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, two-five years part-time
Course Start Month(s)	Full-time: October. Part-time: throughout the year.

Institutions delivering the course

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

- Composites.
- Surface science and engineering.
- Welding.
- Ultra precision engineering
- Microsystems and Nanotechnology.

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) up to and including Academic year 2019-20, Institution of Engineering and Technology (IET) up to and including Academic year 2019-20, Royal Aeronautical Society (RAeS) up to and including Academic year 2019-20, Institute of Materials, Minerals and Mining (IOM3) up to and including Academic year 2018-19 and The Welding Institute (TWI) up to and including Academic year 2017-18.

2. What are the aims of the course?

Cranfield University offers this course in order to:

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

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 a basic understanding of fracture mechanics and an awareness of approaches to failure assessment.
ILO 4.   Demonstrate a 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 5.   Make effective use of finite element analysis programmes.
ILO 6.   Demonstrate a knowledge of specific materials and their applications, including metals, polymers, ceramics and composites.
ILO 7.   Use basic principles of materials selection for engineering and other applications.
ILO 8.   Make effective use of information technology.
ILO 9.   Demonstrate an ability in practical approaches to problem solving.
ILO 10. Critically evaluate data.

B. **Postgraduate Diploma**

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

ILO 11. Demonstrate a knowledge of some key general, personnel and project management techniques and an awareness of the less science-dependent aspects of technology.
ILO 12. Demonstrate an awareness of current research/development in selected topics in the field of materials.
ILO 13. Make effective oral and written presentation of their work.
ILO 14. Operate effectively in a team.
ILO 15. Undertake an appraisal of technical and/or commercial literature.
ILO 16. Work effectively under time pressure.

C. **MSc**

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

ILO 17. Demonstrate a critical awareness of current research/development in selected topics in the field of materials.
ILO 18. Undertake substantial critical appraisal of technical and/or commercial literature.
ILO 19. Carry out substantial scientific programmes of study.
ILO 20. Discuss their work and relate it to the work of others.

ILO 21.   Demonstrate originality in the application of knowledge in relation to an extended individual project.

ILO 22.   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 Blackboard™ 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 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 2,3,7	30
ELECTIVE MODULES:	
Three Modules from 4, 6, 8, 9	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:

Description	Credits
COMPULSORY MODULES:	
Modules 2 to 9 Group Project for full-time students (11a) or Dissertation for part-time students (11b)	80 40
ELECTIVE MODULES:	
*Optional module 10 if available for part time students, plus choose modules to total 8 from taught modules 2 to 9	
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:

Description	Credits
COMPULSORY MODULES:	
Modules 2 to 9	80
Group Project for full-time students (11a) or Dissertation for part-time students (11b)	40
Individual Research Project (12)	80
ELECTIVE MODULES:	
*Optional module 10 if available for part time students, plus choose modules to total 8 from taught modules 2 to 9	
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> 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);

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[1] 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).

[2] 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%).

- o 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);
  - o 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 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. For part-time Students the Group Project component is replaced by a dissertation.

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, 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.

6

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment					
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]		Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-MAT-INWK	Introduction	Dr Sue Impey	26		0	Y		03/10/16	06/10/16	n/a	AO	n/a					n/a	
2	I-MAT-A1009	Introduction to Materials Engineering	Dr David Ayre	30		10	Y		07/10/16	14/10/16	40	EX	100					04/01/17	Manufacturing resit exams will be during week commencing 18/09/17
3	I-MAT-A1011	Machining, Moulding and Metrology	Dr Isidro Durazo-Cardenas	30		10	Y		24/10/16	28/10/16	40			100 MULTI	ICW GPRES	70 30		11/11/16	Re-assessment date to be set by agreement of Course Director

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		and Module Leader as/when required.
4	I-MAT-A1015	Failure of Materials and Structures	Dr David Ayre	32		10	Y		14/11/16	18/11/16	40	EX	100				16/12/16	Manufacturing resit exams will be during week commencing 18/09/17
5	I-MNU-A1018	General Management	Dr Yuchun Xu	32		10	Y		21/11/16	25/11/16	40	EX	100				06/01/17	Manufacturing resit exams will be during week commencing 18/09/17
6	I-MAT-A1014	Finite Element Analysis	Dr Glenn Leighton/ Dr Renaud Jourdain	35		10	Y		05/12/16	09/12/16	40			100 MULTI	ICW ICW	40 60	20/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
7	I-MAT-A1017	Materials Selection	Dr Sue Impey/ Dr David Ayre	34		10	Y		09/01/17	13/01/17	40	ICW	100				30/01/17	Re-assessment date to be set by agreement of Course Director and 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
8	I-MAT-A1016	Surface Science and Engineering	Prof John Nicholls	30		10	Y		23/01/17	27/01/17	40	ICW	100				06/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
9	I-MAT-A1013	Composites Manufacturing for High Performance	Andrew Mills	35		10	Y		31/10/16	04/11/16	40	ICW	100				02/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
10	N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures (option when available)**	Prof Philip Irving	35		10	Y		10/07/17	14/07/17	40	ICW	100				11/09/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
11a	I-MAT-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		06/02/17	28/04/17				80 MULTI 20 MULTI	GPRES GPROJ ICW observed behaviour	16 64 10 10	28/04/17	

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	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[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
11b	I-MAT-DISS	Dissertation for Part Time Students	Dr Sue Impey/ Dr David Ayre	20		40	Y		01/02/17	31/08/17		ICW	100				31/08/17	
12	I-MAT-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		02/05/17 †	04/09/17 †		THESIS OR	90 10				04/09/17 †	

**Timescales suit for part time students only
† Dates for Full time students only. Part time students have flexibility with dates in this component

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-MAT-INWK	Introduction	Manufacturing Technology and Materials Programme	Welding Engineering, Applied Nanotechnology, Aerospace Materials
I-MAT-A1009	Introduction to Materials Engineering	Advanced Materials	Aerospace Materials, Manufacturing Technology and Management
I-MAT-A1011	Machining, Moulding and Metrology	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	Applied Nanotechnology, Manufacturing Technology and Management, Global Product Development and Management, Management and Information Systems, Manufacturing Consultancy, Knowledge Management for Innovation, Engineering & Management of Manufacturing Systems
I-MAT-A1014	Finite Element Analysis	Advanced Materials	Applied Nanotechnology, Manufacturing Technology and Management, Aerospace Materials
I-MAT-A1017	Materials Selection	Advanced Materials	Aerospace Materials
I-MAT-A1016	Surface Science and Engineering	Advanced Materials	Manufacturing Technology and Management, Aerospace Materials
I-MAT-A1013	Composites Manufacturing for High Performance	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
I-MAT-GRPP	Group Project for Full Time Students	Manufacturing Technology and Materials Programme	Aerospace Materials, Applied Nanotechnology, Manufacturing Technology and Management
I-MAT-DISS	Dissertation for Part Time Students	Manufacturing Technology and Materials Programme	Aerospace Materials, Applied Nanotechnology, Manufacturing Technology and Management
I-MAT-THESIS	Individual Research Project	Manufacturing Technology and Materials Programme	Aerospace Materials, Applied Nanotechnology, Manufacturing Technology and Management

7. 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	ILO10
2	EX		EX		EX				EX
3			ICW				ICW	ICW	
4		EX							EX
6				ICW			ICW	ICW	
7	ICW		ICW		ICW	ICW	ICW	ICW	ICW
8			ICW				ICW	ICW	
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.	ILO11	ILO12	ILO13	ILO14	ILO15	ILO16
5	EX					
11a or b		GCW	GCW	GCW ICW	GCW	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.	ILO17	ILO18	ILO19	ILO20	ILO21	ILO22
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 (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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.

COURSE TITLE:	Applied Mathematics and Operational Research Programme (AMOR)

Date of first publication/latest revision:	August 2016

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 – PCMOR-FTR – PDMORFTR - MSMORPTR – PCMOR-PTR – PDMORPTR iii. SPAMRPTR
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert (both DSM and MOR)
Additional exit routes	PgDip, PgCert (both DSM and MOR)
Mode of delivery	Full-time, Part-time
Location of Study	Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Centre for Simulation and Analytics
Awarding Body	Cranfield University
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 or by arrangement

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 industrial partners provide software to the SSEL
- 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

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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:

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- 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 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:

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	0
Foundations of Modelling and Simulation	10
Discrete & Continuous Simulation	10
Computer Graphics	10
War Gaming and Combat Modelling	10
Advanced Module #1	10
Advanced Module #2	10
ELECTIVE MODULES:	
N/A	
TOTAL:	**60**

PgCert in Defence Simulation and Modelling – Part-time	Credits
COMPULSORY MODULES:	
Introductory Studies	0
Foundations of Modelling and Simulation)	10
ELECTIVE MODULES:	
5 modules chosen from: Discrete & Continuous Simulation Computer Graphics War Gaming and Combat Modelling Experimentation Analysis & Trials for Simulation Weapon Systems Performance Assessment Intelligent Systems Networked and Distributed Simulation 13. Advanced Module #1	50 (10 credits per module)

5

14. Advanced Module #2 16.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	0
Foundations of Modelling and Simulation (Core)	10
Discrete and Continuous Simulation	10
Computer Graphics	10
Wargaming and Combat Modelling	10
Experimentation Analysis & Trials for Simulation	10
Weapon Systems Performance Assessment. Intelligent Systems	10
Networked and Distributed Simulation (Core)	10
Advanced Module #1	10
Advanced Module #2	10
Advanced Module #3	10
Networked and Distributed Simulation Exercise	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	0
Foundations of Modelling and Simulation (Core)	10
Discrete and Continuous Simulation	10
Computer Graphics	10
Wargaming and Combat Modelling	10
Experimentation Analysis & Trials for Simulation Weapon Systems	10
Performance Assessment	10
Intelligent Systems	10
Networked and Distributed Simulation (Core)	10
Advanced Module #1	10
Advanced Module #2	10
Advanced Module #3	10
Networked and Distributed Simulation Exercise	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	0
Introduction to Operational Research Techniques	10
Discrete and Continuous Simulation	10
Decision Analysis	10
Wargaming and Combat Modelling	10
Advanced Module #1	10
Advanced Module #2	10
ELECTIVE MODULES:	
N/A	
TOTAL:	**60**

PgCert in Military Operational Research – Part-time	Credits
COMPULSORY MODULES:	
Introductory Studies	0
Introduction to Operational Research Techniques	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	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
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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. <u>How is the course structured?</u>

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

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

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[1] 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).

[2] 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%).

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 CDS Virtual Learning Environment (VLE). A block 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 build on material covered in the standard modules and offer students the opportunity to explore selected topics in more depth. With the exception of 'Networked and Distributed Simulation Exercise' for the DSM Course, advanced modules do not typically involve any additional classroom attendance.

Course Modules

The following modules outline all parts of the programme which lead to an **MSc**. Other awards associated with the courses include some or all of these modules.

Module Number	Module code	Related Award	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Multi-part Assessment Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	R-AMOR-INTRO	DSM MOR	Introductory Studies	20	0	0	Y	A: 05/09/16	05/09/16	09/09/16	N/A	AO	100					
								B: 09/01/17	09/01/17	13/01/17	N/A	AO	100					
2	R-AMOR-FMS	DSM	Foundations of Modelling & Simulation*	30	0	10	Y	A: 12/09/16	12/09/16	16/09/16	50	EX	100				21-25/11/16	06-10/02/17
								B: 16/01/17	16/01/17	20/01/17							10-13/04/17	26-30/06/17
3	R-AMOR-IORT	MOR	Introduction to Operational Research Techniques*	30	0	10	N	12/09/16	12/09/16	16/09/16	50	EX	100				21-25/11/16	06-10/02/17
4	R-AMOR-DCS	DSM MOR	Discrete & Continuous Simulation	30	0	10	Y	26/09/16	26/09/16	30/09/16	40	ICW	100				FT:10/10/16 PT: 07/11/16	09/01/17 FT 30/01/17 PT

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

#	Code		Title					Start				Type						
5	R-AMOR-CG	DSM	Computer Graphics**	30	0	10	N	A: 10/10/16	10/10/16	14/10/16	40	ICW	100				AFT:24/10/16 APT:21/11/16 B 19/12/16 C 10/04/17 D 31/07/17	23/01/17 FT 13/02/17 PT 10/04/17 PT 31/07/17 PT TBC
								B: 10/10/16 C: 30/01/17 D: 22/05/17	10/10/16 30/01/17 22/05/17	16/12/16 07/04/17 28/07/17								
6	R-AMOR-DA	MOR	Decision Analysis	30	0	10	Y	A: 10/10/16	10/10/16	14/10/16	40	ICW	100				A FT:24/10/16 A PT:21/11/16 B:27/03/17	23/01/17 FT 13/02/17PT 26/06/17
								B: 13/02/17	13/02/17	17/02/17								
7	R-AMOR-WGC	DSM MOR	War Gaming & Combat Modelling A War Gaming & Combat Modelling B, C and D **	30	0	10	Y	A: 24/10/16	24/10/16	28/10/16	40	ICW	100				AFT: 07/11/16 APT: 05/12/16 B: 19/12/16 C: 10/04/17 D: 31/07/17	FT: 06/02/17 PT: 27/02/17 B: 10/04/17 C: 31/07/17 D: TBC
								B:10/10/16 C: 30/01/17 D: 22/05/17	10/10/16 30/01/17 22/05/17	16/12/16 07/04/17 28/07/17								
8	R-AMOR-SAT	MOR	Statistical Analysis & Trials*	30	0	10	N	09/01/17	09/01/17	13/01/17	40	EX	100				10-13/04/17	26-30/06/17
9	R-AMOR-EATS	DSM	Experimentation Analysis and Trials for Simulation	30	0	10	N	09/01/17	16/01/17	20/01/17	40	ICW	100				30/01/17 FT 27/02/17 PT	FT & PT 26/06/17
10	R-AMOR-WSAP	DSM MOR	Weapon System Performance Assessment	30	0	10	Y	30/01/17	30/01/17	03/02/17	40	ICW	100				FT: 13/02/17 PT: 13/03/17	FT & PT 26/06/17
11	R-AMOR-IS	DSM MOR	Intelligent Systems	30	0	10	Y	13/02/17	13/02/17	17/02/17	40	ICW	100				FT: 27/02/17 PT: 27/03/17	FT & PT 26/06/17
12	R-AMOR-NDS Occ B	DSM	Networked & Distributed Simulation	30	0	10	Y	27/02/17	27/02/17	03/03/17	50	ICW	100				FT: 13/03/17 PT: 10/04/17	FT & PT 26/06/17
13	R-AMOR-LM	MOR	Logistics Modelling A Logistics Modelling B, C & D**	30	0	10	N	A: 27/02/17	27/02/17	03/03/17	40	ICW	100				AFT: 13/03/17 APT: 10/04/17 B:19/12/16 C: 10/04/17 D: 31/07/17	FT & PT 26/06/17 10/04/17 31/07/17 Tbc
								B: 10/10/16 C: 31/01/17 D: 22/05/17	10/10/16 31/01/17 22/05/17	16/12/16 07/04/17 28/07/17								

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

ADVANCED MODULES AND PROJECT

Module Number	Module code	Related Award	Title	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[12] - 40% or 50%	Assessment						
												Independent Assessment		Multi-part assessment			Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Type of Assessment	Weighting within module[13] (%) of Independent assessments	Weighting within module of multi-part assessments[14](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
14	R-AMOR-AD1	DSM MOR	Advanced Module #1 A(FT) Advanced Modules #1 B, C & D (PT)	5	0	10	Y	A: 07/11/16 B: 10/10/16 C: 30/01/17 D: 22/05/17	FT:07/11/16 10/10/16 30/01/17 22/05/17	FT:18/11/16 16/12/16 07/04/17 28/07/17	40	ICW	100				FT: 21/11/16 PT: 19/12/16 PT:10/04/17 PT:31/07/17	FT:02/05/17 PT: 10/04/17 PT:31/07/17 PT: TBC
15	R-AMOR-AD2	DSM MOR	Advanced Module #2 A (FT) Advanced Modules #2 B, D & D (PT)	5	0	10	Y	A: 05/12/16 B: 10/10/16 C: 30/01/17 D: 22/05/17	FT:05/12/16 10/10/16 30/01/17 22/05/17	FT:16/12/16 16/12/16 07/04/17 28/07/17	40	ICW	100				FT: 19/12/16 PT: 19/12/16 PT:10/04/17 PT:31/07/17	FT:02/05/17 PT: 10/04/17 PT:31/07/17 PT: TBC

[10] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[11] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[12] 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.

[13] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[14] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[15] 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.

[16] 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

16	R-AMOR-AD3	DSM MOR	Advanced Module #3 A (FT) / Advanced Modules #3 B, C & D (PT)	5	0	10	Y	A: 13\03\17 B: 10/10/16 C: 30/01/17 D: 22/05/17	13/03/17 10/10/16 30/01/17 22/05/17	24/03/17 16/12/16 07/04/17 28/07/17	40	ICW	100			FT: 27/03/17 PT: 19/12/16 PT:10/04/17 PT:31/07/17	FT:26/06/17 PT: 10/04/17 PT:31/07/17 PT: TBC	* Coursework for this module is formative only (i.e.it is not summatively assessed), but submission is still mandato
17	R-AMOR-NDSE	DSM	Networked & Distributed Simulation Exercise (Advanced Module #4)	10	0	10	N	27/03/17	27/03/17	07/04/17	40	ICW	100			10/04/17	26/06/17	
18	R-AMOR-AD4	MOR	Advanced Module #4 A (FT) / Advanced Modules #4 B, C & D (PT)	5	0	10	N	A: 27/03/17 B: 10/10/16 C: 30/01/17 D: 22/05/17	FT:27/03/17 10/10/16 30/01/17 22/05/17	FT:07/04/17 16/12/16 07/04/17 28/07/17	40	ICW	100			FT: 10/04/17 PT: 19/12/16 PT:10/04/17 PT:31/07/17	FT:26/06/17 PT: 10/04/17 PT:31/07/17 PT: TBC	
19	R-AMOR-DISS	DSM MOR	MSc Research Project	N/A	N/A	80	Y	03/01/17	03/01/17	31/08/17	50	THESIS	100			FT: 31 08 17 PT: Submission dates vary	By arrangement	

ry.

** Subject to approval by the Course Director, this module may be available for non-residential, on-line distance learning study using the CDS Virtual Learning Environment (VLE). A 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, C and D:

Most Advanced Modules (except NDSE) comprise non-residential, self-study, mini-project coursework, equivalent to 10 days effort for a full-time residential student. For a part-time student the equivalent work will normally be conducted non-residentially over a period of typically 10 weeks. NDSE 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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
R-AMOR-FMS	Foundations of Modelling and Simulation	AMOR	SEDC share teaching in their R-SEDC-SSE module
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.

7. **How are the ILOs assessed?**

The following assessment types are utilised:

With some exceptions for each course (discussed below), most standard taught modules are assessed 100% by written 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.

The remaining standard modules in each course are assessed 100% by formal examinations – with the first in each course being an open book and open notes exam. For these modules, the requirement to submit coursework will therefore be formative (but still compulsory), not summative. Past examination papers are made available.

- **DSM**:
  - · Foundations of Modelling and Simulation : Open book and open notes exam
  ·
- **MOR**:
  - · Introduction to Operational Research Techniques : Open book and open notes exam
  - · Statistical Analysis and Trials: Closed book exam
  ·

Advanced modules are 100% assessed by coursework, which may include an optional viva, following a presentation.

The MSc research project is assessed by a written dissertation and may include an optional viva.

This approach has been adopted in order that the individual elements of the course 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

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.)

Defence Simulation and Modelling

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3
2. FMS	EX	EX	EX
4. DCS	CW	CW	CW
5. CG	CW		CW
7. WGC	CW	CW	CW
9. EATS	CW	CW	CW
10. WSAP	CW		CW
11. IS	CW	CW	
12. NDS	CW	CW	CW
14. AM#1	CW	CW	CW
15. AM#2	CW	CW	CW
17. NDSE	CW	CW	CW

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	EX	EX	EX	EX	EX	EX
4. DCS	CW	CW	CW	CW		
5. WGC	CW	CW	CW	CW		
7. CG	CW	CW	CW	CW		CW
9. EATS	CW	CW	CW	CW	CW	
10. WSAP	CW	CW		CW		
11. IS	CW	CW		CW		
12. NDS	CW	CW	CW	CW	CW	CW
14. AM#1	CW	CW	CW	CW	CW	CW
15. AM#2	CW	CW	CW	CW	CW	CW
16. AM#3	CW	CW	CW	CW	CW	CW
17. NDSE	CW	CW	CW	CW	CW	CW

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.*
19 DISS	DISS

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
4. DCS		CW	CW		
6. DA	CW	CW	CW		
7. WGC	CW	CW			
8. SAT	EX	EX	EX	EX	
10. WSAP		CW		CW	
11. IS			CW		
13. LM			CW	CW	CW
14. ADV#1	CW	CW	CW	CW	CW
15. ADV#2	CW	CW	CW	CW	CW
16. ADV#3	CW	CW	CW	CW	CW

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		
4. DCS			CW	CW			
6. DA			CW	CW	CW		
7. WGC		CW		CW	CW	CW	
8. SAT		EX		EX	EX		
10. WSAP	CW		CW			CW	
11. IS				CW			
13. LM					CW		
14. ADV#1		CW	CW	CW	CW	CW	CW
15. ADV#2		CW	CW	CW	CW	CW	CW
16. ADV#3		CW	CW	CW	CW	CW	CW
18. ADV#4		CW	CW	CW	CW	CW	CW

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 10.*
19 DISS	DISS

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

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

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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

<div style="border:1px solid">

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.

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COURSE TITLE:	MSc in Advanced Mechanical Engineering

Date of first publication/latest revision:	05/09/16

1. What is the course?

Course information

Course Title	Advanced Mechanical Engineering
Course code	MSAMEFTC, MSAMEPT
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full time, Part time
Location of Study	Cranfield
School(s)	School of Water, Energy and Environment
Theme	Energy & Power
Centre	Centre for Power Engineering
Course Director	Dr Joao Amaral Teixeira
Awarding Body	Cranfield University
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 - one year, Part-time MSc - 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, Spain, and Slovenia) and future collaborations with other institutions are planned.

The course is developing an industrial partnership with BPP-tech.

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 currently seeking to extend its formal accreditation by the Institution of Mechanical Engineers (IMechE)

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 and Transport 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. MSc **in Advanced Mechanical Engineering**

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

ILO 1. Demonstrate knowledge, fundamental understanding and critical awareness of advanced mechanical engineering techniques necessary for solutions in the transport and energy sectors

ILO 2. Demonstrate systematic knowledge across appropriate advanced technologies and management issues to provide solutions for international industries and/or research organisations.

ILO 3. Demonstrate the ability to acquire, critically assess the relative merits, and effectively use appropriate information from a variety of sources.

ILO 4. Demonstrate and apply self-direction, independent learning, both individually and in teams and originality in the analysis of problems, working effectively and professionally under time pressure..

ILO 5. Demonstrate the ability to plan and undertake a feasibility/design study or a short piece of research work related to mechanical engineering and management, and present the work in the form of a presentation and/or written report.

ILO 6. Demonstrate an awareness of current research and a systematic application for the solution of mechanical engineering problems..

ILO 7. Demonstrate the ability to effectively work in a team at a professional level, working on a group project (full-time students).

ILO 8. Demonstrate the ability to communicate clearly, both orally and in writing, to specialist and non-specialist audiences.

ILO 9 Integrate knowledge, understanding and skills from the taught modules in a real-life situation.

ILO 10 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

ILO 11 Undertake independent research on a research topic in mechanical engineering, involving project planning, critical evaluation of literature, evaluation of results, and discussion of findings.

ILO 12. Demonstrate the ability to present the results of the research in the form of a Individual Research Project, and to present this orally to an appropriate audience.

ILO 13 Demonstrate the ability to work independently and systematically, applying conceptual thinking and originality.

ILO 14 Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 15   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 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.

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:	
Induction Week Structural Integrity Fluid Mechanics & Loading CFD for Renewable Energy Management For Technology.	0 40
ELECTIVE MODULES:	
2 modules from: Engineering Stress Analysis: Theory and Simulations Advanced Control Systems Power Generation Systems Risk & Reliability Engineering	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 week Modules 2 – 9	0 80

4

Group project (for F-T students)	40
Group project or Dissertation for (P-T students)	40
ELECTIVE MODULES:	
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	0
Modules 2–9	80
Group project (for F-T students)	40
Group Project or Dissertation for (P-T students)	40
Individual Research Project	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);
- **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:
  o 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);
  o 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);
  o 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 are able to register at any point during the year, and to complete the course within 24 or 36 (accordingly to the study plan agreed) calendar months.

Taught part 1: Modules
Each module is generally delivered over one week, with time allowed for more independent learning and reflection. Modules are given in the period between October and March. 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. At the start of the Group Project, a group coordinator is nominated among the students. The group coordinator has to make sure that the part-time members of his group participate in the work outside the weekly meetings with the supervisor: this is not a new responsibility, since he/she has to do the same with full time 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 coordinator will 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.

Individual Research Project
For full time students, the Individual Research Project takes place during the third term (April-September).
By the end of January each year, each student will be issued with a list of suggested titles for research projects. **Full time students** are expected to select three preferred topics of their thesis before the Christmas break. Students are encouraged to discuss the projects with the appropriate member(s) of academic staff, prior to making their selection. **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.

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[1]	Total hours delivered by Visiting Lecturers[2]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[3] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[4] (%) of Independent assessments	Weighting within module of multi-part assessments[5] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[6]	Assessment Submission and/or exam date[7]	Assessment / Exam Retake date
1	I-ENE-INWK	Induction	G Drew	24		0	Y		03/10/16	07/10/16	N/A	AO					N/A	
2	N-AME-FML	Fluid Mechanics and Loading	M Collu	30		10	N		10/10/16	14/10/16	40	ICW	100				22/10/16 FT 29/10/16 PT	
4	N-AME-RR	Risk and Reliability Engineering	A Kolios	30		10	Y		07/11/16	11/11/16	40	EX	100				TBC WC 02/01/17	
3	N-PSE-PGRES	Power Generation Systems	G DiLorenzo	30		10	Y		24/10/16	28/10/16	40	ICW	100				05/11/16 FT 12/11/16 PT	

[1] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[2] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[3] 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.

[4] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[5] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[6] 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.

[7] 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

Module Number	Module code	Title	Module Leader	Contact hours[1]	Total hours delivered by Visiting Lecturers[2]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[3] - 40% or 50%	Type of Assessment (Independent Assessment)	Weighting within module[4] (%) of Independent assessments	Weighting within module of multi-part assessments[5] (100%)	Type of Assessment (Multi-part)	Weighting of individual elements of multi-part assessment[6]	Assessment Submission and/or exam date[7]	Assessment / Exam Retake date
7	N-REE-CFDR	Computational Fluid Dynamics for Renewable Energy	T Nishino	30		10	Y		05/12/16	09/12/16	40	ICW	100				14/01/17 FT 21/01/17 PT	
6	N-AME-ESA	Engineering Stress Analysis: Theory and Simulations	A Mehmanparast	32		10	N		28/11/16	02/12/16	40	ICW	100				07/01/17 FT 14/01/17 PT	
5	N-PSE-ACS	Advanced Control Systems	Y Cao	30		10	N		14/11/16	18/11/16	40	ICW	100				26/11/16 FT 03/12/16 PT	
8	N-AME-SI	Structural Integrity	A Mehmanparast	38.5		10			30/01/17	03/02/17	40	EX	100				W/C 20/02/17	
9	G-MTI	Management for Technology	S Carver	50		10	Y		13/02/17	17/02/17	40	EX GCW	50 50				20/03/17 25/03/17	
10	I-ENE-GRPP	Group Project	Supervisor	16		40	Y		27/02/17	05/05/17	50 50	GPROJ ICW	80 20				02/05/17	
11	I-ENE-DISS	Dissertation (P/T students only)	Supervisor	10		40	Y		03/10/16	30/09/17	50	IPROJ	100				30/09/17	
12	I-ENE-THESIS	Energy Individual Research Project	Supervisor	20		80	Y		08/05/17	08/09/17	50 50	OR THESIS	10 90				04/09/17	

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

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Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
G-MTI	Management for Technology	School of Management	- Advanced Mechanical Engineering - Materials for Energy Systems - Biofuels Process Engineering - Design of Rotating Machines - Energy Supply for Low Carbon Futures - Gas Energy - Offshore and Ocean Technology With Offshore Materials Engineering - Offshore and Ocean Technology With Pipeline Engineering - Offshore and Ocean Technology With Offshore Renewable Energy - Offshore and Ocean Technology With Risk Management - Offshore and Ocean Technology With Subsea Engineering - Renewable Energy Engineering - Renewable Energy Technology - Flow Assurance for Oil and Gas Production - Carbon Capture and Storage - Energy Systems and Thermal Processes - Process Systems Engineering - Energy from Waste
N-AME-ESA	Engineering Stress Analysis: Theory and Simulations	Advanced Mechanical Engineering	- Design of Rotating Machines - OOT With Offshore Materials Engineering - OOT With Pipeline Engineering - OOT With Risk Management - OOT With Offshore

			• Renewable Energy • OOT With Subsea Engineering • Renewable Energy Engineering • REMS EngD
N-AME-RR	Risk and Reliability Engineering	Advanced Mechanical Engineering	• Flow Assurance for Oil and Gas Production • Process Systems Engineering • Renewable Energy Engineering • Carbon Capture and Storage
N-AME-SI	Structural Integrity	Advanced Mechanical Engineering	• Flow Assurance for Oil and Gas Production • Materials for Energy Systems • Design of Rotating Machines • Offshore and Ocean Technology With Offshore Materials Engineering • Offshore and Ocean Technology With Pipeline Engineering • Offshore and Ocean Technology With Offshore Renewable Energy • Offshore and Ocean Technology With Risk Management • Offshore and Ocean Technology With Subsea Engineering • Renewable Energy Engineering • Safety and Accident Investigation
N-PSE-ACS	Advanced Control Systems	Process Systems Engineering	• Advanced Mechanical Engineering • Biofuels Process Engineering • Flow Assurance for Oil and Gas Production • Carbon Capture and Storage • Energy Systems and Thermal Processes
N-PSE-PGRES	Power Generation Systems	Energy Systems and Thermal Processes	• Advanced Mechanical Engineering • Carbon Capture and

			Storage
N-REE-CFDR	Computational Fluid Dynamics for Renewable Energy	Renewable Energy Engineering	• Advanced Mechanical Engineering • Renewable Energy Engineering

7. **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 the External Examiner and 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)

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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.

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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.	

COURSE TITLE:	MSc in Advanced Motorsport Engineering

Date of first publication/latest revision:	June 2016

1. What is the course?

Course information

Course Title	MSc in Advanced Motorsport Engineering
Course code	MTAMGFTC, MSAMGFTC, MSAMGPTC, PDAMGFTC, PDAMGPTC, PCAMGFTC, PCAMGPTC
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-Time, Part-Time
Location 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
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	First or Upper Second class UK Honours degrees or the international equivalent in engineering, aerospace, materials science and closely related disciplines who wish to gain knowledge of the engineering, management, science and technologies 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, 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, 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
- Condition monitoring and reliability
- Precision engineering
- Simulation including the supply of race car simulators to F1 (Cranfield Motorsport 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.
- Electronics and data acquisition
- 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 2017:

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

2. <u>What are the aims of the course?</u>

Cranfield University offers this course in order to:

- 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 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 who wish to gain

knowledge of the engineering, management, science and technologies relevant to motorsport.

- Candidates for the part-time route should be employed in a graduate level position within the high performance technology sectors such as motorsport, automotive and aerospace.

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

ILO 1.   Explain the key engineering subjects as applied to motorsport.
ILO 2.   Evaluate the technologies that underpin motorsport engineering.
ILO 3.   Exhibit an overview of motorsport engineering related disciplines and the context in which they are applied.

B. Postgraduate Diploma

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

ILO 4.   Apply management skills such as team working to deliver a motorsport related group design project.
ILO 5.   Demonstrate an evaluation of one or more motorsport engineering disciplines through contribution to a group report and delivery of a technical presentation as part of a team.
ILO 6.   Critique the personal experience of the group design project in the form of a reflective report with reference to individual contribution and peer assessment.

C. MSc

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

ILO 7.   Provide critical analysis of an area of motorsport engineering in the form of a concisely written thesis project report.
ILO 8.   Deliver a synthesis of the project in the form of an oral examination with reference to a poster that encapsulates the research.

4. <u>How is the course taught?</u>

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 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:	
Introduction to Motorsport To accumulate 60 credits from Modules 2-9	0 60
ELECTIVE MODULES:	
N/A	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:	
Introduction to Motorsport Modules 2-9 Group Design Project or Dissertation for part-time students	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 or Dissertation for part-time students 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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 late 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 theses are not required to attend the exhibition).

Part-time students register for the course in October and are expected to complete the course within 3 years. Students would instead study the eight taught assessed modules over a two to three year period. In the final year a dissertation should be submitted by the end of May and a

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[1] 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).

[2] 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%).

thesis and poster by the beginning of September. The Introduction module is optional for part-time students.

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.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-MEM-INWK	Introduction to Motorsport	Clive Temple	35	0	0	N		03/10/16	07/10/16	n/a	AO	n/a				n/a	n/a
2	I-MEM-A1519	Motorsport Structural Analysis	Dr Rishi Abhyankar	35	0	10	N		10/10/16	14/10/16	50	ICW	100				07/11/16	At the next available opportunity which may not be until the course runs the following year
3	I-MEM-A1001	Motorsport Electronics and	Dr Kim Blackburn	35	0	10	N		24/10/16	28/10/16	50	EX	100				05/01/17	At the next available opportunity which

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

7

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module[6] (%) of Independent assessments	Multi-part Assessment Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
		Data Acquisition																may not be until the course runs the following year
4	I-MEM-A1007	Motorsport Vehicle Dynamics	Dr James Brighton	35	0	10	N		07/11/16	11/11/16	50	EX	100				06/01/17	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		21/11/16	25/11/16	50	GCW	100				16/12/16	At the next available opportunity which may not be until the course runs the following year
6	I-MEM-A1012	Computational Fluid Dynamics for Motorsport	Dr Laszlo Konozsy	35	0	10	N		05/12/16	09/12/16	50	ICW	100				09/01/17	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	N		06/02/17	10/02/17	50			100 MULTI	GPRES GCW	30 70	20/02/17 20/02/17	At the next available opportunity which may not be until the course runs the following year
8	I-MEM-A1004	Composite Structures for	Dr Veronica Marchante	35	0	10	N		23/01/17	27/01/17	50	EX	100				14/02/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
		Motorsport	Rodriguez															may not be until the course runs the following year
9	I-MEM-A1008	Motorsport Power Train Design	Clive Temple	35	32	10	N		09/01/17	13/01/17	50	ICW	100				30/01/17	At the next available 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	n/a	40	N		12/02/17	11/05/17				GPROJ 80 IPROJ 20	GPROJ GPRES ICW ICW	80 20 50 50	11/05/17 11/05/17	
12	I-MEM-THESIS	Individual Research Project	Clive Temple Dr Kim Blackburn	40	n/a	80	N		12/05/17	06/09/17		THESIS OR	80 20				31/08/17 06/09/17	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N/A	N/A	N/A	N/A

7. 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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Certificate

Award ILOs / Module No.									

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.									

C. MSc

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

Award ILOs / Module No.									

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

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

Engineering roles in motorsport and high performance engineering: students have gone onto careers in F1, WRC, 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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE: MSc in Aerospace Dynamics

Date of first publication/latest revision: October 2016

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	2016-17
Valid entry routes	MSc
Additional exit routes	PgCert
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Aeronautics
Course Director	Professor Kevin Garry
Awarding Body	Cranfield University
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 Applications

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 2016.

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 students 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 be competent to analyse performance quantitatively.

ILO 2.   Demonstrate the ability to critically analyse the engineering aspects of aerospace applications.

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.

ILO 4.   Be able to apply their knowledge and understanding practically to the design and analysis of aerospace projects.

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.

ILO 6.   Develop project objectives.

ILO 7.   Select and justify methodologies appropriate to the task.

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:

Candidates are required 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 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:	
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 and the successful completion of the thesis as detailed below:

Description	Credits
COMPULSORY MODULES:	
Flight Experimental Methods (Group Flight Test Report) (module 1)	20
Individual Research Project (module 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o   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

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[1]   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).

[2]   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

award capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);

- o 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);
- o 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 October and are expected to complete the course within 12 calendar months.

This course is also offered on a part-time basis. Students 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 students the remainder of the programme is devoted to the Research Thesis.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-ASD-GFTR	Flight Experimental Methods (Group Flight Test Report)	Dr Alastair Cooke	50		20	Y		10/10/16	28/10/16	50			100 MULTI	GPRAC OR	70 30	23/11/16	At the next available opportunity which may not be until the course runs the following year
2	N-ASD-CF	Compressible Flows	Dr Simon Prince	20		10	N		09/11/16	11/11/16	40	EX	100				15/12/16	At the next available opportunity which may not be until the course runs the following year

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
3	N-ASD-VF	Viscous Flow	Prof Kevin Garry	22		10	N		14/11/16	09/12/16	40	EX	100				10/01/17	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	28		10	Y		07/11/16	25/11/16	40			100 MULTI	ICW EX	50 50	16/12/16 11/01/17	At the next available opportunity which may not be until the course runs the following year
5	N-ASD-FRPSC	Fundamentals of Rotorcraft Performance, Stability and Control	Dr Alastair Cooke	10		5	Y		21/11/16	25/11/16	40	EX	100				09/01/17	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	Y		21/11/16	02/12/16	40	ICW	100				01/02/17	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 Nick Lawson	10		5	N		31/10/16	01/11/16	40	EX	100				16/12/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												Independent Assessment		**Multi-part Assessment**			**Submission dates**	
8	N-ASD-FQFC	Flying Qualities and Flight Control	Dr Alastair Cooke	40		15	Y		23/01/17	10/02/17	40	ICW	100				10/03/17	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		30/01/17	10/02/17	40	EX	100				08/04/17	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		16/01/17	20/01/17	40	ICW	100				03/02/17	At the next available opportunity which may not be until the course runs the following year
11	N-ASD-LRA	Launch and Re-Entry Aerodynamics	Dr Simon Prince	10		5	Y		25/01/17	27/01/17	40	EX	100				27/04/17	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 and Jenny Holt	10		5	N		30/01/17	03/02/17	40	EX	100				28/04/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment — Type of Assessment	Independent Assessment — Weighting within module6 (%) of Independent assessments	Multi-part Assessment — Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment — Type of Assessment	Multi-part Assessment — Weighting of individual elements of multi-part assessment[8]	Submission dates — Assessment Submission and/or exam date[9]	Submission dates — Assessment / Exam Retake date
13	N-ASD-ICFD	Introduction to CFD	Dr Panagiotis Tsoutsanis	35		10	Y		20/02/17	24/02/17	40	ICW	100				07/04/17	At the next available opportunity which may not be until the course runs the following year
14	N-ASD-EXA	Experimental Aerodynamics	Jenny Holt	35		10	N		13/03/17	17/03/17	40			100 MULTI	GCW OR	55 45	13/04/17	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	26		10	Y		27/02/17	14/03/17	40			100 MULTI	EX ICW	50 50	24/04/17 07/04/17	At the next available opportunity which may not be until the course runs the following year
16	N-ASD-SAD	Supercritical Aerofoil Design	Dr Simon Prince	10		5	N		01/03/17	03/03/17	40	ICW	100				31/03/17	At the next available opportunity which may not be until the course runs the following year
17	N-ASD-FASD	Fundamentals of Aircraft System Identification	Dr Mudassir Lone	20		10	Y		06/03/17	10/03/17	40	EX	100				25/04/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar			Assessment						
												Independent Assessment		Multi-part Assessment			Submission dates	
18	N-ASD-EFARW	CFD for External Flows in Aerospace Applications and Rotating Wings	Dr Panagiotis Tsoutsanis	20		10	N		04/04/17	07/04/17	40	ICW	100				08/05/17	At the next available opportunity which may not be until the course runs the following year
19	N-AVD-MDS	Modelling of Dynamic Systems	Dr James Whidborne	13		0	Y		24/10/16	28/10/16	N/A	AO	N/A				N/A	N/A
20	N-ASD-THESIS	Individual Research Project	Prof Kevin Garry	0		100	N		02/05/17	16/08/17				100 MULTI	THESIS OR	85 15	16/08/17	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ASD-GFTR	Flight Experimental Methods (Group Flight Test Report)	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control
N-ASD-CS	Control Systems	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control, Aerospace Vehicle Design, Astronautics and Space Engineering
N-ASD-FRPSC	Fundamentals of Rotorcraft Performance, Stability and Control	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control
N-ASD-FDP	Flight Dynamics Principles	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control, Aircraft Engineering
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, Astronautics and Space Engineering
N-ASD-AMS	Air Vehicle Modelling and Simulation	Aerospace Dynamics	Flight Test and Flight Dynamics, Autonomous Vehicle Dynamics and Control
N-ASD-LRA	Launch and Re-Entry Aerodynamics	Aerospace Dynamics	Astronautics and Space Engineering
N-ASD-ICFD	Introduction to CFD	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control
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-AVD-MDS	Modelling of Dynamic Systems	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control, Aerospace Vehicle Design, Astronautics and Space Engineering

7. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students 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.

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

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Certificate

Award ILOs / Module No.									

B. MSc

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

Award ILOs / Module No.									

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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.	

COURSE TITLE:	MSc in Aerospace Manufacturing

Date of first publication/latest revision:	December 2016

1. What is the course?

Course information

Course Title	MSc in Aerospace Manufacturing
Course code	MSAMFFTC, MSAMFPTC, PDAMFFTC, PDAMFPTC, PCAMFFTC, PCAMFPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace , Transport and Manufacturing
Theme	Manufacturing
Centre	Sustainable Manufacturing Systems Centre
Course Director	Dr Konstantinos Salonitis
Awarding Body	Cranfield University
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 and March. Part-time: throughout the year

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) up to and including Academic year 2015-16**, Institution of Engineering and Technology (IET) up to and including Academic year 2015-16**, Royal Aeronautical Society (RAeS) up to and including Academic year 2015-16**.

(** Accreditation up to and including Academic year 2019-20 is awaiting review of the output of the accreditation visit).

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.

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. For part-time students, a Dissertation replaces the Group Project. 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 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 2-6	50
ELECTIVE MODULES:	
Modules 7-12 (Select 1) NOTE: for the March intake some electives may not be available	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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-6 Group Project for full-time students (13a) or Dissertation for part-time students (13b)	50 40
ELECTIVE MODULES:	
Modules 7-12 (Select 3) NOTE: for the March intake some electives may not be available	30
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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-6 Group Project for full-time students (13a) or Dissertation for part-time students (13b) Individual Research Project (14)	50 40 80
ELECTIVE MODULES:	
Modules 7-12 (Select 3) NOTE: for the March intake some electives may not be available	30
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);

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[1]   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).

[2]   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, 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 <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. <u>How is the course structured?</u>

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/Dissertation 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 Dissertation in year 1 and the remainder of the modules plus the Thesis in year two and/or year 3.

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 Intake

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-MAN-INWK	Induction	Dr Konstantinos Salonitis	22		0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
2	I-MNU-A1034	Operations Management	Prof Charalampos (Harris) Makatsoris	32		10	Y		10/10/16	14/10/16	40	EX	100				11/11/16	Manufacturing resit exams will be during week commencing 18/09/17

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

7

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
3	I-MNU-A1027	Manufacturing Systems Engineering	Prof Charalampos (Harris) Makatsoris	32		10	Y		21/11/16	25/11/16	40	ICW	100				09/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
4	I-MNU-A1038	Supply Chain Management	Dr Chris Turner	32		10	Y		16/01/17	20/01/17	40	ICW	100				03/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
5	I-MNU-A1019	Manufacturing Strategy	Dr Patrick McLaughlin	35		10	Y		23/01/17	27/01/17	40			100 MULTI	GPRES GCW ICW	30 50 20	10/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
6	I-MNU-A1047	Aircraft Assembly	Prof Phil Webb	34		10	N		09/01/17	13/01/17	40	ICW	100				03/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
7	I-MAT-A1011	Machining, Moulding and Metrology	Dr Isidro Durazo-Cardenas	30		10	Y		24/10/16	28/10/16	40			100 MULTI	ICW GPRES	70 30	11/11/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		Course Director and Module Leader as/when required.
8	I-UPT-A1181	Precision Engineering	Paul Morantz	30		10	Y		17/10/16	21/10/16	40	ICW	100				18/11/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
9	I-MAT-A1013	Composites Manufacturing for High Performance	Andrew Mills	35		10	Y		14/11/16	18/11/16	40	ICW	100				02/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
10	I-MAT-A1015	Failure of Materials and Structures	Dr David Ayre	32		10	Y		14/11/16	18/11/16	40	EX	100				16/12/16	Manufacturing resit exams will be during week commencing 18/09/17
11	I-WEE-A1110	Advanced Welding Processes	Dr Wojciech Suder	32		10	Y		28/11/16	02/12/16	40	EX	100				06/02/17	Manufacturing resit exams will be during week commencing 18/09/17

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment (Independent)	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment (Multi-part)	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
12	I-MNU-A1029	Operations Analysis	Dr Konstantinos Salonitis	32	8	10	Y		31/10/16	04/11/16	40	EX	100				12/12/16	Manufacturing resit exams will be during week commencing 18/09/17
13a	I-MNU-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		06/02/17	28/04/17				80 MULTI / 20 MULTI	GPRES GPROJ / ICW observed behaviour	16% 64% / 10% 10%	28/04/17	
13b	I-MNU-DISS	Dissertation for Part Time Students	Dr Konstantinos Salonitis	20		40	Y		01/02/17	31/08/17		ICW	100				31/08/17	
14	I-MNU-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		02/05/17	04/09/17		THESIS OR	90 10				04/09/17	

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

March Intake

Module Number	Module code	Title	Module Leader	Contact hours [10]	Total hours delivered by Visiting Lecturers [11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark [12] - 40% or 50%	Type of Assessment	Weighting within module [13] (%) of Independent assessments	Weighting within module of multi-part assessments [14] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment [15]	Assessment Submission and/or exam date [16]	Assessment / Exam Retake date
									Calendar			Independent Assessment		Multi-part Assessment			Submission dates	
1	I-MAN-INWK	Induction	Dr Konstantinos Salonitis	22		0	Y		27/03/17	31/03/17	N/A	AO	N/A				N/A	
2	I-MNU-A1034	Operations Management	Prof Charalampos (Harris) Makatsoris	32		10	Y		03/04/17	07/04/17	40	EX	100				TBC (May 2017)	November 2017
3	I-MNU-A1027	Manufacturing Systems Engineering	Prof Charalampos (Harris) Makatsoris	32		10	Y		30/05/17	02/06/17	40	ICW	100				30/06/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.

[10] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[11] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[12] 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.

[13] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[14] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[15] 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.

[16] 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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
4	I-MNU-A1038	Supply Chain Management	Dr Chris Turner	32		10	Y		26/06/17	30/06/17	40	ICW	100				28/07/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
5	I-MNU-A1019	Manufacturing Strategy	Dr Patrick McLaughlin	35		10	Y		03/07/17	07/07/17	40			100 MULTI	GPRES GCW ICW	30 50 20	18/07/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
6	I-MNU-A1047	Aircraft Assembly	Prof Phil Webb	34		10	N		12/06/17	16/06/17	40	ICW	100				14/07/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
7	I-MAT-A1011	Machining, Moulding and Metrology	Dr Isidro Durazo-Cardenas	30		10	Y		24/04/17	28/04/17	40			100 MULTI	ICW GPRES	70 30	26/05/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
8	I-UPT-A1181	Precision Engineering	Paul Morantz	30		10	Y	Not available for this intake			40	ICW	100				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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
								Calendar				**Assessment**						
												Independent Assessment		Multi-part Assessment			Submission dates	
9	I-MAT-A1013	Composites Manufacturing for High Performance	Andrew Mills	35		10	Y		15/05/17	19/05/17	40	ICW	100				16/06/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
10	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	
11	I-WEE-A1110	Advanced Welding Processes	Dr Wojciech Suder	32		10	Y	Not available for this intake			40	EX	100				Not available for this intake	
12	I-MNU-A1029	Operations Analysis	Dr Konstantinos Salonitis	32	8	10	Y		08/05/17	12/05/17	40	EX	100				TBC (June 2017)	December 2017
13a	I-MNU-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		24/07/17	27/10/17				80 MULTI	GPRES GPROJ	16% 64%	w/c 23/10/17	
														20 MULTI	ICW observed behaviour	10% 10%		
13b	I-MNU-DISS	Dissertation for Part Time Students	Dr Konstantinos Salonitis	20		40	Y		24/07/17	30/03/18		ICW	100				w/c 26/03/18	

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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[12] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments14 (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment15	Assessment Submission and/or exam date16	Assessment / Exam Retake date
14	I-MNU-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		30/10/17	30/03/18		THESIS OR	90 10				w/c 26/03/18	

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

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Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-MAN-INWK	Induction	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Management and Information Systems, Manufacturing Consultancy, Knowledge Management for Innovation, Global Product Development and Management, Cyber-Secure Manufacturing
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, Manufacturing Consultancy, Cost Engineering, Cyber-Secure Manufacturing
I-MNU-A1027	Manufacturing Systems Engineering	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy, Cyber-Secure Manufacturing
I-MNU-A1038	Supply Chain Management	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy
I-MNU-A1019	Manufacturing Strategy	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy
I-MAT-A1011	Machining, Moulding and Metrology	Advanced Materials	Advanced Materials, Manufacturing Technology and Management
I-UPT-A1181	Precision Engineering	Manufacturing Technology and Management	Manufacturing Technology and Management
I-MAT-A1013	Composites Manufacturing for High Performance	Advanced Materials	Advanced Materials, Manufacturing Technology and Management, Aerospace Materials, Renewable Energy Marine Structures EngD
I-MAT-A1015	Failure of Materials and Structures	Advanced Materials	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 Consultancy

I-MNU-GRPP	Group Project for Full Time Students	Manufacturing Systems and Management Programme	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy, Management and Information Systems, Knowledge Management for Innovation, Global Product Development and Management, Cyber-Secure Manufacturing
I-MNU-DISS	Dissertation for Part Time Students	Manufacturing Systems and Management Programme	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy, Management and Information Systems, Knowledge Management for Innovation, Global Product Development and Management
I-MNU-THESIS	Individual Research Project	Manufacturing Systems and Management Programme	Engineering & Management of Manufacturing Systems, Manufacturing Consultancy, Management and Information Systems, Knowledge Management for Innovation, Global Product Development and Management, Cyber-Secure Manufacturing

7. 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			

Module No. \ Award ILOs	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7
4	ICW	ICW	ICW	ICW			
5		ICW	ICW	ICW			
6	ICW	ICW	ICW	ICW	ICW	ICW	
7		ICW			ICW	ICW	
8					ICW		
9					ICW	ICW	
10					EX		EX
11					EX		
12	EX	EX	EX	EX			

B. Postgraduate Diploma

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

Module No. \ Award ILOs	ILO 8	ILO 9	ILO 10	ILO 11
13a	GPRES GPROJ ICW	GPRES GPROJ ICW	GPRES GPROJ ICW	GPRES GPROJ ICW
13b	ICW	ICW	ICW	ICW

C. MSc

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

Module No. \ Award ILOs	ILO 12	ILO 13
14	THESIS OR	THESIS OR

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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.

COURSE TITLE:	MSc in Aerospace Materials

Date of first publication/latest revision:	June 2016

1. What is the course?

Course information

Course Title	MSc in Aerospace Materials
Course code	MSAMRFTC, MSAMRPTC, PDAMRFTC, PDAMRPTC, PCAMRFTC, PCAMRPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Surface Engineering & Nanotechnology Institute
Course Director	Dr Sue Impey
Awarding Body	Cranfield University
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: throughout the year.

Institutions delivering the course

This course is delivered by School of Aerospace, Transport and Manufacturing, Manufacturing Theme, Surface Engineering & Nanotechnology Institute where the broach research interests include:

- Composites.
- Surface engineering and nanotechnology.

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) up to and including Academic year 2015-16**, Institution of Engineering and Technology (IET) up to and including Academic year 2015-16**, Royal Aeronautical Society (RAeS) up to and including Academic year 2015-16**,, Institute of Materials, Minerals and Mining (IOM3) up to and including Academic year 2015-16***,

(** Accreditation up to and including Academic year 2019-20 is awaiting review of the output of the accreditation visit.
*** Accreditation up to and including Academic year 2018-19 is awaiting review of the output of the accreditation visit).

2. <u>What are the aims of the course?</u>

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. 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 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. Demonstrate a knowledge and scientific understanding of the processes and manufacturing routes used to convert materials into aerospace engineering products, and the influence of processing conditions on performance.

by choice of module

ILO 3. Make effective use of finite element analysis programmes.
ILO 4. Demonstrate a knowledge of aerospace materials including metals, polymers, ceramics and composites.
ILO 5. Use basic principles of materials selection for aerospace engineering and other applications.
ILO 6. Demonstrate a basic understanding of fracture mechanics and an awareness of approaches to failure assessment.
ILO 7. Make effective use of information technology.
ILO 8. Demonstrate an ability in practical approaches to problem solving.
ILO 9. Critically evaluate data.

B. Postgraduate Diploma

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

ILO 10. Demonstrate a systematic understanding of materials properties and an appreciation of how this understanding can be applied to problems relevant to aerospace
ILO 11. Demonstrate a knowledge of some key general, personnel and project management techniques and an awareness of the less science-dependent aspects of technology
ILO 12. Demonstrate an awareness of current research and development in selected topics in the field of aerospace materials engineering.
ILO 13. Make effective oral and written presentation of their work.
ILO 14. Operate effectively in a team.
ILO 15. Undertake an appraisal of technical and/or commercial literature.
ILO 16. Work effectively under time pressure.

C. MSc

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

ILO 17. Demonstrate a critical awareness of current research/development in selected topics in the field of aerospace materials.
ILO 18. Undertake substantial critical appraisal of technical and/or commercial literature.

ILO 19. Carry out substantial scientific programmes of study.
ILO 20. Discuss their work and relate it to the work of others.
ILO 21. Demonstrate originality in the application of knowledge in relation to an extended individual project.
ILO 22. Plan, execute and manage materials-related projects.

4. How is the course taught?

The teaching methods include lectures, group and individual exercises, seminar and computer based demonstrations and exercises. All students attend a week of introductory lectures (given during the first week of the course). The introduction is followed by 8 weeks of assessed modules.

All Masters students undertake a Group Project (full time students) or produce a Dissertation (part time students). The Group projects are group-based activities typically undertaken between February and April. 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 materials problem or challenge relevant to aerospace materials. For part-time students, a Dissertation replaces the Group Project. The topic is to be agreed between the University and the student.

Students undertaking a research project (thesis project) will do this 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, 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 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 2, 3, 8	30
ELECTIVE MODULES:	
Three modules from 4-7, 9, 10* (if available) Choose three modules from six	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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-9 Group Project for full-time students (11a) or Dissertation for part-time students (11b)	80 40
ELECTIVE MODULES:	
*Optional module 10 if available for part time students, plus choose modules to total 8 from taught modules 2 to 9	
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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-9 Group Project for full-time students (11a) or Dissertation for part-time students (11b) Individual Research Project (12)	80 40 80
ELECTIVE MODULES:	
*Optional module 10 if available for part time students, plus choose modules to total 8 from taught modules 2 to 9	
RECOMMENDED MODULE	
Introduction	0
TOTAL:	200

* Module 10 is based on a short CPD course, which may or may not be available in any one academic year. Students are advised to consult with the Course Tutor about availability.

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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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. <u>How is the course structured?</u>

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 Dissertation in year 1 and the remainder of the modules plus the Thesis in year two and/or year 3.

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[1] 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).

[2] 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%).

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-MAT-INWK	Introduction	Dr Sue Impey	26		0	Y		03/10/16	06/10/16	n/a	AO	n/a				n/a	
2	I-MAT-A1009	Introduction to Materials Engineering	Dr David Ayre	30		10	Y		07/10/16	14/10/16	40	EX	100				04/01/17	Manufacturing resit exams will be during week commencing 18/09/17
3	I-MAT-A1005	Aerospace Materials Properties and Processing	Dr Sue Impey	30		10	N		24/10/16	28/10/16	40	ICW	100				11/11/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Course / SAS Version:

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	I-MAT-A1013	Composites Manufacturing for High Performance	Andrew Mills	35		10	Y		31/10/16	04/11/16	40	ICW	100				02/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
5	I-MAT-A1015	Failure of Materials and Structures	Dr David Ayre	32		10	Y		14/11/16	18/11/16	40	EX	100				16/12/16	Manufacturing resit exams will be during week commencing 18/09/17
6	I-MAT-A1007	Functional Materials	Dr Qi Zhang	30		10	N		21/11/16	25/11/16	40	ICW	100				05/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
7	I-MAT-A1014	Finite Element Analysis	Dr Glenn Leighton/ Dr Renaud Jourdain	35		10	Y		05/12/16	09/12/16	40			100 MULTI	ICW ICW	40 60	20/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
8	I-MAT-A1017	Materials Selection	Dr Sue Impey/ Dr David Ayre	34		10	Y		09/01/17	13/01/17	40	ICW	100				30/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		required.
9	I-MAT-A1016	Surface Science and Engineering	Prof John Nicholls	30		10	Y		23/01/17	27/01/17	40	ICW	100				06/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
10	N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures - (option when available)**	Prof Philip Irving	35		10	Y		10/07/17	14/07/17	40	ICW	100				11/09/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
11a	I-MAT-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		06/02/17	28/04/17				80 MULTI 20 MULTI	GPRES GPROJ ICW observed behaviour	16 64 10 10	28/04/17	
11b	I-MAT-DISS	Dissertation for Part Time Students	Dr Sue Impey/ Dr David Ayre	20		40	Y		01/02/17	31/08/17		ICW	100				31/08/17	
12	I-MAT-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		02/05/17	04/09/17		THESIS OR	90 10				04/09/17	

**Timescales suit for part time students only

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-MAT-INWK	Introduction	Manufacturing Technology and Materials Programme	Welding Engineering, Applied Nanotechnology, Advanced Materials
I-MAT-A1009	Introduction to Materials Engineering	Advanced Materials	Advanced Materials, Manufacturing Technology and Management
I-MAT-A1015	Failure of Materials and Structures	Advanced Materials	Advanced Materials, Aerospace Manufacturing
I-MAT-A1014	Finite Element Analysis	Advanced Materials	Applied Nanotechnology, Manufacturing Technology and Management, Advanced Materials
I-MAT-A1017	Materials Selection	Advanced Materials	Advanced Materials
I-MAT-A1016	Surface Science and Engineering	Advanced Materials	Manufacturing Technology and Management, Advanced Materials
I-MAT-A1013	Composites Manufacturing for High Performance	Advanced Materials	Manufacturing Technology and Management, Aerospace Manufacturing, Advanced Materials, Renewable Energy Marine Structures EngD
N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft Structures	Airworthiness	Airworthiness, Military Aerospace and Airworthiness, Advanced Materials
I-MAT-GRPP	Group Project for Full Time Students	Manufacturing Technology and Materials Programme	Advanced Materials, Applied Nanotechnology, Manufacturing Technology and Management
I-MAT-DISS	Dissertation for Part Time Students	Manufacturing Technology and Materials Programme	Advanced Materials, Applied Nanotechnology, Manufacturing Technology and Management
I-MAT-THESIS	Individual Research Project	Manufacturing Technology and Materials Programme	Advanced Materials, Applied Nanotechnology, Manufacturing Technology and Management

7. 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.

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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Certificate

Award ILOs / Module No.									

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.									

C. MSc

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

Award ILOs / Module No.									

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE:	MSc in Aerospace Vehicle Design

Date of first publication/latest revision:	September 2016

1. What is the course?

Course information

Course Title	MSc in Aerospace Vehicle Design with options in: Aircraft Design *(October and March Intake)* Avionic Systems Design *(October and March Intake)* Structural Design *(October Intake only)*
Course code	MSAVDFTC, MSAV2FTC
Academic Year	2016-17
Valid entry routes	MSc
Additional exit routes	Not Applicable
Mode of delivery	Full-Time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Aeronautics
Course Director	Ioannis Giannopoulos (October Intake) Professor Shijun Guo (March Intake)
Awarding Body	Cranfield University
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
Course Start Month(s)	March or October

Institutions delivering the course

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

- Novel aircraft configurations
- Unmanned air vehicles
- Aeroelasticity
- More electric and green aircraft technologies
- Modelling and simulation
- Flight simulation
- Multidisciplinary design, analysis and optimisation

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) through 2019.

2. What are the aims of the course?

The Aerospace Vehicle Design MSc aims to build on knowledge acquired from undergraduate study to develop a comprehensive understanding of aircraft design methods and techniques in the areas of aircraft structures, systems and avionics.

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. **MSc**

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

ILO 1.   Demonstrate a systematic understanding in the knowledge, the principles and the applicable regulatory requirements of Aerospace Vehicle Design.

ILO 2.   Apply the current aircraft design methods, tools and techniques used in the aerospace industry onto aircraft design projects in the engineering fields of either aerospace structures, systems or avionics.

ILO 3.   Independently undertake research in a relevant field of either aerospace structures, systems or avionics by means of critically analysing and processing current research and generating valuable research outcomes.

Aircraft Design Option and Avionic Systems Design Option

ILO 4.   Effectively plan, communicate, collaborate and manage tasks individually and within a project team.

Structural Design Option (Oct Intake only)

ILO 5.   Effectively plan, communicate, collaborate and manage tasks within a research project relevant to Aerospace Structures.

4. How is the course taught?

The course is taught using a combination of methods:

- Taught modules (lectures and lab work) are provided over two teaching periods. These are assessed through exams, assignments and in-class exercises and for the Aircraft Design Option and Avionic Systems Design Option through the content of their Group Design Project report.
- The Aircraft Design Option and Avionic Systems Design Option students participate in a comprehensive group design project which is a strong example of problem-based learning at the post graduate level providing a virtual industrial environment supported by experienced staff.
- All students must undertake individual research under the guidance of academic staff which is assessed through a thesis.

In addition to the teaching methods outlined in section 3 above, students will be supported in their learning and personal development by:
- Extensive computer network and IT facilities.
- Library facilities including journals, papers, and numerous databases.
- A dedicated course electronic Blackboard.
- Numerous social events to enhance team building.

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. MSc
The accumulation of 200 credits (or more) through the assessment of taught modules and the successful completion of the Group Design Project (where required) and Thesis as detailed below:

Aircraft Design Option (October and March Intake)

Description	Credits
COMPULSORY MODULES - Assessed:	
15 17a 34 – Group Design Project 35a – Individual Research Project	10 10 100 80
COMPULSORY MODULES– Non Assessed:	
1, 7, 9, 16, 18, 19a, 22, 24, 28, 31	0
ELECTIVE MODULES – Non Assessed:	
4, 6, 8, 12, 14, 21a, 26, 27, 32, 33a	0
TOTAL:	200

Avionic Systems Design Option (October and March Intake)

Description	Credits
COMPULSORY MODULES - Assessed:	
13 23 34 – Group Design Project 35a – Individual Research Project	10 10 100 80
COMPULSORY MODULES– Non Assessed:	
3, 5, 7, 9, 10, 11, 17b, 20, 22, 25, 29, 30	0
ELECTIVE MODULES – Non Assessed:	
2, 4, 6, 8, 12, 16, 24, 26, 27, 31	0
TOTAL:	200

Structural Design Option (October Intake only)

Description	Credits
COMPULSORY MODULES - Assessed:	
15, 19b, 21b, 33b 35b – Individual Research Project	40 160
ELECTIVE MODULES – Non Assessed:	
1, 6, 7, 8, 9, 12, 14, 16, 17b, 18, 22, 24, 27, 28, 31, 32	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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

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[1] 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).

[2] 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

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- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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 either October or March and are expected to complete the course within 12 calendar months.

The course has 3 main components, a taught component (all course options), a group design project component (aircraft design and avionic systems design options only), and an individual research project component (all course options). Timeframes for the delivery of these components is indicated in the table below.

October Intake	Aircraft Design Option	Avionic Systems Design Option	Structural Design Option
Course Start	October	October	October
Taught Component	October to March	October to March	October to March
Examinations	January	January	January and April
Group Design Project	October to April	October to April	Not Applicable
Group Project Thesis Submission	April	April	Not Applicable
Group Project Industry Presentation	May	May	Not Applicable
Individual Research Project	May to September	May to September	October to September
Oral Examination	August	August	August
Thesis Submission	August	August	August
Course End	September	September	September

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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%).

March Intake	Aircraft Design Option	Avionic Systems Design Option
Course Start	March	March
Taught Component	March to August	March to August
Examinations	June	June
Group Design Project	March to Sept	March to Sept
Group Project Thesis Submission	September	September
Group Project Industry Presentation	October	October
Individual Research Project	March to February	March to February
Oral Examination	February	February
Thesis Submission	January	January
Course End	February	February

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.

October Intake

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-AVD-AE	Aeroelasticity	Prof Shijun Guo	10		0	N		06/03/17	10/03/17	n/a	AO	n/a				n/a	n/a
2	N-AVD-ANCS	Aeronautical Communication Systems	Dr Huamin Jia	10		0	N		30/01/17	02/02/17	n/a	AO	n/a				n/a	n/a
3	N-AVD-ASE	Aerospace Software Engineering and Ada	Dr Huamin Jia Dr Irfan Madani	20		0	N		03/10/16	02/12/16	n/a	AO	n/a				n/a	n/a

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	N-AVD-ASDL	Aerospace System Development and Life Cycle Model	Tim Mackley	10		0	N		17/10/16	19/10/16	n/a	AO	n/a				n/a	n/a
5	N-AVD-ATC	Avionics Air Traffic Control	Dr Francisco J Saez-Nieto	10		0	N		20/02/17	24/02/17	n/a	AO	n/a				n/a	n/a
6	N-AVD-AA	Aircraft Aerodynamics	Prof Howard Smith	10		0	N		03/10/16	07/10/16	n/a	AO	n/a				n/a	n/a
7	N-AVD-AP	Aircraft Performance	Dr Craig Lawson	10		0	N		31/10/16	04/11/16	n/a	AO	n/a				n/a	n/a
8	N-AVD-APPI	Aircraft Power Plant Installation	Dr Adrian Clarke	10		0	N		06/03/17	10/03/17	n/a	AO	n/a				n/a	n/a
9	N-AVD-ACSC	Aircraft Stability and Control	Dr Alastair Cooke	10		0	N		31/10/16	04/11/16	n/a	AO	n/a				n/a	n/a
10	N-AVD-AISI	Avionics Data Networking, Hardware Integration and Testing	Dr Huamin Jia	10		0	N		14/11/16	01/02/17	n/a	AO	n/a				n/a	n/a
11	N-AVD-CE	Cockpit Environment	Dr David Zammit-Mangion	10		0	N		24/10/16	28/10/16	n/a	AO	n/a				n/a	n/a
12	N-AVD-CAD	Computer Aided Design	Dr Helen Lockett	20		0	N		10/10/16	12/12/16	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

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Module Number	Module code	Title	Module Leader	Contact hours [3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark [5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Multi-part Assessment Type of Assessment	Weighting of individual elements of multi-part assessment [8]	Assessment Submission and/or exam date [9]	Assessment / Exam Retake date
13	N-ASD-CS	Control Systems	Dr James Whidborne	28		10	Y		07/11/16	25/11/16	40			100 MULTI	ICW EX	50 50	16/12/16 11/01/17	16/06/17 11/06/17
14	N-AVD-CW	Crashworthiness	Ioannis Giannopoulos	20		0	N		13/03/17	17/03/17	n/a	AO	n/a				n/a	n/a
15	N-AVD-FRP	Design and Analysis of Composite Structures	Prof Shijun Guo	20		10	Y		28/11/16	05/12/16	40			100 MULTI	EX ICW	75 25	05/01/17 05/12/16	05/06/17 05/05/17
16	N-AVD-DMO	Design for Manufacture and Operation	Prof Howard Smith	10		0	N		05/12/16	09/12/16	n/a	AO	n/a				n/a	n/a
17a	N-AVD-DAS	Design of Airframe Systems	Dr Craig Lawson	23		10	N		10/10/16	21/10/16	40	EX	100				04/01/17	04/06/17
17b	N-AVD-DASY	Design of Airframe Systems	Dr Craig Lawson	23		0	N		10/10/16	21/10/16	n/a	AO	n/a				n/a	n/a
18	N-AVD-DS	Detail Stressing	Ioannis Giannopoulos	20		0	Y		07/11/16	18/11/16	n/a	AO	n/a				n/a	n/a
19a	N-AVD-FFMDT	Fatigue, Fracture Mechanics and Damage Tolerance	Dr Wenli Liu	20		0	Y		21/11/16	25/11/16	n/a	AO	n/a				n/a	n/a
19b	N-AVD-ASC	Fatigue, Fracture Mechanics and Damage Tolerance	Dr Wenli Liu	20		10	Y		21/11/16	25/11/16	40	EX	100				06/01/17	06/06/17

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
20	N-AVD-FTAD	Fault Tolerant Avionics Design	Dr Huamin Jia	10		0	N		16/01/17	23/01/17	n/a	AO	n/a				n/a	n/a
21a	N-AVD-FINEA	Finite Element Analysis	Ioannis Giannopoulos	22		0	Y		07/11/16	18/11/16	n/a	AO	n/a				n/a	n/a
				10		0						AO	n/a				n/a	n/a
21b	N-AVD-FEA	Finite Element Analysis	Ioannis Giannopoulos	22		10	Y		07/11/16	18/11/16	40	EX	100				09/01/17	09/06/17
				10		0						AO	n/a				n/a	n/a
22	N-AVD-FEM	Flight Experience	Dr Alastair Cooke	4 plus 2 flights		0	N		03/10/16	25/03/17	n/a	AO	n/a				n/a	n/a
23	N-AVD-N1	Inertial and Satellite Navigation Systems	Dr Huamin Jia Dr Irfan Madani	20		10	N		11/11/16	23/11/16	40	EX	100				06/01/17	06/06/17
24	N-AVD-IAD	Initial Aircraft Design - Structural Layout - Conceptual Design	Prof Howard Smith	10 20		0 0	N		05/12/16 06/02/17	09/12/16 17/02/17	n/a	AO	n/a				n/a	n/a
25	N-AVD-N2	Integrated Navigation Systems	Dr Huamin Jia	20		0	N		15/11/16	02/12/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
26	N-AVD-IVHM	Integrated Vehicle Health Management	Dr Suresh Perinpanayagam	10		0	N		16/01/17	20/01/17	n/a	AO	n/a				n/a	n/a
27	NEW MODULE	Landing Gear Design	Jack Stockford	10		0	N		12/12/16	16/12/16	n/a	AO	n/a				n/a	n/a
28	N-AVD-LA	Loading Actions	Prof Howard Smith	20		0	N		03/10/16	14/10/16	n/a	AO	n/a				n/a	n/a
29	N-AVD-MDS	Modelling of Dynamic Systems	Dr James Whidborne	13		0	Y		24/10/16	28/10/16	n/a	AO	n/a				n/a	n/a
30	N-AVD-RS	Radio Systems	Dr David Zammit-Mangion	10		0	N		20/02/16	24/02/16	n/a	AO	n/a				n/a	n/a
31	N-AVD-RSAC	Reliability, Safety Assessment and Certification	Jack Stockford	20		0	N		16/01/17	27/01/17	n/a	AO	n/a				n/a	n/a
32	N-AVD-SD	Structural Dynamics	Prof Shijun Guo	20		0	Y		20/02/17	24/02/17	n/a	AO	n/a				n/a	n/a
33a	N-AVD-STS	Structural Stability	Dr Wenli Liu	20		0	Y		23/01/17	03/02/17	n/a	AO	n/a				n/a	n/a
33b	N-AVD-SS	Structural Stability	Dr Wenli Liu	20	10		Y		23/01/17	03/02/17	40	EX	100				24/04/17	24/09/17

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module6 (%) of Independent assessments	Multi-part Assessment Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
34	N-AVD-GP	Group Design Project	Prof Howard Smith	200		100	N		13/10/16	03/05/17		THESIS GPRAC	90 10				12/04/17	
35a	N-AVD-THESIS	Individual Research Project	Various	10		80	N		03/10/16	06/09/17		THESIS OR	90 10				09/08/17	
35b	N-AVD-SDTHES	Individual Research Project	Various	20		160	N		03/10/16	06/09/17		THESIS OR	90 10				09/08/17	

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

March Intake

Module Number	Module code	Title	Module Leader	Contact hours [10]	Total hours delivered by Visiting Lecturers [11]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[12] - 40% or 50%	Assessment						Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment				Submission dates	
												Type of Assessment	Weighting within module13 (%) of Independent assessments	weighting within module of multi-part assessments [14 (100%)]	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
1	N-AVD-AE	Aeroelasticity	Prof Shijun Guo	10		0	N		31/07/17	04/08/17	n/a	AO	n/a					n/a	n/a
2	N-AVD-ANCS	Aeronautical Communication Systems	Dr Huamin Jia	10		0	N		10/07/17	14/07/17	n/a	AO	n/a					n/a	n/a
3	N-AVD-ASE	Aerospace Software Engineering and Ada	Dr Huamin Jia Dr Irfan Madani	20		0	N		10/04/17	11/04/17	n/a	AO	n/a					n/a	n/a
4	N-AVD-ASDL	Aerospace System Development and Life Cycle Model	Tim Mackley	10		0	N		13/03/17	17/03/17	n/a	AO	n/a					n/a	n/a

[10] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[11] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[12] 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.

[13] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[14] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[15] 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.

[16] 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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Multi-part Assessment Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
5	N-AVD-ATC	Avionics Air Traffic Control	Dr Francisco J Saez-Nieto	10		0	N		07/08/17	11/08/17	n/a	AO	n/a				n/a	n/a
6	N-AVD-AA	Aircraft Aerodynamics	Prof Howard Smith	10		0	N		06/03/17	10/03/17	n/a	AO	n/a				n/a	n/a
7	N-AVD-AP	Aircraft Performance	Dr Craig Lawson	10		0	N		27/03/17	31/03/17	n/a	AO	n/a				n/a	n/a
8	N-AVD-APPI	Aircraft Power Plant Installation	Dr Adrian Clarke	10		0	N		31/07/17	04/18/17	n/a	AO	n/a				n/a	n/a
9	N-AVD-ACSC	Aircraft Stability and Control	Dr Alastair Cooke	10		0	N		27/03/17	31/03/17	n/a	AO	n/a				n/a	n/a
10	N-AVD-AISI	Avionics Data Networking, Hardware Integration and Testing	Dr Huamin Jia	10		0	N		17/07/17	20/07/17	n/a	AO	n/a				n/a	n/a
11	N-AVD-CE	Cockpit Environment	Dr David Zammit-Mangion	10		0	N		18/04/17	21/04/17	n/a	AO	n/a				n/a	n/a
12	N-AVD-CAD	Computer Aided Design	Dr Helen Lockett	20		0	N		20/03/17	05/05/17	n/a	AO	n/a				n/a	n/a
13	N-ASD-CS	Control Systems	Dr James Whidborne	28		10	Y		10/04/17	12/05/17	40			100 MULTI	ICW EX	50 50	12/05/17 12/06/17	12/11/17 12/01/17

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

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Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[13] (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
14	N-AVD-CW	Crashworthiness	Ioannis Giannopoulos	20		0	N		07/08/17	11/08/17	n/a	AO	n/a				n/a	n/a
15	N-AVD-FRP	Design and Analysis of Composite Structures	Prof Shijun Guo	20		10	Y		10/04/17	21/04/17	40			100 MULTI	EX ICW	75 25	15/06/17 21/04/17	15/01/18 21/11/17
16	N-AVD-DMO	Design for Manufacture and Operation	Prof Howard Smith	10		0	N		24/04/17	28/04/17	n/a	AO	n/a				n/a	n/a
17a	N-AVD-DAS	Design of Airframe Systems	Dr Craig Lawson	23		10	N		13/03/17	24/03/17	40	EX	100				04/06/17	04/01/18
17b	N-AVD-DASY	Design of Airframe Systems	Dr Craig Lawson	23		0	N		n/a	n/a	n/a	AO	n/a				n/a	n/a
18	N-AVD-DS	Detail Stressing	Ioannis Giannopoulos	20		0	Y		10/07/17	21/07/17	n/a	AO	n/a				n/a	n/a
19a	N-AVD-FFMDT	Fatigue, Fracture Mechanics and Damage Tolerance	Dr Wenli Liu	20		0	Y		08/05/17	19/05/17	n/a	AO	n/a				n/a	n/a
20	N-AVD-FTAD	Fault Tolerant Avionics Design	Dr Huamin Jia	10		0	N		08/05/17	12/05/17	n/a	AO	n/a				n/a	n/a
21a	N-AVD-FINEA	Finite Element Analysis	Ioannis Giannopoulos	22		0	Y		03/04/17	13/04/17	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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Independent Assessment – Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Multi-part Assessment – Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
				10		0						AO	n/a				n/a	n/a
22	N-AVD-FEM	Flight Experience	Dr Alastair Cooke	4 plus 2 flights		0	N		03/03/17	01/09/17	n/a	AO	n/a				n/a	n/a
23	N-AVD-N1	Inertial and Satellite Navigation Systems	Dr Huamin Jia Dr Irfan Madani	20	10		N		03/04/17	07/04/17	40	EX	100				06/06/17	06/01/18
24	N-AVD-IAD	Initial Aircraft Design - Structural Layout - Conceptual Design	Prof Howard Smith	10 20		0 0	N		24/04/17 03/07/17	28/04/17 07/07/17	n/a	AO	n/a				n/a	n/a
25	N-AVD-N2	Integrated Navigation Systems	Dr Huamin Jia	20		0	N		02/05/17	19/05/17	n/a	AO	n/a				n/a	n/a
26	N-AVD-IVHM	Integrated Vehicle Health Management	Dr Suresh Perinpanayagam	10		0	N		14/08/17	18/08/17	n/a	AO	n/a				n/a	n/a
27	NEW MODULE	Landing Gear Design	Jack Stockford	10		0	N		15/05/17	19/05/17	n/a	AO	n/a				n/a	n/a
28	N-AVD-LA	Loading Actions	Prof Howard Smith	20		0	N		06/03/17	17/03/17	n/a	AO	n/a				n/a	n/a
29	N-AVD-MDS	Modelling of Dynamic Systems	Dr James Whidborne	13		0	Y		03/04/17	07/04/17	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

Module Number	Module code	Title	Module Leader	Contact hours[10]	Total hours delivered by Visiting Lecturers[11]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[12] - 40% or 50%	Type of Assessment	Weighting within module13 (%) of Independent assessments	Weighting within module of multi-part assessments[14] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[15]	Assessment Submission and/or exam date[16]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
30	N-AVD-RS	Radio Systems	Dr David Zammit-Mangion	10		0	N		19/06/17	23/06/17	n/a	AO	n/a				n/a	n/a
31	N-AVD-RSAC	Reliability, Safety Assessment and Certification	Jack Stockford	20		0	N		19/06/17	30/06/17	n/a	AO	n/a				n/a	n/a
32	N-AVD-SD	Structural Dynamics	Prof Shijun Guo	20		0	Y		10/07/17	21/07/17	n/a	AO	n/a				n/a	n/a
33a	N-AVD-STS	Structural Stability	Dr Wenli Liu	20		0	Y		19/06/17	30/06/17	n/a	AO	n/a				n/a	n/a
34	N-AVD-GP	Group Design Project	Prof Howard Smith	200		100	N		16/03/17	16/09/17		THESIS GPRAC	90 10				12/04/17	12/04/18
35a	N-AVD-THESIS	Individual Research Project	Various	10		80	N		03/03/17	03/02/18		THESIS OR	90 10				09/08/17	17/08/18

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ASD-CS	Control Systems	Aerospace Dynamics	Aerospace Dynamics, Autonomous Vehicle Dynamics and Control, Astronautics and Space Engineering
N-AVD-FRP	Design and Analysis of Composite Structures	Aerospace Vehicle Design	Astronautics and Space Engineering
N-AVD-DS	Detail Stressing	Aerospace Vehicle Design	Airworthiness, Aircraft Engineering
N-AVD-ASC (assessed) N-AVD-FFMDT (non-assessed)	Fatigue, Fracture Mechanics and Damage Tolerance	Aerospace Vehicle Design	Aircraft Engineering
N-AVD-MDS	Modelling of Dynamic Systems	Aerospace Dynamics	Autonomous Vehicle Dynamics and Control, Astronautics and Space Engineering, Aerospace Dynamics
N-AVD-SS	Structural Stability	Aerospace Vehicle Design	Advanced Lightweight Structures and Impact
N-AVD-FINEA (non-assessed) N-AVD-FEA (assessed)	Finite Element Analysis	Aerospace Vehicle Design	Astronautics and Space Engineering
N-AVD-SD	Structural Dynamics	Aerospace Vehicle Design	Astronautics and Space Engineering

7. How are the ILOs assessed?

The course assessment strategy must be consistent with its teaching and learning strategy. The assessments therefore are designed around problem based learning and problem solving skills. Hence much more emphasis is placed on the thesis assessment rather than knowledge recall assessment such as examinations.

The following assessment types are utilised:

- The course uses a range of assessment types. The taught component of the course is assessed by a combination of both examinations, and also by the application of the knowledge gained to the group design project and the individual research project, which are both examined by a thesis.

- Students following the aircraft design and avionic systems design options can expect to have 2 written examinations and 1 assignment. All students participate in the group design project which is assessed by a thesis and peer review. The group design project is an example of problem based learning. Peer review has been shown to be a good fit with problem based learning because it emphasises the cooperative nature of learning environment. The individual research project requires students to be assessed on their written and oral presentation skills, through a submitted thesis and oral examination.

- Students following the structural design option do not participate in the group design project, but instead undertake a more extensive individual research project. Students can expect to have 4 written examinations and 1 assignment. The individual research project requires students to be assessed on their written and oral presentation skills, through a submitted thesis and oral examination.

This approach has been adopted to ensure that students demonstrate their understanding through a range of learning techniques and are therefore 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.)

For Example:

A. MSc

Award ILOs Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.
1	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
2	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
3	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
4	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
5	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
6	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
7	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
8	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
9	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
10	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
11	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
12	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
13	GPROJ, EX, ICW	GPROJ, EX, ICW	GPROJ, EX, ICW		
14	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
15	GPROJ, EX, ICW	GPROJ, EX, ICW	GPROJ, EX, ICW		
16	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
17a	GPROJ, EX	GPROJ, EX	GPROJ, EX		
17b	AO	AO	AO		
18	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
19a	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
19b	EX	EX	EX		
20	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
21a	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
21b	EX	EX	EX		
22	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
23	GPROJ, EX	GPROJ, EX	GPROJ, EX		
24	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.
25	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
26	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
27	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
28	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
29	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
30	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
31	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
32	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
33a	GPROJ, AO, THESIS	GPROJ, AO, THESIS	GPROJ, AO, THESIS		
33b	GPROJ, EX	GPROJ, EX	GPROJ, EX		
34	GPROJ	GPROJ	GPROJ	GPROJ	
35a	THESIS, OR	THESIS, OR	THESIS, OR		THESIS, OR
35b	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 (%)
Group Design Project	All modules except IRP	Thesis	90
		Peer Review 1	5
		Peer Review 2	5
Individual Research Project	All modules except GDP	Thesis	90
		Oral Exam	10

8. **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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known

as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

Cranfield University has been at the forefront of postgraduate education in aerospace engineering since 1946. Aircraft design at Cranfield was one of the original foundation courses of the College of Aeronautics, which has evolved over the years, and more recently broadened in content, into the Aerospace Vehicle Design course that we have today.

Cranfield has a global reputation for advanced postgraduate education and extensive applied research. 94% of Cranfield graduates secure employment within 6 months. The Aerospace Vehicle Design course is valued and respected by employers worldwide.

The aerospace industry has a continuing need to recruit structural designers, stress engineers, systems design engineers and avionics design engineers. Graduates from the MSc in Aerospace Vehicle Design can therefore look forward to a varied choice of challenging career opportunities in the above disciplines. Many of the graduates occupy very senior positions in their organisations, making valuable contributions to the international aerospace industry.

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 Air Transport Management

Date of first publication/latest revision:	September 2016

1. What is the course?

Course information

Course Title	MSc in Air Transport Management
Course code	MSATRFTC
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip
Mode of delivery	Full-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Centre for Air Transport Management
Course Director	Dr Robert Mayer
Awarding Body	Cranfield University
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	1st or upper 2nd class UK honours degree or equivalent in any relevant discipline. A lower qualification plus a number of year's relevant working experience may be accepted as equivalent. For applicants whose first language is not English there is a requirement to achieve the level of 7.0 on IELTS and equivalent grades on other English language qualifications recognised by the University.
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, Centre for Air Transport Management where the research interests include:

- Air Transport Economics
- Airline and Airport Planning and Operations
- Safety and Air Accident Investigation.

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 masters-level programme of learning for existing air transport managers to enhance their knowledge and skills;
- provide a masters-level programme of learning for graduates seeking to pursue a career in air transport management;
- provide the foundation necessary for graduates to go on to undertake doctoral research in air transport management.

This programme is intended for the following range of students:

- New graduates seeking to pursue a career in the air transport industry
- Practitioners in the sector, particularly at junior and middle management levels, who are seeking to expand their knowledge and skills in air transport management in order to further develop their careers.
- Practitioners who are not employed in the sector, who are seeking a career in the air transport industry.
- Both practitioners and new graduates seeking to pursue doctoral research in the area of air transport.

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

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

A. MSc Air Transport Management

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

ILO 1.   Demonstrate an in-depth understanding of economics and financial management relevant to air transport, air transport commercial practice and air transport operations (as they relate to both aircraft and infrastructure);

ILO 2.   Demonstrate an understanding of regulatory framework that defines the air transport industry;

ILO 3.   Demonstrate an understanding of mathematical modelling relevant to air transport management problems

ILO 4. Demonstrate an in-depth understanding of the complex interrelationships of technical and operational aspects of the air transport industry with the commercial pressures and realities facing its management;

ILO 5. Analyse critically practical problems in the air transport and related industries to provide timely solutions, having regard to technical, regulatory, commercial, political, social and environmental constraints;

ILO 6. Demonstrate originality in data collection;

ILO 7. Undertake independent research on a subject relevant to technical, operational or commercial aspects of the air transport or related industries, including a review of relevant literature, methodological planning, data collection, analysis, presentation of results, and evaluation and discussion of these results, and the contribution made;

ILO 8. Make effective use of electronic and hardcopy library resources;

ILO 9. Undertake critical appraisal of literature pertaining to the technical, operational and commercial aspects of the air transport industry;

ILO 10. Select and use appropriate analytical and decision making approaches to research and investigative air transport management problems;

ILO 11. Make effective oral and written presentations of their work;

ILO 12. Work effectively to set deadlines;

ILO 13. Demonstrate the ability to work within teams and possess an understanding and appreciation of the contributions made by other specialists;

ILO 14. Undertake and successfully complete a substantial programme of research independently, applying robust methods of data collection and analysis, and communicating the findings coherently.

4. How is the course taught?

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

- lectures and workshops delivered by industry practitioners, demonstrating the application of theory to various examples and case studies;
- training on how to use the library's on-campus and on-line resources undertaken by a Cranfield University librarian;
- training on how to use the OAG airline schedule database.

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 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, 9, 13	90
Group Project (14)	20
ELECTIVE MODULES:	
Modules 8, 10, 11, 12 (Choose One)	10
TOTAL:	120

B.   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, 9, 13	90
Group Project (14)	20
Individual Research Project (15)	80
ELECTIVE MODULES:	
Modules 8, 10, 11, 12 (Choose One)	10
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);[1] [2]
- **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:

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[1]   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).

[2]   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?

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

Teaching is delivered in one week modules.   In the first teaching period, students will have completed five modules. During teaching period two students complete the remaining modules. Students complete a group project which starts mid-April and concludes just before May. Students are required to submit a thesis proposal by the end of January. The thesis is handed-in at the beginning of August. Oral examinations are held in early September.

Students are typically granted four weeks to complete course work. Exams are scheduled in December (before Christmas). Students are required to contribute to a report for their group projects and to participate in a group presentation. Once students have handed in their thesis, students must deliver a presentation summarising their thesis and be cross-examined on this presentation as part of their thesis viva.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-ATF-IAT10	Introduction to Air Transport Industry	Mr Andy Foster	25		10	Y	10/10/16	10/10/16	14/10/16	40	ICW	100				14/11/16	08/05/17
2	N-ATF-TEF10	Theory of Air Transport Economics and Finance	Dr Robert Mayer	25		10	N	31/10/16	31/10/16	04/11/16	40	EX	100				13/12/16 TBC	08/05/17
3	N-ATF-AEF10	Applications of Air Transport	Dr Robert Mayer	25		10	N	07/11/16	07/11/16	11/11/16	40	ICW	100				12/12/16	08/05/17

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Independent Assessment Weighting within module6 (%) of Independent assessments	Multi-part Assessment Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment Type of Assessment	Multi-part Assessment Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Submission dates Assessment / Exam Retake date
		Economics and Finance																
4	N-ATF-RPA10	Regulatory Policy and Air Law	Dr Keith Mason	25		10	Y	17/10/16	17/10/16	21/10/16	40	EX	100				28/10/16	08/05/17
5	N-APM-STA10	Research Methods and Statistics	Dr Nicola Volta	30		10	Y	28/11/16	08/11/16	06/12/16	40	ICW	100				16/01/17	08/05/17
6	N-APM-RMF10	Air Transport Market Analysis and Forecasting	Dr Chika Miyoshi	25		10	Y	09/01/17	09/01/17	13/01/17	40	ICW	100				13/02/17	08/05/17
7	N-ATF-ATO10	Air Transport Operations	Mr Andy Foster	25		10	N	16/01/17	16/01/17	20/01/17	40	ICW	100				20/02/17	08/05/17
8	N-ATF-ATN10	Air Transport and the Environment	Dr Chika Miyoshi	25		10	Y	30/01/17	30/01/17	03/02/17	40	ICW	100				06/03/17	08/05/17
9	N-ATF-ATS10	Air Transport Strategic Management	Dr Frankie O'Connell	25		10	N	06/02/17	06/02/17	10/02/17	40	ICW	100				13/03/17	08/05/17
10	N-SAI-ISMS Occ C	Aviation Safety Management	Dr Simon Mitchell/ Mr Dave Barry	30		10	Y	13/02/17	13/02/17	17/02/17	40	ICW	100				20/03/17	08/05/17

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

Air Transport Management (Full Time) COURSE SPECIFICATION
QA&E Version: 2.3 December 2016   Course / SAS Version:

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar			Independent Assessment		Multi-part Assessment			Submission dates	
11	N-AW-ATEMO	Air Transport Engineering – Maintenance Operations	Cengiz Turkoglu	30		10	Y	20/02/17	20/02/17	24/02/17	40			100	EX ICW	30 70	24/02/17 27/03/17	08/05/17
12	N-ATF-AFP10	Airline Fleet Planning	Mr Andy Foster	25		10	Y	20/02/17	20/02/17	24/02/17	40	ICW	100				27/03/17	08/05/17
13	N-ATF-ATM10	Air Transport Marketing	Dr Keith Mason	25		10	Y	27/02/17	27/02/17	03/03/17	40	ICW	100				03/04/17	08/05/17
14	N-ATF-GP20	Group Project	Mr Andy Foster Dr Frankie O'Connell	10		20	N	20/03/17	20/03/17	07/04/17	40	GCW GPRES	50 50				07/04/17	08/05/17
15	N-ATF-THES10	Individual Research Project (IRP)	Dr Romano Pagliari	10		80	Y	20/01/17	20/01/17	08/09/17		THESIS OR	80 20				01/08/17 30 & 31/08/17	

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

Air Transport Management (Full Time) COURSE SPECIFICATION
QA&E Version: 2.3 December 2016   Course / SAS Version:

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ATF-IAT10	Introduction to Air Transport Industry	F-T Air Transport Management	F-T Airport Planning and Management
N-ATF-RPA10	Regulatory Policy and Air Law	F-T Air Transport Management	F-T Airport Planning and Management Executive Air Transport Management Executive Airport Planning and Management
N-APM-STA10	Research Methods and Statistics	F-T Airport Planning and Management	F-T Air Transport Management
N-APM-RMF10	Air Transport Market Analysis and Forecasting	F-T Air Transport Management	F-T Airport Planning and Management
N-ATF-ATM10	Air Transport Marketing	F-T Air Transport Management	Executive Air Transport Management
N-AW-ATEMO	Air Transport Engineering – Maintenance Operations	Airworthiness	F-T Air Transport Management Executive Air Transport Management Military Aerospace and Airworthiness Safety and Human Factors in Aviation
N-ATF-ATN10	Air Transport and the Environment	F-T Air Transport Management	Executive Air Transport Management
N-SAI-ISMS	Aviation Safety Management	F-T Air Transport Management	Airworthiness Military Aerospace and Airworthiness Safety and Human Factors in Aviation Safety & Accident Investigation (Air)
N-ATF-AFP10	Airline Fleet Planning	F-T Air Transport Management	Executive Air Transport Management
N-ATF-THES10	Individual Research Project	F-T Air Transport Management	F-T Airport Planning and Management

7. **How are the ILOs assessed?**

The course uses a range of assessment types. Students can expect to have two written examinations, ten pieces of assessment by submitted work and two elements of assessment by presentation or viva.

Students are subject to two forms of assessment with regard to the group project. 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 presentation. The oral presentation provides an opportunity for each student to present their thesis to members of staff. These 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 been communicated and how well the student has responded to questions from the audience.

This approach has been adopted in order to ensure that students achieve the intended learning outcomes.

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	IL3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11	ILO12	ILO13	ILO14
1								ICW						
2	EX				EX			EX						
3	IWC				ICW		ICW	ICW	ICW					
4		EX			EX			EX						
5			ICW				ICW	ICW						
6		ICW					ICW	ICW						
7	IWC			ICW	ICW			ICW	ICW					
8					ICW			ICW						
9								ICW						
10								ICW						
11								ICW	ICW					
12								ICW						
13								ICW						
14						GCW		GCW					GCW	
15						THESIS		THESIS	THESIS	THESIS	OR	THESIS OR		THESIS OR

Air Transport Management (Full Time) COURSE SPECIFICATION
QA&E Version: 2.3 December 2016   Course / SAS Version::

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

Graduates from this course will be well prepared for employment in the field of air transport management. The MSc Air Transport Management is designed to equip students with the skills required to pursue a successful career in various sectors of the air transport industry, including, but not restricted to, airlines, airport companies and authorities, civil aviation departments, air transport consultancies and aerospace companies. Cranfield students are also well prepared to undertake research leading to the award of a PhD.

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 Airport Planning and Management

Date of first publication/latest revision:	September 2016

1. What is the course?

Course information

Course Title	MSc in Airport Planning and Management
Course code	MSAPMFTC
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip
Mode of delivery	Full-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Centre for Air Transport Management
Course Director	Dr Pere Suau-Sanchez
Awarding Body	Cranfield University
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	1st or upper 2nd class UK honours degree (or non-UK equivalent) in any discipline. A recognised professional qualification plus a number of years' relevant working experience may be accepted as equivalent. For applicants whose first language is not English there is a requirement to achieve the level of 7.0 on IELTS and equivalent grades on other English language qualifications recognised by the University.
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, Centre for Air Transport Management where the research interests include:

- Air Transport Economics
- Airline and Airport Planning and Operations
- Safety and Air Accident Investigation

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 Chartered Institute of Logistics and Transport in the UK until September 2016.

2. What are the aims of the course?

Cranfield University offers this course in order to:

- provide a masters-level programme of learning for existing airport managers to enhance their skills in airport planning and management;
- provide a masters-level programme of learning for graduates seeking to pursue a career in airport planning and management;
- provide a masters-level programme of learning to meet the management training needs of existing airport operators and planning consultants;
- provide the foundation necessary for graduates to undertake doctoral research in airport planning and management.

This programme is intended for the following range of students:

- New graduates seeking to pursue a career in airport planning and management;
- Practitioners in the sector, particularly at junior and middle management levels, who are seeking to expand their knowledge and skills in airport planning and management in order to further develop their careers;
- Practitioners who are not employed in the airport or related sector, who are seeking a career in airport planning and management;
- Both practitioners and new graduates seeking to pursue doctoral research in airport planning and management.

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 understanding of relevant international and national regulations and explain their effects on airport business, planning, design, operations and safety management decisions;

ILO 2.   Demonstrate a critical awareness of the key issues that affect users of airport facilities (e.g. airlines and retailers) and explain how their commercial pressures, strategic decisions and priorities impact on airport business, planning, design, operations and safety management decisions;

ILO 3.   Identify, analyse and design solutions in order to address a given research problem within the context of airport planning and management, having regard to regulatory constraints and commercial and environmental imperatives;

ILO 4.   Collaborate and contribute effectively to a group project, and communicating the findings of this exercise coherently to academics and other practitioners;

ILO 5.   Collect information from a variety of electronic (internet) and hard copy sources to support a research project;

ILO 6.   Appraise and critique the work of other practitioners and specialists;

ILO 7.   Communicate effectively, both orally and in written form, research work produced to both practitioner and academic audiences;

ILO 8.   Take responsibility for research produced, including, efficient time management, working to set deadlines and targets, demonstrating self-discipline, creative thinking and critical reflections of their own performance.

ILO 9.   Undertake and successfully complete a substantial programme of research independently, applying robust methods of data collection and analysis, and communicating the findings coherently.

4. **How is the course taught?**

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

- lectures and workshops delivered by industry practitioners, demonstrating the application of theory to various examples and case studies;
- training on how to use the library's on-campus and on-line resources undertaken by a Cranfield University librarian;
- training on how to use the OAG airline schedule database;
- a four-day workshop designed to enable students to develop a working competency in the use of CAST airport passenger terminal design software.

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 Diploma**

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

Description	Credits
COMPULSORY MODULES:	
Modules 1 to 9 Group project (10)	100 20
ELECTIVE MODULES:	
n/a	
TOTAL:	120

B. **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 to 9 Group project (10) IRP (11)	100 20 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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 October and are expected to complete the course within 11 calendar months.

Teaching is delivered in one week modules (with the exception of Research Methods and Statistics which is taught over a week and a half). In the first teaching period, students will have completed five modules. During teaching period two, students complete the remaining modules. Students complete a three week group project which concludes just after the Easter break. Students are required to submit a thesis proposal by the end of January. The thesis is handed-in at the beginning of August. Thesis oral examinations are held in early September.

Students are typically granted four weeks to complete course work. Students are required to contribute to a report for their group projects and to participate in a group presentation. Following handing in their thesis, students must deliver a presentation summarising their thesis and be cross-examined on this presentation as part of their thesis viva.

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[1] 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).

[2] 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%).

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-ATF-IAT10	Introduction to the Air Transport Industry	Mr Andy Foster	25		10	Y	10/10/16	10/10/16	14/10/16	40	ICW	100				14/11/16	08/05/17
2	N-APM-APO10	Airport Operations	Mr Richard Moxon	30		10	Y	31/10/16	31/10/16	04/11/16	40	ICW	100				05/12/16	08/05/17
3	N-APM-FBM10	Airport Finance and Business Management	Dr Romano Pagliari	50		20	N	14/11/16	14/11/16	25/11/16	40 40 40	EX ICW ICW	45 45 10				06/01/17 03/01/17 25/11/16	08/05/17

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
												Independent Assessment		Multi-part Assessment			Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	N-ATF-RPA10	Regulatory Policy and Air Law	Dr Keith Mason	25		10	Y	17/10/16	17/10/16	21/10/16	40	EX	100				28/10/16	08/05/17
5	N-APM-STA10	Research Methods and Statistics	Dr Nicola Volta	30		10	Y	28/11/16	28/11/16	06/12/16	40	ICW	100				16/01/17	08/05/17
6	N-APM-RMF10	Air Transport Market Analysis and Forecasting	Dr Chikage Miyoshi	25		10	Y	09/01/17	09/01/17	13/01/17	40	ICW	100				13/02/17	08/05/17
7	N-APM-ASP10	Airport Strategic Planning	Mr Richard Moxon	24		10	Y	16/01/17	16/01/17	20/01/17	40	ICW	100				20/02/17	08/05/17
8	N-APM-AEP10	Airport Environmental Planning	Dr Pere Suau-Sanchez	30		10	Y	30/01/17	30/01/17	03/02/17	40 40	ICW GPRES	75 25				06/03/17	08/05/17
9	N-APM-ADE10	Airport Design	Mr Henrik Rothe	30		10	Y	13/02/17	13/02/17	17/02/17	40	ICW	100				20/03/17	08/05/17
10	N-APM-GP20	Group Project	Dr Pere Suau-Sanchez	10		20	N	20/03/17	20/03/17	07/04/17	40 40	GCW GPRES	50 50				07/04/17	
11	N-ATF-THES10	Individual Research Project	Dr Romano Pagliari	10		80	Y	20/01/17	20/01/17	08/09/17	50 50	THESIS OR	80 20				01/08/17 25/11/17	

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

7

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ATF-IAT10	Introduction to the Air Transport Industry	F-T Air Transport Management	F-T Airport Planning and Management
N-APM-STA10	Research Methods and Statistics	F-T Airport Planning and Management	F-T Air Transport Management
N-APM-APO10	Airport Operations	F-T Airport Planning and Management	Executive Air Transport Management Executive Airport Planning and Management
N-APM-ASP10	Airport Strategic Planning	F-T Airport Planning and Management	Executive Airport Planning and Management
N-ATF-RPA10	Regulatory Policy and Air Law	F-T Air Transport Management	F-T Airport Planning and Management Executive Air Transport Management Executive Airport Planning and Management
N-APM-RMF10	Air Transport Market Analysis and Forecasting	F-T Air Transport Management	F-T Airport Planning and Management
N-APM-AEP10	Airport Environmental Planning	F-T Airport Planning and Management	Executive Airport Planning and Management
N-APM-ADE10	Airport Design	F-T Airport Planning and Management	Executive Airport Planning and Management
N-ATF-THES10	Individual Research Project	F-T Air Transport Management	F-T Airport Planning and Management

7. How are the ILOs assessed?

The following assessment types are utilised:

Students will be required to complete one form of assessment for each module. There are nine taught modules under the current structure, seven of which have one point of assessment (six modules assessed by Individual Coursework and one by Examination). The remaining two modules are assessed by a mix of Individual Coursework/Group Presentations/Examination/Individual Project.

Students are subject to two forms of assessment with regard to the group project. 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 presentation. The oral presentation provides an opportunity for each student to present their thesis to members of staff. These 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 been communicated and how well the student has responded to questions from the audience.

This approach has been adopted in order to ensure that students achieve the intended learning outcomes set out in Section 3.

Assessment and ILO Mapping

A. 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	ILO4	ILO 5	ILO 6	ILO 7	ILO 8	ILO 9
1	ICW					ICW		ICW	
2	ICW					ICW		ICW	
3	EX ICW ICW	EX ICW ICW	EX ICW ICW			EX ICW ICW		EX ICW ICW	
4	EX							EX	
5					ICW			ICW	
6					ICW			ICW	
7	ICW					ICW		ICW	
8	ICW GPRES		ICW GPRES			ICW GPRES	GPRES	ICW GPRES	
9	ICW	ICW	ICW			ICW		ICW	
10	GCW GPRES			GCW GPRES		GCW GPRES	GPRES	CGW GPRES	
11					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 (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

Graduates from this course will be well prepared for employment in the field of airport planning and management. Opportunities for employment will exist in the planning departments of airport authorities or as a planner in one of airport management and planning consultancies that are involved in various airport development projects worldwide. Opportunities are also possible within regulatory organisations both in the UK and worldwide as well as with various other suppliers that have B2B relationships with the airport sector such as IT companies, airlines and aircraft manufacturers. Cranfield students are also well prepared to undertake research leading to the award of a PhD.

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 Airworthiness

Date of first publication/latest revision: September 2016

1. What is the course?

Course information

Course Title	MSc in Airworthiness
Course code	MSAWOPTC, PDAWOPTC, PCAWOPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	PgDip and PgCert
Mode of delivery	Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Centre for Safety and Accident Investigation
Course Director	Cengiz Turkoglu
Awarding Body	Cranfield University
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	Part-time MSc - up to three years, Part-time PgDip - up to three years, Part-time PgCert - two years,
Course Start Month(s)	September

Airworthiness COURSE SPECIFICATION
QA&E USE ONLY: Version 3.0 January   Course / SAS Version:

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Transport Systems Theme, Centre for Safety and Accident Investigation where the research interests include:

- Aviation Safety
- Reliability
- Aircraft Maintenance
- Risk Management

Industrial visits and technical experts from external institutions play a large part in the course.

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 Royal Aeronautical Society (RAeS) until September 2019 intake Their statement reads "The accredited MSc programme has met the academic requirements (of the Engineering Council) for Further Learning for registration as a Chartered Engineer (CEng) by both the Institution of Mechanical Engineers and the Royal Aeronautical Society. For students with an accredited first degree, this satisfies the requirements of the educational base for CEng registration."

2. What are the aims of the course?

Cranfield University offers this course in order to provide a wide spectrum of technical knowledge in the context of the related regulatory and safety issues. This is a background that managers in today's aerospace industry must possess. A detailed knowledge of airworthiness issues early in the development stage of a product's design, modification, repair or process helps the downstream 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 to the technology concerned in the design, production and maintenance of aircraft – the airworthiness issues.
- Establish a centre of excellence that delivers a high technology Masters programme in airworthiness.
- Promote relevant research and development activity in airworthiness within Cranfield University, industry and government agencies.

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. It is also suggested that the latter two qualifications may be more appropriate for engineers in the aviation industry who have no need for a separate research project (thesis).

This programme is intended for the following range of students:

- Graduate engineers from airlines
- Licensed engineers in aviation industry (PgCert / PgDip possibly extending to MSc)
- Airworthiness engineers working in manufacturing, maintenance and/or operations

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 an understanding of major issues surrounding the design and performance of complex aircraft, engine, their components and associated equipment used in aviation at a level appropriate to airworthiness requirements;

ILO 2.   Describe and detail the organisation and nature of airworthiness requirements covering aircraft design, manufacture and maintenance;

ILO 3.   Develop an awareness of the analytical, diagnostic and practical skills required for safe operation of aircraft, engines and their components;

ILO 4.   Work both independently and as a member of a team towards the solution of complex safety related engineering problems;

ILO 5.   Use transferable skills developed through team work, communication and problem-solving to enhance their careers in engineering and technical management;

ILO 6.   Understand the roles and significance of compliance, substantiation, validation, certification and approval in the demonstration of airworthiness;

ILO 7.   Be cognisant of the application of the studied technologies in other fields besides aerospace.

B. **Postgraduate Diploma**

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

ILO 8.   Access and apply the relevant specific requirements in an appropriate way within the technology areas covered by the course and relate the technology to the requirements in such a way that sound engineering judgements can be made.

C. **MSc**

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

ILO 9.   Undertake independent research on a topic relevant to airworthiness and safety in aircraft or engine design, manufacture or maintenance utilising the techniques of literature review, data gathering, analysis, results evaluation, and presentation both written and oral.

4. How is the course taught?

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

- Lectures from external speakers with expertise in particular aspects of the course;
- Access to library resources;
- Use of class exercises (e.g. group work in AW02, Safety Assessment of Aircraft Systems) to help develop knowledge and techniques;
- Conducting individual research project in a commercial or research organisation to provide a '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 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, 12 and 16 [AW00, AW02, AW17, AW22	40
ELECTIVE MODULES:	
20 credits selected from Modules: 2, 4-11, 14-15, 17-19	20 (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:

Description	Credits
COMPULSORY MODULES:	
Modules: 1*, 2, 3, 4, 12, 16, 17 [AW00, AW01, AW02, AW03, AW17, AW22, AW23] AWD Airworthiness Dossier: 20	70 20
ELECTIVE MODULES:	
30 credits selected from Modules: 5-11, 13-15, 18-19	30 (10 credits per module except for Module 13 which is 20 credits)
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

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* Module MAA03 Airworthiness of Military Aircraft (at Shrivenham) may be claimed as equivalent.

COMPULSORY MODULES:	
Modules: 1*, 2, 3, 4, 12, 16, 17 [AW00, AW01, AW02, AW03, AW17, AW22, AW23] AWD Airworthiness Dossier: 20 Individual Research Project: 21	70 20 80
ELECTIVE MODULES:	
Any other modules selected from Modules: 5-11, 13-15, 18-19 to the value of 30 credits	30 (10 credits per module except for Module 13 which is 20 credits)
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);[1] [2]
- **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:
  o 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);
  o 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);
  o it is not permissible for you to fail an elective module and then proceed to take a different elective module in its place.

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* Module MAA03 Airworthiness of Military Aircraft (at Shrivenham) may be claimed as equivalent.

1 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).

2 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. <u>How is the course structured?</u>

This course is ONLY offered on a part-time basis. Students should register and start the course in September and are expected to complete the course within three years. The taught phase of a 10 credit module lasts one week, two weeks for a 20 credit module, and it should be noted that most modules are held just once per year.

All MSc and PgDip students must complete the following seven mandatory modules as part of the course. Students must accumulate 30 credits through the selection of further modules in line with their interests.
PgCert students must complete AW00, AW02, AW17 and AW22 and further elective modules from those permitted in the table above to make up 20 credits. There is no requirement to complete mandatory modules before taking optional modules.

- AW00 Airworthiness Fundamentals / MAA03 Airworthiness of Military Aircraft[+]
- AW01 Aircraft Fatigue & Damage Tolerance
- AW02 Safety Assessment of Aircraft Systems [1]
- AW03 Gas Turbine Fundamentals
- AW17 Air Transport Engineering – Maintenance Operations [1]
- AW22 Aviation Safety Management [1]
- AW23 Airframe Systems

[+] Module MAA03 Airworthiness of Military Aircraft (at Shrivenham) is based on the same ILOs as module AW00 Airworthiness Fundamentals. The subject areas within the two modules are directly equivalent; therefore either of these two modules may be taken. Students will not be able to claim credit for both modules.

Airworthiness COURSE SPECIFICATION
QA&E USE ONLY: Version 3.0 January   Course / SAS Version:

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[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-AW-AW	AW00 Airworthiness Fundamentals[*]	Dr S Place	30	10	10	N	12/09/16	12/09/16	16/09/16	40			100	EX ICW	30 70	16/09/16 14/11/16	At the next available opportunity which may not be until the

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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 MAA03 Airworthiness of Military Aircraft (at Shrivenham) R-MAA-AMA may be claimed as equivalent**.

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		module runs the following year
2	N-AW-AFDT	AW01 Aircraft Fatigue and Damage Tolerance	Dr W Liu	30	10	10	Y	12/06/17	12/06/17	16/06/17	40	ICW	100				14/08/17	At the next available opportunity which may not be until the module runs the following year
3	N-AW-SAAS	AW02 Safety Assessment of Aircraft Systems	Dr S Place	35	15	10	Y	14/11/16 (Occ A) \ 26/06/17 (Occ B)	14/11/16 \ 26/06/17	18/11/16 \ 30/06/17	40 \ 40			100 \ 100	GPRES ICW \ GPRES ICW	30 70 \ 30 70	16/01/17 (Occ A) \ 29/08/17 (Occ B)	At the next available opportunity which may not be until the module runs the following year
4	N-AW-GTF	AW03 Gas Turbine Fundamentals	Prof V Pachidis	30	0	10	N	06/03/17	06/03/17	10/03/17	40	ICW	100				08/05/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		be until the module runs the following year
5	N-AW-MIGT	AW05 Mechanical Integrity of Gas Turbines	Dr P Laskaridis	30	0	10	Y	24/04/17	24/04/17	28/04/17	40	ICW	100				26/06/17	At the next available opportunity which may not be until the module runs the following year
6	N-AVD-[new code]	AW06 Detail Stressing	Mr I Giannopoulos	20		10	Y	07/11/16	07/11/16	18/11/16	40	ICW	100				16/01/17	At the next available opportunity which may not be until the module runs the following year
7	N-AW-RA	AW09 Practical Reliability	Dr S Place	30	0	10	Y	17/10/17	17/10/16	21/10/16	40	ICW	100				19/12/16	At the 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		which may not be until the module runs the following year
8	N-HFS-AAI	AW10 Aircraft Accident Investigation and Response	P McCarthy	30	0	10	Y	03/04/17	03/04/17	07/04/17	40	ICW	100				05/06/17	At the next available opportunity which may not be until the module runs the following year
9	N-AW-FAEC	AW12 Fundamentals of Aircraft Engine Control	Dr T Nikolaidis	30	0	10	Y	13/03/17	13/03/17	17/03/17	40	ICW	100				15/05/17	At the next available opportunity which may not be until the module runs the following year
10	N-AW-	AW13 Fundamentals of	Prof K Garry	30	0	10	N	03/10/16	03/10/16	07/10/16	40	ICW	100				05/12/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar — Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment — Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment — Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates — Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
	FAEA	Aerodynamics																opportunity which may not be until the module runs the following year
11	N-AEN-M	AW15 Manufacturing	Dr K Salonitis	25	0	10	y	15/05/17	15/05/17	19/05/17	40	ICW	100				17/07/17	At the next available opportunity which may not be until the module runs the following year
12	N-AW-ATEMO	AW17 Air Transport Engineering – Maintenance Operations	C Turkolglu	30	0	10	Y	20/02/17	20/02/17	24/02/17	40			100	EX ICW	30 70	24/02/17 24/04/17	At the next available opportunity which may not be until the module 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

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Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment		Submission dates	
												Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
13	N-AW-FEM	AW18-19 Flight Experimental Methods (Airworthiness)	Dr A Cooke	40	0	20	N	10/10/16	10/10/16	21/10/16	40	ICW	100				16/01/17	At the next available opportunity which may not be until the module runs the following year
14	N-AW-ICAS	AW20 Design, Durability and Integrity of Composite Aircraft Structures	Prof P Irving	30	5	10	Y	10/07/17	10/07/17	14/07/17	40	ICW	100				11/09/17	At the next available opportunity which may not be until the module runs the following year
15	N-AW-IA	AW21 Introduction to Avionics	Dr D Zammit-Mangion	30	0	10	Y	03/04/17	03/04/17	07/04/17	40	ICW	100				05/06/17	At the next available opportunity which may not be until the module 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
16	N-SAI-ISMS	AW22 Aviation Safety Management	Dr S Mitchell/Mr D Barry	30	10	10	Y	(Occ A) 05/09/16 (OccB) 24/04/17	05/09/16 24/04/17	09/09/17 28/04/17	40 40	ICW ICW	100 100				Occ A 07/11/16 Occ B 26/06/17	At the next available opportunity which may not be until the module runs the following year
17	N-AEN-AMS	AW23 Airframe Systems	Dr CLawson	25	0	10	Y	05/06/17	05/06/17	09/06/17	40	IPRAC ICW	30 70				09/06/17 07/08/17	At the next available opportunity which may not be until the module runs the following year
18	N-AEN-ASC	AW24 Introduction to Aircraft Structural Crashworthiness	Dr H Ghasemnejad	25	10	10	Y	03/07/17	03/07/17	07/07/17	40	ICW	100				04/09/17	At the next available opportunity which may not be until the module 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
19	N-HFS-HFAM	AW25 Human Factors in Aviation Maintenance	Dr M Langer	30	0	10	Y	13/03/17	13/03/17	17/03/17	40 40	ICW GPRES	90 10				15/05/17 17/03/17	At the next available opportunity which may not be until the module runs the following year
20	N-AW-CD	AWD Airworthiness Dossier	Dr S Place	10	0	20	N	03/10/16	03/10/16	15/09/17	40	RP	100				15/09/17	
21	N-AW-RP	AWR Individual Research Project	Dr S Place	20	0	80	N	03/10/16	03/10/16	01/09/17	50	THESIS OR	80 20				01/09/17	

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

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Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Other course(s)/ programme(s) that use the module
N-AW-AFDT	Aircraft Fatigue and Damage Tolerance	Airworthiness	Military Aerospace and Airworthiness
N-AW-SAAS	Safety Assessment of Aircraft Systems	Airworthiness	Military Aerospace and Airworthiness Safety and Accident Investigation (Air Transport) Safety and Human Factors in Aviation
N-AW-MIGT	Mechanical Integrity of Gas Turbines	Airworthiness	Military Aerospace and Airworthiness
N-AVD-[new code]	Detail Stressing	Aerospace Vehicle Design	Aerospace Vehicle Design, Aircraft Engineering
N-AW-RA	Practical Reliability	Airworthiness	Military Aerospace and Airworthiness
N-HFS-AAI	Aircraft Accident Investigation and Response	Safety and Human Factors in Aviation	Airworthiness Forensic Engineering and Science Military Aerospace and Airworthiness
N-AW-FAEC	Fundamentals of Aircraft Engine Control	Airworthiness	Military Aerospace and Airworthiness
N-AEN-M	Manufacturing	Aircraft Engineering	Airworthiness
N-AW-ATEMO	Air Transport Engineering – Maintenance Operations	Airworthiness	F-T Air Transport Management Executive Air Transport Management Military Aerospace and Airworthiness Safety and Human Factors in Aviation
N-AW-ICAS	Design, Durability and Integrity of Composite Aircraft	Airworthiness	Military Aerospace and Airworthiness

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	Structures		
N-AW-IA	Introduction to Avionics	Airworthiness	Aircraft Engineering
N-AIS- ISMS	Aviation Safety Management	Safety and Accident Investigation (Air Transport)	Military Aerospace and Airworthiness F-T Air Transport Management Safety and Human Factors in Aviation Airworthiness
N-AEN-AS	Airframe Systems	Aircraft Engineering	Airworthiness
N-AEC-ASC	Introduction to Aircraft Structural Crashworthiness	Aircraft Engineering	Airworthiness Military Aerospace and Airworthiness Safety and Accident Investigation (Air Transport)
N-HFS-HFAM	Human Factors in Aviation Maintenance	Safety and Human Factors in Aviation	Airworthiness Military Aerospace and Airworthiness Safety and Accident Investigation (Air Transport)

7. **How are the ILOs assessed?**

The following assessment types are utilised:

The MSc in Airworthiness has **two** distinct but interrelated elements: the taught modules (which includes the Course Dossier) and the thesis (Individual Research Project). All modules are assessed by written assignments and (in the case of the thesis) an oral examination, or viva. Short examinations are used on certain modules.

The Post-Modular Assignments are set to be challenging and to promote the student to study the module topic areas in more depth, in particular the relationship of the regulations to the technology issues. The objectives of the assignments are for the students to:

- Acquire the skill to efficiently search literature
- Acquire an in-depth knowledge of Airworthiness regulations
- Apply skills and knowledge to assess the regulatory aspects of a particular technology
- 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

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This approach has been adopted in order to facilitate the completion of the course by external (part-time) students, often from abroad, without the need to return for examinations.

Over the duration of the course each MSc/PgDip student will be asked to complete an Airworthiness Dossier, containing a range of documentation related to each module taken. The dossier is an "Integrative Assessment", which brings together the airworthiness theme of the course, over all taught modules.

This will include relevant airworthiness regulatory and guidance material, published papers, case studies etc. Its preparation will lead students to research each module topic in more depth, building both on the information taught in formal lectures and the material gleaned from the pre-module reading and post-module assignments. The objectives of the dossier are for the students to:

- Obtain and retain an in-depth knowledge of airworthiness regulations and guidance material
- Acquire skills in data gathering and literature searching
- Demonstrate an overall knowledge of the technology of the modules taken
- Demonstrate information organisational and presentational skills

The dossier is to provide a summary of the whole course with a focus on airworthiness and technology issues, showing the linkage between the two. It is up to each student to decide which lectures are fundamental to their interests and airworthiness/safety and select them for inclusion. This will vary from module to module but should cover a representative number of lectures in addition to key references found in background reading and assignment work.

Assessment of the Course Dossier will be undertaken when all taught modules have been completed. However, students should take the opportunity to review it with a course supervisor at an early stage, and also mid-way through the course.

This approach has been adopted because this is the best means to assess the wide-ranging set of subjects.

Assessment and ILO Mapping

A. Postgraduate Certificate

Award ILOs / Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7
1 - 12	ICW	ICW	ICW	ICW	ICW	ICW	ICW
14 - 19	ICW	ICW	ICW	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 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 8
1-19	ICW	ICW	ICW	ICW	ICW	ICW	ICW	
20								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.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7	ILO 8	ILO 9
1-19	ICW	ICW	ICW	ICW	ICW	ICW	ICW		
20								RP	
21									THESIS

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

Title	Modules Covered	Assessment	
		Type	Weight (%)
Airworthiness Dossier	Taught Modules to the value of 100 credits selected by the students.	RP	100

8. **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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known

as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

All students are part-time and therefore most are in full-time employment. However the MSc prepares them for a higher level of responsibility in the airworthiness field. This is often a legal requirement so that they can fulfil customer's obligation as an Approved organisation.

An example is the sponsoring of six students by the MOD to undertake the MSc Airworthiness. They were then appointed to the Airworthiness "Centre of excellence" which advised MOD on matters relating to aircraft safety and regulation. Other course members are part of the Military Aviation Authority, which was set up in 2010.

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 Applied Bioinformatics

Date of first publication/latest revision:	26/07/16 – 10/10/16

1. What is the course?

Course information

Course Title	Applied Bioinformatics
Course code	MSABIFTC, MSABIPTC, PDABIFTC, PDABIPTC, PCABIFTC, PCABIPTC
Academic Year	2016/17
Valid entry routes	MSc
Additional Exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location 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
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

1

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:

Sanger, GlaxoSmithKline, Unilever, Sanofi Aventis, Rothamsted Research, the European Bioinformatics Institute, the Wellcome Trust Institute University of Athens and Cambridge University. 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.

> **NOTE: For new courses, please indicate which accrediting body/bodies (PSRBs) you are applying to for accreditation?   Give details of how you have designed this course to meet the requirements of the relevant PSRB(s) - this section will be deleted in the public document)**

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:

2

ILO 1. Define the field of bioinformatics and related disciplines, and demonstrate a critical awareness of current research in the area.

ILO 2. Demonstrating a comprehensive knowledge and understanding of various programming languages to develop tailored bioinformatics applications to achieve specific computational biology tasks

ILO 3. Effective application of statistical methods and machine learning and pattern recognition algorithms to analyse and classify high throughput data

ILO 4. Demonstrate good communication skills of 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:

ILO 5. Application of automation tools for various bioinformatics tasks by integrating existing bioinformatics resources and tools

ILO 6. Integration of various research platforms and programming languages in order to build bioinformatics solutions

ILO 7. Demonstrate ability to organise and manage a programme of software development

ILO 8. Integrate knowledge, understanding and skills from the taught modules in a real-life situation

ILO 9. 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:

ILO 10. Demonstrate the ability to apply experimental design principles and appropriate bioinformatics methods to obtain, analyse and discuss data through the individual research project

ILO 11. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 12. 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 Health 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 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:	
Any 6 taught modules from 2-9	60
ELECTIVE MODULES:	
N/A	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 2-9	80
Group project	40
ELECTIVE MODULES:	
N/A	N/A

4

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 2-9	80
Group Project	40
Individual Thesis Project	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);[1] [2]
- **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:
  - o 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);
  - o 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

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[1] 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).

[2] 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%).

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);

- o   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.   <u>How is the course structured?</u>

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.

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Course modules

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar				**Assessment**					
												Independent Assessment		**Multi-part Assessment**			**Submission dates**	
1	I-AGF-INWK	Induction module	A Medina Vaya	33	0	0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
2	I-BIX-PRL	Introduction to Bioinformatics Using Perl	F Mohareb	25	3	10	N		10/10/16	14/10/16	40	ICW	100				FT 22/10/2016 PT 29/10/2016	
3	I-BIX-STS	Exploratory Data Analysis and Essential Statistics Using R	F Mohareb	25	20	10	N		24/10/16	28/10/16	40	ICW	100				FT 05/11/2016 PT 12/11/2016	

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

4	I-BIX-NGS	Next Generation Sequencing Informatics	F Mohareb	25	5	10	N		07/11/16	11/11/16	40	ICW	100				FT 19/11/2016 PT 26/11/2016	
5	I-BIX-PRO	Proteome Informatics	F Mohareb	25	10	10	N		21/11/16	25/11/16	40	ICW	100				FT 03/12/2016 PT 10/12/2016	
6	I-BIX-MET	Informatics for Metabolomics	F Mohareb	25	15	10	N		05/12/16	09/12/16	40	ICW	100				FT 17/12/2016 PT 03/01/2017	
7	I-BIX-JAV	Programming Using Java	F Mohareb	25	0	10	Y		09/01/17	13/01/17	40	ICW	100				FT 21/01/2017 PT 28/01/2017	
8	I-BIX-DAT	Data Integration and Interaction Networks	T Kurowski	25	3	10	N		23/01/17	27/01/17	40	ICW	100				FT 04/02/2017 PT 11/02/2017	
9	I-BIX-SIM	Simulating Biological Systems	F Mohareb	25	5	10	N		06/02/17	10/02/17	40	ICW	100				FT 18/02/2017 PT 25/02/2017	
10	I-BIX-GRPP	Group Project: Building Bioinformatics Solutions	F Mohareb	50		40	N		20/02/17	05/05/17	50	GPROJ ICW	80 20				GPROJ 02/05/2017 (FT/PT) IPROJ 06/05/2017 (FT/PT)	
11	I-BIX-THESIS	Individual Thesis Project	Individually assigned	20		80	N		08/05/17	08/09/17	50	THESIS OR	90 10				04/09/2017	

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.

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-BIX-JAV	Programming Using Java	Applied Bioinformatics	Environmental Data Science

7. 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.

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7

(External Examining) which emphasises that 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.

9. **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.

COURSE TITLE: MSc in Applied Nanotechnology

Date of first publication/latest revision: June 2016

1. What is the course?

Course information

Course Title	MSc in Applied Nanotechnology
Course code	MSANAFTC, MSANAPTC, PDANAFTC, PDANAPTC, PCANAFTC, PCANAPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Surface Engineering and Nanotechnology Institute
Course Director	Dr Zhaorong Huang
Awarding Body	Cranfield University
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, two-five years part-time
Course Start Month(s)	Full-time: October. Part-time: throughout the year.

Institutions delivering the course

This course is delivered by The School of Aerospace, Transport and Manufacturing, Manufacturing Theme, Surface Engineering and Nanotechnology Institute where the research activities extend from the development of new functional materials through to the prototyping of micro electromechanical system (MEMS) devices. The work is multidisciplinary, encompassing diverse fields such as micro engineering, nanotechnology, biology, materials science, physics and chemistry.

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) up to and including Academic year 2019-20, Institution of Engineering and Technology (IET) up to and including Academic year 2019-20, Royal Aeronautical Society (RAeS) up to and including Academic year 2019-20 and Institute of Materials, Minerals and Mining (IOM3) up to and including Academic year 2018-19.

2. What are the aims of the course?

The aim of the course is to provide a comprehensive knowledge and the skills necessary for a technically-based career in the new high-tech industries, in which the manufacture of multi-functional devices with dimensions in the micron or nanometre range is fundamental to wealth creation. This MSc course covers the technologies to design, realise and analyse micro and nano-scale materials, devices and systems.

The objectives of the course are to:

1. Provide students with a good working knowledge and understanding of:
   - The science of the functional materials commonly used in microsystems technology (MST), and the methods and processes that are used to manipulate them into the forms required and to characterise their properties.
   - How the processes interact with each other in a manufacturing environment, how to use the modern   software tools to design devices and processes, to link functional materials, microstructures and electronics into complete working microsystems.
   - The applications potential for, and manufacturing of, MST devices.
   - The use of the scanning probe microscope as a tool for both characterisation and molecular surface manipulation.
   - The science, technology and applications potential of nanotechnology.

2. Develop the management/transferable skills necessary for a successful career in industry, including the ability to:
   - Communicate effectively, both orally and in writing.
   - Plan, execute and manage projects.
   - Operate effectively in a team, working and communicating in a group environment.

Provide students with an introduction to the microsystems and nanotechnology environments, providing familiarity with fabrication and testing methods, practical approaches to problem solving, critical evaluation of data and the use of information technology.

Postgraduate Diploma (PgDip) and Postgraduate Certificate (PgCert) exist 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 scientists and engineers wishing to apply their skills into new area.

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

ILO 1. Demonstrate a good working knowledge and systematic understanding of the science of the functional materials commonly used in microsystems and nanotechnology (MSN), and the methods and processes that are used to manipulate them into the forms required and to characterise their properties.
ILO 2. Demonstrate a good working knowledge and systematic understanding of how the processes interact in a manufacturing environment.
ILO 3. Use modern software tools to design devices and processes, to link functional materials, microstructures and electronics into complete working microsystems.
ILO 4. Demonstrate a critical awareness and understanding of the applications potential for, and manufacturing of, MSN devices.
ILO 5. Demonstrate a good working knowledge and understanding of the science, technology and applications potential of nanotechnology.
ILO 6. Make effective use of information technology.
ILO 7. Prepare effective written reports of their work.
ILO 8. Communicate effectively both orally and in writing.

B. **Postgraduate Diploma**

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

ILO 9. Demonstrate a good working knowledge and understanding of the use of microscopes as a tool for both characterisation and surface modification.
ILO 10. Demonstrate a knowledge of some key general management, personal management and project management techniques and awareness of some of the less science-dependent aspects of technology.
ILO 11. Undertake an appraisal of technical and/or commercial literature.
ILO 12. Discuss the work conducted and relate it to the work of others.
ILO 13. Work effectively under time pressure.
ILO 14. Operate effectively in a team working and communicating in a group environment.
ILO 15. Critically appraise data.

C. **MSc**

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

ILO 16. Demonstrate a critical awareness of current research/development in selected topics in microsystems and nanotechnology.
ILO 17. Carry out substantial scientific programmes of study.
ILO 18. Plan, execute and manage projects.
ILO 19. Demonstrate an ability in practical approaches to problem solving.
ILO 20. Demonstrate originality in the application of knowledge in relation to an extended individual project.

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 Blackboard™ 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 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 3, 6, 7	30
ELECTIVE MODULES:	
Modules 2, 4, 5, 8, 9 Chose three modules from five	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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-9 Group Project for full-time students (10b) or Dissertation for part-time students (10a)	80 40
ELECTIVE MODULES:	
None	
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:

Description	Credits
COMPULSORY MODULES:	
Modules 2-9	80
Group Project for full-time students (10b) or Dissertation for part-time students (10a)	40
Individual Research Project (11)	80
ELECTIVE MODULES:	
None	
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o   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);
  - o   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

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[1]   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).

[2]   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%).

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);

o 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).

Where Public, Statutory or Regulatory Body (PSRB) accreditation requires additional or higher levels of assessment the PSRB requirements will take precedence.

6. <u>How is the course structured?</u>

The course has been structured through discussions with Industrial Advisors from the field of Nanotechnology. The course comprises an introductory week and eight one week modules which are assessed, and an assessed group and individual projects. The course is structured to initially provide the student with the fundamental principles of Nanotechnology, before moving on to where the two areas overlap and merge. Specialisation is provided though suitable group and individual projects.

Full-time students register for the course in October and are expected to complete the course within 11 calendar months. This course is also offered on a part-time basis. Students would instead complete the course over a 24 month period with the Group Project component replaced by a dissertation.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-MAT-INWK	Introduction	Dr Sue Impey	26		0	Y		03/10/16	06/10/16	n/a	AO	n/a				n/a	
2	I-MNU-A1018	General Management	Dr Yuchun Xu	32		10	Y		14/11/16	18/11/16	40	EX	100				06/01/17	Manufacturing resit exams will be during week commencing 18/09/17
3	I-MSN-A1046	Foundation in Materials for Nanotechnology	Dr Paul Jones	32		10	N		07/10/16	14/10/16	40	ICW	100				31/10/16	Re-assessment date to be set by agreement of Course Director

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		and Module Leader as/when required.
4	I-MSN-A1048	Engineering Microdevices	Dr Paul Kirby	32		10	Y		31/10/16	04/11/16	40	ICW	100				14/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
5	I-MSN-A1049	Nano and Microscale Rapid Prototyping Manufacture	Dr Paul Jones	28		10	Y		09/01/17	13/01/17	40	ICW	100				23/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
6	I-MSN-A1047	Nano and Micro Technologies for Energy	Dr Qi Zhang	27		10	Y		21/11/16	25/11/16	40	ICW	100				05/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
7	I-MAT-A1014	Finite Element Analysis	Dr Glenn Leighton/ Dr Renaud Jourdain	35		10	Y		05/12/16	09/12/16	40			100 MULTI	ICW ICW	40 60	20/01/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		Course Director and Module Leader as/when required.
8	I-MSN-A1068	Nanotechnology	Dr Zhaorong Huang	28		10	Y		24/10/16	28/10/16	40	ICW	100				11/11/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
9	I-UPT-A1186	Functional Coatings and Thin Films	Dr Jose Endrino Armenteros	32		10	Y		23/01/17	27/01/17	40	ICW	100				06/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
10a	I-MAT-DISS	Dissertation for Part Time Students	Dr Sue Impey/ Dr David Ayre	20		40	Y		01/02/17	31/08/17		ICW	100				31/08/17	
10b	I-MAT-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		06/02/17	28/04/17				80 MULTI 20 MULTI	GPRES GPROJ ICW observed behaviour	16 64 10 10	28/04/17	

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

9

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
11	I-MAT-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		02/05/17	04/09/17		THESIS OR	90 10				04/09/17	

* Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice.

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-MAT-INWK	Introduction	Manufacturing Technology and Materials Programme	Welding Engineering, Advanced Materials, Aerospace Materials
I-MNU-A1018	General Management	Engineering & Management of Manufacturing Systems	Advanced Materials, Manufacturing Technology and Management, Global Product Development and Management, Management and Information Systems, Manufacturing Consultancy, Knowledge Management for Innovation, Engineering & Management of Manufacturing Systems
I-MAT-A1014	Finite Element Analysis	Advanced Materials	Advanced Materials, Manufacturing Technology and Management, Aerospace Materials
I-UPT-A1186	Functional Coatings and Thin Films	Applied Nanotechnology	Manufacturing Technology and Management
I-MSN-A1048	Engineering Microdevices	Applied Nanotechnology	Manufacturing Technology and Management
I-MSN-A1049	Nano and Microscale Rapid Prototyping Manufacture	Applied Nanotechnology	Manufacturing Technology and Management
I-MSN-A1047	Nano and Micro Technologies for Energy	Applied Nanotechnology	Manufacturing Technology and Management
I-MSN-A1068	Nanotechnology	Applied Nanotechnology	Manufacturing Technology and Management
I-MAT-GRPP	Group Project for Full Time Students	Manufacturing Technology and Materials Programme	Advanced Materials, Aerospace Materials, Manufacturing Technology and Management
I-MAT-DISS	Dissertation for Part Time Students	Manufacturing Technology and Materials Programme	Advanced Materials, Aerospace Materials, Manufacturing Technology and Management
I-MAT-THESIS	Individual Research Project	Manufacturing Technology and Materials Programme	Advanced Materials, Aerospace Materials, Manufacturing Technology and Management

7. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have either written examinations, 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.	ILO 1	ILO2	ILO 3	ILO4	ILO 5	ILO 6	ILO 7	ILO 8
2						EX	EX	EX
3	ICW			ICW	ICW	ICW	ICW	ICW
4	ICW	ICW		ICW	ICW	ICW	ICW	ICW
5	ICW	ICW	ICW	ICW	ICW	ICW	ICW	ICW
6	ICW	ICW		ICW			ICW	ICW
7			ICW			ICW	ICW	ICW
8	ICW			ICW	ICW	ICW	ICW	ICW
9	ICW	ICW		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 9	ILO 10	ILO 11	ILO 12	ILO 13	ILO 14	ILO 15
10a	ICW				ICW		ICW
10b	GPROJ GPRES ICW	GPROJ GPRES ICW	GPROJ GPRES ICW	GPROJ GPRES ICW	GPROJ GPRES ICW	GPROJ GPRES ICW	GPROJ GPRES 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 16	ILO 17	ILO 18	ILO 19	ILO 20
11	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 (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

With a wide portfolio of technical and transferable skills students can expect to advance to senior positions in research, development, design, engineering, consultancy, and management in sectors such as space, aerospace, optics, medical and health, energy generation, sensors, displays, and micro electromechanical systems.

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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE:	MSc in Astronautics and Space Engineering

Date of first publication/latest revision:	October 2016

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	2016/17
Valid entry routes	MSc
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location 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
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, two-five years part-time (by extended thesis)
Course Start Month(s)	October

1

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 Julius Maximilian University Wurzburg (Germany) and 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 October 2016 intake. Renewal of accreditation will be sought for 2017 intake onwards.

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 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.

2

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.

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:

- 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 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.   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 and 4	10
Modules: 2 and 3	20
Group Design Project: 11	60
Individual Research Project: 12	90
ELECTIVE MODULES:	
2 modules chosen from: 5-10	20
TOTAL:	200

Astronautics and Space Engineering (extended thesis option)

Description	Credits
COMPULSORY MODULES:	

Description	Credits
Modules: 1 and 4 Modules: 2 and 3 Extended Individual Research Project: 13	10 20 150
ELECTIVE MODULES:	
2 modules chosen from: 5-10	20
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: 12	120 10 90
ELECTIVE MODULES:	
2 modules chosen from: 5-10	20
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);[1] [2]
- **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:
  - o 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

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[1] 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).

[2] 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 capped at 50% would be insufficient to achieve an overall average mark of ≥50% across the taught assessments);

- o 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);
- o 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 usually register for the course in October and are expected to complete the course within 5 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 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.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment					
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-ASE-AMA	Astrodynamics and Mission Analysis	Dr Joan Pau Sanchez	12	0	5	N		21/11/16	25/11/16	40	EX	100				15/12/16	At the next available opportunity which may not be until the course runs the following year
2	N-ASE-SSE	Space Systems Engineering	Dr Jenny Kingston	26	0	10	N		03/10/16	21/10/16	40	EX	100				13/01/17	At the next available opportunity which may not be until the course runs the following year

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												Independent Assessment		Multi-part Assessment			Submission dates	
3	N-ASE-SP	Space Propulsion	Dr Jenny Kingston	22	22	10	N		17/10/16	02/12/16	40	EX	100				09/01/17	At the next available opportunity which may not be until the course runs the following year
4	N-ASE-SCO4	Space Communications	Dr Jenny Kingston	12	12	5	N		31/10/16	04/11/16	40	EX	100				15/12/16	At the next available opportunity which may not be until the course runs the following year
5	N-ASD-CS	Control Systems	Dr James Whidborne	28		10	Y		07/11/16	25/11/16	40			100 MULTI	ICW EX	50 50	16/12/16 11/01/17	At the next available opportunity which may not be until the course runs the following year
6	N-AVD-FEA	Finite Element Analysis	Ioannis Giannopoulos	22	22	10	Y		07/11/16	18/11/16	40	EX	100				13/12/16	At the next available opportunity which may not be until the course runs the following year
7	N-AVD-FRP	Design and Analysis of Composite Structures	Dr Shijun Guo	20	0	10	Y		28/11/16	05/12/16	40			100 MULTI	EX ICW	75 25	05/01/17 05/12/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
8	N-ASD-MVCAA	Multivariable Control Systems for Aerospace Applications	Dr James Whidborne	30	0	10	Y		30/01/17	10/02/17	40	EX	100				08/04/17	At the next available opportunity which may not be until the course runs the following year
9	N-ASE-SADC	Spacecraft Attitude Dynamics and Control	Dr Joan Pau Sanchez	22	22	10	N		13/02/17	10/03/17	40	EX	100				21/04/17	At the next available opportunity which may not be until the course runs the following year
10	N-ASE-GPS	Aerospace Navigation and Sensors	Dr Stephen Hobbs	26		10	Y		27/02/17	14/03/17	40			100 MULTI	EX ICW	50 50	24/04/17 07/04/17	At the next available opportunity which may not be until the course runs the following year
11	N-ASE-GP	Group Design Project	Dr Jenny Kingston	40-60	0	60	N		10/10/16	31/03/17	50 40 40	GPROJ IPRES GCW	90 5 5				22/03/17	
12	N-ASE-THESIS	Individual Research Project	Dr Jenny Kingston	20	0	90	N		27/02/17	30/08/17		THESIS	100				31/08/17	
13	N-ASE-EIRP	Extended Individual Research Project	Dr Jenny Kingston	40	0	150	N		28/11/16	30/08/17		THESIS	100				31/08/17	
14	N-ASD-LRA	Launch and Re-entry Aerodynamics	Dr Simon Prince	10		0	Y		25/01/17	27/01/17	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
15	NEW CODE	Environmental Control and Life Support	Dr Craig Lawson	8		0	N		15/02/17	16/02/17	n/a	AO	n/a				n/a	n/a
16	N-AVD-MDS	Modelling of Dynamics Systems	Dr James Whidborne	13		0	Y		24/10/16	28/10/16	n/a	AO	n/a				n/a	n/a
17	NEW CODE	On Board Data Handling and Software Development	Dr Stephen Hobbs	10		0	N		10/10/16	14/10/16	n/a	AO	n/a				n/a	n/a
18	NEW CODE	Space Environment	Dr Jenny Kingston	10		0	N		06/03/17	10/03/17	n/a	AO	n/a				n/a	n/a
19	NEW CODE	Payload Engineering and Instrumentation	Dr Stephen Hobbs	10		0	N		17/10/16	21/10/16	n/a	AO	n/a				n/a	n/a
20	NEW CODE	Earth Observation and the Environment	Dr Stephen Hobbs	10		0	N		30/01/17	03/02/17	n/a	AO	n/a				n/a	n/a
21	NEW CODE	Research Skills	Dr Stephen Hobbs	2		0	N		16/11/16	16/11/16	n/a	AO	n/a				n/a	n/a
22	NEW CODE	Structural Mechanics	Dr Jason Brown	20		0	N		03/10/16	21/10/16	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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment — Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment — Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates — Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
23	NEW CODE	Impact Dynamics and Spacecraft Protection	Dr Jason Brown	10		0	N		24/10/16	28/10/16	n/a	AO	n/a				n/a	n/a
24	N-AVD-SD	Structural Dynamics	Dr Shijun Guo	20		0	Y		20/02/17	24/02/17	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

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Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ASD-CS	Control Systems	Aerospace Dynamics	Aerospace Dynamics, Aerospace Vehicle Design, Autonomous Vehicle Dynamics and control
N-AVD-FEA	Finite Element Analysis	Aerospace Vehicle Design	Aerospace Vehicle Design
N-AVD-FRP	Design and Analysis of Composite Structures	Aerospace Vehicle Design	Aerospace Vehicle Design
N-ASD-MVCAA	Multivariable Control for Aerospace Applications	Aerospace Dynamics	Aerospace Dynamics, Flight Test and Flight Dynamics
N-ASE-GPS	Aerospace Navigation and Sensors	Astronautics and Space Engineering	Aerospace Dynamics, Flight Test and Flight Dynamics
N-ASD-LRA	Launch and Re-Entry Aerodynamics	Aerospace Dynamics	Aerospace Dynamics
N-AVD-MDS	Modelling of Dynamics Systems	Aerospace Dynamics	Aerospace Dynamics, Aerospace Vehicle Design, Autonomous Vehicle Dynamics and control
N-AVD-SD	Structural Dynamics	Aerospace Vehicle Design	Aerospace Vehicle Design

7. **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							
2	EX	EX	EX	EX					
3	EX	EX							
4	EX	EX							

Module No. / Award ILOs	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	ILO 9.
5	EX	EX							
6	EX	EX							
7	EX	EX							
8	EX	EX							
9	EX	EX							
10	EX	EX							
11	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	GPROJ IPRES GCW	IPRES		GPROJ IPRES GCW	
12	THESIS	THESIS		THESIS	THESIS		THESIS		THESIS
13	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

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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

COURSE TITLE: Automotive Programme

Date of first publication/latest revision: July 2016

1. What is the course?

Course information

Course Title	MSc in Automotive Engineering MSc in Automotive Mechatronics
Course code	MSAEGFTC, PDAEGFTC, PCAEGFTC (Automotive Engineering) MSAMCFTC, PDAMCFTC, PCAMCFTC (Automotive Mechatronics)
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PGDip, PGCert
Mode of delivery	Full-Time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Transport Systems
Centre	Advanced Vehicle Engineering Centre
Course Director	Dr Glen Sherwood (Automotive Engineering) Dr Stefano Longo (Automotive Mechatronics)
Awarding Body	Cranfield University
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
Course Start Month(s)	October

Institutions delivering the course

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

- Vehicle Electrification
- Advanced Control
- Multi-domain Modelling
- 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)

The Automotive Engineering course is accredited formally by the Institution of Mechanical Engineers (IMechE) until October 2015.

The Advanced Vehicle Engineering Centre will seek to accredit the award of MSc in Automotive Mechatronics with the IET by 2016.

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).

ILO 1. Demonstrate the ability to work in a team and act as team leader on problem solving when making decisions in complex and unpredictable situations.

ILO 2. Employ reduced order models to analyse vehicle system or component dynamics as a pre-requisite to the design and evaluation of a vehicle control algorithm.

ILO 3. Critically evaluate the dynamics of a system and be able to formulate the design of a Single-Input-Single-Output controller that will satisfy vehicle level performance targets.

ILO 4. Critically evaluate the vehicle ride and handling subjective requirements and, through the use of simplified vehicle dynamic models, demonstrate an understanding of objective requirements for vehicle ride and handling.

ILO 5.   Evaluate and design fundamental vehicle concepts, taking into account the interdependencies that exist between vehicle structure, powertrain, suspension, steering and braking systems.

ILO 6.   Evaluate and be able to match the characteristics of powertrain systems and components to demonstrate a critical understanding of vehicle noise vibration and harshness (NVH), refinement and driveability.

ILO 7.   To critically evaluate the structure of different vehicle types and to assess the impact of different load path faults within the vehicle.

ILO 8.   Assess, evaluate and design vehicle systems, assemblies and components taking into account typical vehicle requirements and the constraints of packaging, ergonomics, active and passive safety, legislation and regulation.

ILO 9.   Develop a critical understanding of the physical processes at work during the preparation of the fuel & air mixture and its subsequent combustion and emission. to demonstrate a knowledge of the performance and emissions requirements of engines in road vehicles.

ILO 10. Explain the importance of instrumentation within the vehicle development life-cycle, including the ability to review, evaluate and select the most appropriate technology, method of integration and data-processing techniques that are required to support system and component testing.

ILO 11. Assess and critically evaluate various suspension and steering systems, including the selection of the most appropriate criteria for comparison, and the ability to design new suspension concepts to satisfy vehicle ride and handling requirements.

ILO 12. Evaluate the different methods and technologies available that aid in the global decarbonisation and life-cycle sustainability of the automotive sector.

ILO 13. Critically evaluate different hybrid electric vehicle and electric vehicle architectures, including their usage requirements, designs, and the integration of different subsystem technologies.

ILO 14. Critically evaluate and formulate physical models of vehicle mechatronic systems using various modelling methodologies.

ILO 15. Critically evaluate the design of a multi-input-multi-output system and be able to select an appropriate design method to realise an implementable control system with appropriate performance and robustness.

ILO 16. Critically evaluate existing control system structures and be able to formulate alternative solutions to existing and future applications of vehicle control technology across the powertrain, transmission, chassis and body domains of the vehicle.

ILO 17. Analyse the functional and non-functional requirements of the vehicle mechatronic system and be able to formulate appropriate hardware implementation and verification strategies.

ILO 18. Demonstrate the ability to independently evaluate and apply the results of scholarly research.

ILO 19. Independently plan and implement a programme of individual research including the effective written and oral dissemination of the research outcomes

A. Postgraduate Certificate

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

Automotive Engineering:
Depending upon the modules completed, a subset of the following ILOs would be applicable:
- ILO 1 (compulsory)
- ILOs 2-11

Automotive Mechatronics:
Depending upon the modules completed, a subset of the following ILOs would be applicable:
- ILO 1 (compulsory)
- ILOs 2-7
- ILOs 12-17

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

Automotive Engineering:
- ILOs 1-11

Automotive Mechatronics:
- ILOs 1-7
- ILOs 12-17

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

Automotive Engineering:
- ILOs 1-11
- ILOs 18-19

Automotive Mechatronics:
- ILOs 1-7
- ILOs 12-19

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 and 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?

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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:

Automotive Engineering

Description	Credits
COMPULSORY MODULES:	
Module 13 and to accumulate 40 credits from the following taught modules: 1, 2, 3, 4, 5, 10, 11, 12,	60
ELECTIVE MODULES:	
n/a	
TOTAL:	60

Automotive Mechatronics

Description	Credits
COMPULSORY MODULES:	
Module 14 and to accumulate 40 credits from the following taught modules: 1, 2, 3, 5, 6, 7, 8, 9, 10	60
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:

Automotive Engineering

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4, 5, 10, 11, 12, 13	120
ELECTIVE MODULES:	
n/a	
TOTAL:	120

Automotive Mechatronics

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 5, 6, 7, 8, 9, 10, 14	120
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:

Automotive Engineering

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 4, 5, 10, 11, 12, 13, 15	200
ELECTIVE MODULES:	
n/a	
TOTAL:	200

Automotive Mechatronics

Description	Credits
COMPULSORY MODULES:	
Modules 1, 2, 3, 5, 6, 7, 8, 9, 10, 14, 15	200
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]

- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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. <u>How is the course structured?</u>

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. During the second term, students will attend those modules defined for their respective specialism (Automotive Engineering / Automotive Mechatronics). 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.

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[1]   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).

[2]   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%).

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment — Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment — Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates — Assessment Submission and/or exam date[9]	Submission dates — Assessment / Exam Retake date
1	N-APE-VDP	Vehicle Design Powertrain and Performance	Dr Marko Tirovic	60		20	Y		04/10/16	27/01/17	50	EX	100				24/04/17	Sept 2017
2	N-AP-AE02	Engine Fuels and Lubrication	Dr Glenn Sherwood	30		10	Y		03/10/16	08/12/16	50	EX	100				05/01/17	Sept 2017
3	N-AP-AE03	Automotive Control and Simulation	Dr Daniel Auger	30		10	Y		17/10/16	24/10/16	50	ICW	100				14/11/16	31/08/17
4	N-APE-VSC	Vehicle Structures and Crashworthiness	Dr Rishi Abhyankar	70		20	N		06/02/17	20/02/17	50	ICW	100				17/03/17	31/08/17

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment: Type of Assessment	Independent Assessment: Weighting within module[6] (%) of Independent assessments	Multi-part Assessment: Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment: Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
5	N-AP-AE05	Vehicle Dynamics, Ride and Handling	Dr Efstathios Velenis	30		10	Y		28/11/16	05/12/16	50	EX	100				11/01/17	Sept 2017
6	N-AP-AM01	Mechatronic Modelling for Automotive Systems	Dr Stefano Longo	30		10	N		30/01/17	03/02/17	50	EX	100				26/04/17	Sept 2017
7	N-AP-AM02	Advanced Control and Optimisation	Dr Daniel Auger	30		10	N		13/02/17	17/02/17	50	ICW	100				13/03/17	31/08/17
8	N-AP-AM03	Applied Automotive Control	Dr Dongpu Cao	30		10	N		13/03/17	17/03/17	50	EX	100				28/04/17	Sept 2017
9	N-AP-AM04	Implementation of Automotive Control Systems	Dr Stefano Longo	30		10	N		27/02/17	03/03/17	50			100 MULTI	GPRES ICW	10 90	27/03/17	August 2017
10	N-AP-AM05	Vehicle Electrification and Hybridisation	Dr Amir Soltani	30		10	Y		14/11/16	18/11/16	50	ICW	100				16/12/16	August 2017
11	N-AP-AE08	Engine Simulation and Performance	Dr Glenn Sherwood	30		10	N		27/02/17	03/03/17	50	GCW	100				30/03/17	August 2017
12	N-AP-AE09	Vehicle Dynamics and Suspension Design	Dr Efstathios Velenis	30		10	N		20/03/17	24/03/17	50	EX	100				28/04/17	Sept 2017

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar			Independent Assessment		Multi-part Assessment			Submission dates	
13	N-AP-AE11	Automotive Engineering Design Project	Dr Marko Tirovic	60		20	N		27/10/16	09/03/17	50 50			MULTI 50	**Individual:** Computer Aided Design Intellectual Property CANBus Individual Project Overview	20 15 5 10	09/03/17	August 2017
														MULTI 50	**Group:** First Presentation Report Final Presentation	15 25 10		
14	N-AP-AE12	Automotive Mechatronics Group Project	Dr Amir Soltani	60		20	N		27/10/16	09/03/17	50 50			MULTI 50	**Individual:** Computer Aided Design Intellectual Property Individual Project Overview	25 15 10	09/03/17	August 2017
														MULTI 50	**Group:** First Presentation Report Final Presentation	15 25 10		
15	N-AP-AE13	Individual Research Project	Dr Efstathios Velenis	10		80	Y		09/03/17	01/09/17		ICW THESIS OR	10 80 10				07/08/17 18/05/17 30/08/17 to 01/09/17	No Retake

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-APE-VDP	Vehicle Design Powertrain and Performance	Automotive Engineering	Automotive Engineering Automotive Mechatronics
N-AP-AE02	Engines Fuels and Lubrication	Automotive Engineering	Automotive Engineering, Automotive Mechatronics
N-AP-AE03	Automotive Control and Simulation	Automotive Engineering	Automotive Engineering, Automotive Mechatronics
N-AP-AE05	Vehicle Dynamics, Ride and Handling	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

7. **How are the ILOs assessed?**

The following assessment types are utilised:

- Within the subset of core automotive modules taught in term 1 are assed via written examinations that will be set early in term 2. Conversely, module 4 will be assessed via an individual assignment. It is noteworthy that this assignment will be aligned to the respective ILOs and may include elements of computer based analysis, model development and simulation.

- The specialised stream modules (4, 11, 12) 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.

- Modules 13 and 14, represent an extended open-ended Group Project Activity for both streams and are 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 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 and Postgraduate Diploma**

Module No. \ Award ILOs	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	ILO7	ILO8	ILO9	ILO10	ILO11	ILO12	ILO13	ILO14	ILO15	ILO16	ILO17
1					EX	EX		EX		EX	EX						
2									EX			EX					
3		ICW	ICW														
4							ICW										
5				EX													
6														EX			
7															ICW		
8																EX	
9																	MULTI
10													ICW				
11									GCW								
12											EX						
13	MULTI				MULTI												
14	MULTI															MULTI	

B. MSc

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

Module No. \ Award ILOs	ILO18	ILO19							
15	THESIS	THESIS							

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. **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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE:	MSc in Autonomous Vehicle Dynamics and Control

Date of first publication/latest revision:	October 2016

1. What is the course?

Course information

Course Title	MSc in Autonomous Vehicle Dynamics and Control
Course code	MSAVCFTC, MSAVCPTC, PDAVCFTC, PDAVCPTC, PCAVCFTC, PCAVCPTC
Academic Year	2016/17
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Cyberphysical Systems
Course Director	Professor Rafal Zbikowski
Awarding Body	Cranfield University
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)	October

Institutions delivering the course

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

- Autonomous Systems
- Flight Dynamics
- Decision making in Autonomous Systems
- Autonomous Systems Technology and Operations
- Guidance and Navigation of Air/Ground and Underwater Vehicles
- Control Systems Computational Engineering and Design
- Computational Fluid Dynamics with the applications in aerospace, automotive, environmental, energy, sensor technology, data and information fusion.

Teaching and/or assessment is conducted at the two campuses: in the School of Aerospace, Transport and Manufacturing and Cranfield Defence and Security at Shrivenham.

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?

Vehicle autonomy is predicted to be one of the defining technologies of the next few decades. At present there is no explicit provision for such technologies at Masters Level in the United Kingdom. In Europe, a masters programme in "Intelligent Autonomous Systems" has been launched at Aalborg University, Denmark. A computer science based masters course runs at Bonn-Rhein-Sieg University of Applied Science, Germany. MIT, Princeton and other leading US universities have started to provide modules on autonomous systems on their masters programs.

These programmes address the predicated future needs of industry and research for personnel with the fundamental knowledge and enabling skills required for the advance of the technologies of autonomous vehicles. The programme reflects the burgeoning research interests of the staff within the Centre and compliments other activities in autonomous air vehicle engineering within the School.

The course provides a unique opportunity for cross-disciplinary education and knowledge transfer for candidates interested in working in the area of autonomous system and understand their operations and integration covering a broad range of applications from defence to health care.

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:

- Engineers wishing to apply their skills into new areas.
- Qualified engineers working with autonomous systems in a particular area and wishing to move to a different application area, for example, from ground robots to unmanned air-vehicles.
- Recent 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.   Demonstrate an appreciation of the issues involved with the deployment of autonomous vehicle systems.

ILO 2.   Construct and analyse dynamic models of either an air, marine or ground vehicle.

ILO 3.   Analyse, design and simulate control systems for the stability, performance, navigation and autonomous operation of an air, marine or ground vehicle.

ILO 4.   Demonstrate a systematic understanding of some of the fundamental principles of vehicle dynamics, control systems and autonomous decision making, and a systematic understanding of the nature of the relationship between the dynamics, control and decision-making subsystems within the autonomous vehicle system.

ILO 5.   Demonstrate an awareness of the nature of the autonomy and decision making under uncertainty.

B. Postgraduate Diploma

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

ILO 6.   Define problems and develop methods and strategies for solving them.

ILO 7.   Utilise manual and computer based information retrieval systems and correctly reference their use.

ILO 8.   Work independently and/or in a group environment.

ILO 9.   Plan and execute a short piece of research or design study (i.e., dissertation)

ILO 10. Critically evaluate their own work and manage their time.

ILO 11. Communicate effectively verbally or in writing to suit a range of audiences.

ILO 12. Program and drive leading mathematical and engineering software packages.

C. MSc

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

ILO 13. Demonstrate independent learning by planning, conducting and critically evaluating an individual programme of extended research into some aspect of autonomous vehicle systems and presenting the work both in the form of presentations and written thesis.

4. How is the course taught?

The course is delivered through a combination of lectures, tutorials and hands-on lab sessions. The majority of the modules feature a strong interactive element.

Written coursework assignments take the form of technical reports, laboratory reports and traditional style essays. The students can have up to 9 written assignments depending on the choice of modules they undertake, 6 of which are compulsory. Some modules are 100% assessed on the written report while others feature 50-50 split (assignment and exam).

The learning support builds on the standard mechanisms provided by the University including library facilities, specialised IT provision, etc. The course uses the Blackboard learning environment with all materials delivered in electronic form.

In addition to standard learning support facilities the course utilises a number of specialised facilities, namely:

- Wind-tunnel facilities used for demonstrations/labs – in the first two weeks of the course the students have several sessions and demonstrations using the wind tunnel facilities.

- The Introduction to Aerodynamics, Aircraft Performance, Stability and Control which is a compulsory module uses the NLFC Jetstream plane for in-flight data recording and measurements. The students are divided into groups and use the data collected from the flight for the flight lab assignment. In addition, the students are given 2-hours in the Bulldog where they can experience and get a better understanding of aircraft handling, limitations and performance. The student have this unique opportunity at Cranfield to be taught the theoretical component of the course then go out flying with the Jetstream and experience and collect the data in flight for the written report.
- The course collaborates with CDS.
- Currently working on expanding the experimental part to include the airport and tower to give the students the understanding of ground/air-operations, aerodrome traffic movement and rules of the air.
- Individual Research Projects are proposed by industrial partners (not sponsored). Each year a limited number of industry internships become available to students.

Group assignments and lab sessions are utilised in order to enhance the transferable skills related to teamwork and communication.

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, 2, 5, 6, 7, 8, 9,10	55
ELECTIVE MODULES:	
Modules selected from: 3 **OR** 18, to the value of 5 credits	5
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 Dissertation: 20	80 20
ELECTIVE MODULES:	
Modules selected from: 11-18, to the value of 20 credits	20
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	80
Individual Research project: 19	100
ELECTIVE MODULES:	
Modules selected from: 11-18, to the value of 20 credits	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);[1] [2]
- **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.

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[1]   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).

[2]   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. <u>How is the course structured?</u>

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 are recommended to register in October but they can also register in January. However, depending on the student background and their knowledge in control systems it is advisable that the Autonomous Vehicle Control Systems, which is an optional module, be taken in the second year. The course takes 2 or 3 years to complete and selecting the modules to be taken each year is done in consultation with the Course Director.

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 [3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark [5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment [8]	Assessment Submission and/or exam date [9]	Assessment / Exam Retake date
1	N-ASD-FDP	Flight Dynamics Principles	Dr Alastair Cooke	20		10	Y		21/11/16	02/12/16	40	ICW	100				15/02/17	At the next available opportunity which will be approximately six months later
2	N-ASD-CS	Control Systems	Dr James Whidborne	28		10	Y		07/11/16	25/11/16	40			100 MULTI	ICW EX	50 50	16/12/16 11/01/17	At the next available opportunity which will be approximately six

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		months later
3	N-AVC-DAMS	Decision Making for Autonomous Systems	Prof Rafal Zbikowski	14		5	N		27/02/17	28/02/17	40	ICW	100				28/03/17	At the next available opportunity which will be approximately six months later
4	N-ASD-GFTR[10]	Flight Experimental Methods (Group Flight Test Report)	Dr Alastair Cooke	50		20	Y		10/10/16	28/10/16	40			100 MULTI	GPRAC OR	70 30	23/11/16	At the next available opportunity which will be approximately six months later
5	N-AVC-GNS	Guidance and Navigation for Autonomous Systems	Dr Hyo-sang Shin	28		10	N		06/02/17	10/02/17	40	EX	100				24/04/17	At the next available opportunity which will be approximately six months later
6	N-AVD-MDS	Modelling of Dynamic Systems	Dr James Whidborne	13		0	Y		24/10/16	28/10/16	N/A	AO	N/A				N/A	N/A
7	N-ASD-AMS	Air-Vehicle Modelling and	Dr James Whidborne/	28		10	Y		16/01/17	20/01/17	40	ICW	100				06/03/17	At the next available opportunity which

[10] Assessment Group 40

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment (Independent)	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment (Multi-part)	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
		Simulation	Dr Mudassir Lone															will be approximately six months later
8	N-AVC-SF	Sensor Fusion: Architectures, Algorithms and Applications	Dr Hyo-sang Shin	30		10	N		14/11/16	18/11/16	40			100 MULTI	EX ICW	70 30	10/01/17 27/01/17	At the next available opportunity which will be approximately six months later
9	N-AVC-IA	Introduction to Aerodynamics	Prof Kevin Garry/ Dr Nick Lawson	22		0	N		03/10/16	07/10/16	n/a	AO	n/a				n/a	n/a
10	N-AVC-ASO	Autonomous Systems and Operations	Dr Al Savvaris	14		5	N		01/03/17	02/03/17	40	ICW	100				31/03/17	At the next available opportunity which will be approximately six months later
11	N-CFD-CFDAE	CFD for Aerospace Applications	Dr Panagiotis Tsoutsanis	10		5	Y		22/03/17	24/03/17	40	ICW	100				08/05/17	At the next available opportunity which will be approximately six months later
12	N-ASD-ICFD	Introduction to CFD	Dr Panagiotis Tsoutsanis	35		10	Y		20/02/17	24/02/17	40	ICW	100				07/04/17	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

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Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		opportunity which will be approximately six months later
13	N-AVC-DIF	Data and Information Fusion	Prof Rafal Zbikowski	30		10	N		30/01/17	03/02/17	40	EX	100				28/04/17	At the next available opportunity which will be approximately six months later
14	N-ASD-FRPSC	Fundamentals of Rotorcraft Performance, Stability and Control	Dr Alastair Cooke	10		5	Y		21/11/16	25/11/16	40	EX	100				09/01/17	At the next available opportunity which will be approximately six months later
15	N-AVC-VPP	Vehicle Power and Propulsion	Dr Al Savvaris	28		10	N		13/02/17	17/02/17	40 40	ICW ** EX	50 50				17/03/17 25/04/17	At the next available opportunity which will be approximately six months later
16	N-AVC-FDHM	UAS Fault Diagnosis and Health Management	Dr Al Savvaris	28		10	N		06/03/17	10/03/17	40	EX	100				26/04/17	At the next available opportunity which will be approximately six

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Independent Assessment Weighting within module6 (%) of Independent assessments	Multi-part Assessment Weighting within module of multi-part assessments[7] (100%)	Multi-part Assessment Type of Assessment	Multi-part Assessment Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Submission dates Assessment / Exam Retake date
																		months later
17	N-AVC-AVCS	Autonomous Vehicle Control Systems	Dr Hyo-sang Shin	28		10	N		23/01/17	27/01/17	40	ICW	100				17/03/17	At the next available opportunity which will be approximately six months later
18	N-AVC-CSN	UAS Communication Systems and Networks	Dr Al Savvaris	14		5	N		13/03/17	14/03/17	40	ICW	100				13/04/17	At the next available opportunity which will be approximately six months later
19	N-AVC-THESIS	Individual Research Project	Prof Antonios Tsourdos	20		100	N		01/05/17	08/09/17		THESIS OR	85 15				23/08/17 05/09/17	
20	N-AVC-DISS	Dissertation***	Prof Antonios Tsourdos	30		20	N		01/05/17	08/09/17		THESIS	100				08/09/17	

*Laboratory case study based assessment

***Please note that Dissertation for PgDip is examined 100% by thesis. However, the candidate will be required to give a non-assessed presentation in order to demonstrate that learning outcomes have been achieved.

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-ASD-FDP	Flight Dynamics Principles	Aerospace Dynamics	Aerospace Dynamics, Aircraft Engineering
N-ASD-CS	Control Systems	Aerospace Dynamics	Aerospace Dynamics, Aerospace Vehicle Design, Astronautics and Space Engineering
N-ASD-GFTR	Flight Experimental Methods (Group Flight Test Report)	Aerospace Dynamics	Aerospace Dynamics
N-AVD-MDS	Modelling of Dynamic Systems	Aerospace Dynamics	Aerospace Vehicle Design Astronautics and Space Engineering, Aerospace Dynamics
N-ASD-AMS	Air-Vehicle Modelling and Simulation	Aerospace Dynamics	Aerospace Dynamics, Flight Test and Flight Dynamics
N-CFD-CFDAE	CFD for Aerospace Applications	Computational Fluid Dynamics	Computational Fluid Dynamics
N-ASD-ICFD	Introduction to CFD	Aerospace Dynamics	Aerospace Dynamics
N-ASD-FRPSC	Fundamentals of Rotorcraft Performance, Stability and Control	Aerospace Dynamics	Aerospace Dynamics

7. **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 3:2, but depends on the chosen options.

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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Certificate

Award ILOs / Module No.									

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.									

C. MSc

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

Award ILOs / Module No.									

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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. The first group of graduates from this course went on to work in the aerospace sector and automotive industry, while 2 graduates pursued careers in academic 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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE: MSc in Battlespace Technology

Date of first publication/latest revision: 14/12/15

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1. **What is the course?**

Course information

Course Title	Battlespace Technology
Course code	MSBTCPTR - PDBTCPTR
Academic Year	2015-16
Valid entry routes	MSc
Exit routes	MSc, PgDip
Mode of delivery	Part time
Location of Study	Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Head of School
Awarding Body	Cranfield University
Teaching Institution	Cranfield University
Admissions body	Cranfield University
Entry requirements	Standard University academic entry requirements
UK Qualifications Framework Level	QAA FHEQ level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s) available	A student who registers for the PgDip will have a registration period of 4 years and for the MSc, 5 years.
Course Start Month(s)	June

Institutions delivering the course
This course is delivered by Cranfield Defence and Security where the research interests include a wide range of Defence related topics. The military context of the taught material is reinforced by

experienced Military Directing Staff and visiting lecturers including experts from industry, research establishments and Government departments, particularly MoD.

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 broad understanding of fundamental technologies, their acquisition and support, and a deeper understanding of a particular sub-set of battlespace technologies and capability integration, to enable graduates to contribute most effectively to the delivery of defence capability.

The Postgraduate Diploma (PgDip) exit route is provided for students who not wish to undertake a research project on successful completion of the taught phase of the course.

This programme is intended mainly for selected non-specialist UK Army Officers.

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

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

A. Postgraduate Diploma in Battlespace Technology

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

ILO 1.   Understand and critically evaluate those fundamental technologies under-pinning defence equipment capability and their integration in weapon and vehicle systems

ILO 2.   Analyse the role of information superiority in enhancing operational effectiveness

ILO 3.   Demonstrate an ability to think conceptually within a defined area of battlespace technology

ILO 4.   Describe and critically evaluate the role of systems engineering and project management in defence acquisition and equipment support

ILO 5.   Analyse and critically compare potential solutions to meet a capability requirement within a particular area of battlespace technology

ILO 6.   Express knowledge and critical deduction both orally and in writing

ILO 7.   Work to agreed timelines and milestones, establishing clear aims, objectives and specifications

ILO 8.   Apply appropriate methods, tools, techniques, processes and knowledge acquired during the course

ILO 9.   Demonstrate an ability to play an effective part as a member of a project team in the formulation and communication of a design solution to a system requirement

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B. MSc in Battlespace Technology

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

ILO 11.   Plan and undertake a defence related research project in a technical subject or having a technical implication

ILO 12.   Acquire, critically evaluate, synthesise and correctly reference literature relating to a specific project topic

ILO 13.   Effectively communicate their findings and the associated technical information

ILO 14   Defend their approach to the project and their conclusions

4. How is the course taught?

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

- coursework involving investigation into a technical subject area and presentation to their peers
- small group and whole class guided discussions
- guidance from experienced Military Directing Staff
- Learning and Teaching resources and course material on the Virtual Learning Environment
- a maths support package including supporting tutorials.

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

Description	Credits
COMPULSORY MODULES:	
Modules 1 & 11	40
Module 12	10
Module 13	30
ELECTIVE MODULES:	
Four from modules 3-10 or module 2 plus two from modules 7-9	40
TOTAL:	**120**

B.   MSc

The accumulation of 200 credits (or more) through the assessment of taught modules as detailed below:

Description	Credits
COMPULSORY MODULES:	
Modules 1 & 11	40
Module 12	10
Module 13	30
Module 14 - Project	80
ELECTIVE MODULES:	
Four from modules 3-10 or module 2 plus two from modules 7-9	
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> 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);

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[1]   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).

[2]   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%).

- o 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. <u>How is the course structured?</u>

Students start the BTC in June and complete all of the residential, PgDip, taught phase of the course by the end of December, except the Capability Integration module. They then complete their Staff Course from January to August, but are released to complete the BTC Capability Integration module during March.

Those students wishing to complete the MSc are then expected to complete the research project during their two year BTC related employment posting.

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	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
							Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
											Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	R-BT-IBT	Introduction to Battlespace Technologies	120		20		01/06/15	01/06/15	17/07/15	40	GCW	100				17/07/15	N/A
12	R-BT-ECN	Achieving Information Superiority	35		10		20/07/15	20/07/15	31/07/15	40	ICW	100				03/08/15	04/12/15
SUMMER BREAK																	

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

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Module Number	Module code	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
							Calendar				Assessment						
											Independent Assessment		Multi-part Assessment			Submission dates	
2	R-BT-MS	Defence Modelling &Simulation (Sim ET)	74		20		24/08/15	24/08/15	25/09/15	40	OR	50				25/09/15	N/A
										40	ICW	50				28/09/15	
3	R-BT-BM(M)	Mobility (Battlespace Manoeuvre Stream)	35		10		03/08/15	03/08/15	25/09/15	40	ICW	100				28/09/15	N/A
4	R-BT-IS(CI)	Communication Infrastructure (Information Manoeuvre Stream)	35		10		03/08/15	03/08/15	25/09/15	40	ICW	50				07/09/15	N/A
										40	ICW	50				28/09/15	
7	R-BT-BM(L)	Lethality (Battlespace Manoeuvre Stream)	35		10		07/09/15	07/09/15	25/09/15	40	ICW	100				28/09/15	N/A
6	R-BT-IS(SS)	Sensor Systems (Information Manoeuvre Stream)	35		10		07/09/15	07/09/15	25/09/15	40	ICW	100				28/09/15	N/A
5	R-BT-BM(PA)	Precision Attack (Battlespace Manoeuvre	35		10		28/09/15	28/09/15	30/10/15	40	ICW	50				02/11/15	N/A
										40	ICW	50				02/11/15	

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

Module Number	Module code	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
											Independent Assessment		Multi-part Assessment			Submission dates	
							Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
		Stream															
8	R-BT-IS(N)	Network Infrastructure (Information Manoeuvre Stream)	35		10		28/09/15	28/0915	30/10/15	40	ICW	100				02/11/15	N/A
9	R-BT-BM(S)	Survivability (Battlespace Manoeuvre Stream)	35		10		12/10/15	12/10/15	30/10/15	40	ICW	100				02/11/15	N/A
10	R-BT-IS(CS)	Cyber and Electromagnetic Activities	35		10		12/10/15	12/10/15	30/10/15	40	ICW	100				02/11/15	N/A
11	R-BT-DAPM	Defence Acquisition & Project Management (AET)	80		20		02/11/15	02/11/15	04/12/15	40 40	EX ICW	50 50				30/11/15 18/12/15	N/A
13	R-BT-CI	Capability Integration	50		30		07/12/15	07/12/15	25/03/16	50 50	ICW ICW	30 70				18/12/15 24/03/16	28/02/16 MARCH 17

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

Module Number	Module code	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
							Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
											Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
14	R-BT-DISS	MSc Project	8		80		01/06/15	N/A	N/A	50			100	ICW THESIS OR	10% 65% 25%	07/01/19 Viva to be arranged	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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
R-BT-DAPM	Defence Acquisition & Project Management	Acquisition Employment Training (AET)	Acquisition Employment Training (AET)
R-BT-MS	Defence Modelling and Simulation	Simulation Employment Training (Sim ET)	Simulation Employment Training (Sim ET)

7. How are the ILOs assessed?

The following assessment types are utilised:

Modules are assessed by written examination, written coursework or presentation with oral questioning, or a weighted combination.
The Capability Integration team project, which brings together the core elements of the course in a realistic acquisition exercise, is assessed through data packs including outline business cases and presentations with oral questioning.
The MSc research project is assessed through continuous assessment of the project execution, a written thesis and a viva voce examination.

This approach has been adopted in order that the individual elements of the course can be assessed by the most appropriate method but also that the students can demonstrate their learning in a number of different ways.

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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Diploma

Award ILOs / Module No.									

Award ILOs / Module No.									

B. MSc

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

Award ILOs / Module No.									

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8.   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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

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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.

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

Students on this course are sponsored by their employer and have been selected for specific employment posts within the MOD or Defence related establishments.

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 Biofuels Process Engineering

Date of first publication/latest revision:	21/07/16

What is the course?

Course information

Course Title	Biofuels Process Engineering
Course code	MSBPEFTC, MSBPEPTC
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield
School(s)	School of Water, Energy & Environment
Theme	Energy & Power
Centre	Centre for Bioenergy & Resource Management
Course Director	Dr Beatriz Fidalgo-Fernandez
Awarding Body	Cranfield University
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
Course Start Month(s)	October

Institutions delivering the course
This course is delivered by Centre for Bioenergy & Resource Management 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

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- Process Control
- Environmental Protection & Management

Although this is a new course, it is planned that Cranfield University will interact 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.
- Set up an industrial advisory committee including members from biofuels industries: Biofuels Corporation trading limited, TMO renewables, Green biologics and British Sugar. The industrial advisory committee will meet on a yearly basis to help in steering the course content. 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)

This course is not yet accredited formally by any external body.

1. What are the aims of the course?

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

The aim of this course is to prepare science and engineering graduates to meet the increasing demand in industry, consultancies and the education and public sectors for engineers, scientists and officers and advisors in biofuels area.

This programme is intended for the following range of students:

- Graduates with engineering or related applied and/or life-science degrees keen to pursue a career in energy and biofuel industries.
- 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. MSc in Biofuel Process Engineering

ILO 1. Demonstrate a deep understanding of the current theory and practice of bioenergy and biofuels production processes;

ILO 2. Critically evaluate and differentiate the current technologies and bioprocesses appropriate for the production of biofuels;

ILO 3. Recognize and assess different feedstocks used for the production of biofuels and available characterization techniques;

ILO 4. Apply effectively the knowledge gained to the design and control of bioenergy and biofuel processes;

ILO 5. Identify and appraise current research activities in selected topics in the area of biofuels from a technical, economic and environmental perspective;

ILO 6. Demonstrate ability to undertake independent learning, particularly via the effective use and critical appraisal of technical and/or commercial literature;

ILO 7. Demonstrate good time management, successful work to deadlines and team working;

ILO 8. Communicate effectively, via oral and written presentations and reports.

ILO 9. Select and employ appropriate tools and techniques for modelling, optimisation and control of bioenergy and biofuel processes;

ILO 10. Critically evaluate the technical, economic and environmental issues involved in the design, implementation and operation of biofuel process plants;

ILO 11. Demonstrate professional approach to problem solving;

ILO 12. Integrate knowledge, understanding and skills from the taught modules in a real-life situation.

ILO 13. 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

ILO 14. Demonstrate ability to manage research studies, and plan and execute projects in biofuel applications systems;

ILO 15. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 16. 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 structured lectures, tutorial sessions, computer-based workshops 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 feedbacks 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 related to biofuel processes
- Arrangement of attendance of relevant modules offered by other MSc programmes

The taught programme is generally delivered from October to November and from January to March. Each module is generally delivered over one to one week.

The group project/dissertation is taken between February and May. Each group will typically include 4-6 students and an academic supervisor 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.

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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:	
N-BPE-CWM (Module 3)	10
N-BPE-BPT (Module 7)	10
N-BPE-EFB (Module 5)	10
N-PSE-ACS (module 4)	10
ELECTIVE MODULES:	
2 modules chosen from:	
I-EDI-A1127 (Module 6)	10
N-PSE-PPO (Module 2)	10
N-PSE-PSD (Module 8)	10
G-MTI (Module 9)	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:	
Module 1	0
Modules 2-9	80
Module 10 (FT students)	40
ELECTIVE MODULES:	
Part-time student to choose one:	40
Module 10	40
Module 11)	
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:	
Module 1	0
Modules 2-9	80
Module 10 (Group project) FT	40
Module 12 (Thesis project)	80
ELECTIVE MODULES:	
Part-time student to choose one:	40
Module 10	40
Module 11	
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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

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[1]   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).

[2]   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%).

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);

- o 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 a group project within a six month period, the same as for Full-time students. MSc individual research projects are commonly undertaken in collaboration with the candidate's place of work.

All 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.

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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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment					Submission dates	
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment				
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-ENE-INWK	Induction	G Drew	24		0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
2	N-PSE-PPO	Process Plant Operations	G Kopanos	30		10	Y		10/10/16	14/10/16	40	EX	100				W/C 12/12/16	
3	N-BPE-CWM	Circular Waste Management: Biological Processes[10]	R Villa	28		10	Y		24/10/16	28/10/16	40	ICW	100				05/11/16 FT 12/11/16 PT	

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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.

[10] Shares teaching with MSc Waste and Resource Management 20 credit module, I-WRM-CRM.

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	N-BPE-BPT	Biofuels and Biorefining	B Fidalgo Fernandez	30		10	N		09/01/17	13/01/17	40	EX	100				W/C20/02/17	
5	N-BPE-EFB	Energy from Biomass and Waste: Thermochemical Processes	B Fidalgo Fernandez	30		10	Y		28/11/16	02/12/16	40	EX	100				W/C 12/12/16	
6	I-EDI-A1127	Evaluating Sustainability through Lifecycle Approaches	P Goglio	30		10	Y		05/12/16	09/12/16	40	ICW	100				FT & PT 07/01/17	
7	N-PSE-ACS	Advanced Control Systems	Y Cao	30		10	Y		14/11/16	18/11/16	40	ICW	100				26/11/16 FT 03/12/16	
8	N-PSE-PSD	Process Design and Simulation	G Kopanos	30		10	Y		23/01/17	27/01/17	40	ICW	100				04/03/17 FT 11/03/17 PT	
9	G-MTI	Management for Technology	S Carver	50		10	Y		13/02/17	17/02/17	40	EX GCW	50 50				20/03/17 25/03/17	
10	I-ENE-GRPP	Group Project	Supervisor	16		40	Y		27/02/17	05/05/17	50	GPROJ ICW	80 20				02/05/17 06/05/17	

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

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Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
11	E-ENE-DISS	Dissertation (P-T option only)	Supervisor	20		40	Y		03/10/16	30/09/17	50	IPROJ	100				30/09/17	
12	I-ENE-THESIS	Individual Research Project	Supervisor	20		80	Y		08/05/17	08/09/17	50	OR THESIS	10 90				04/09/17 04/09/17	

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

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Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-BPE-CWM	Circular Waste Management: Biological Processes	Biofuels Process Engineering	Shares teach with the 20 credit Circular Waste Management; Recycle, Recover and Dispose modules used by • Waste and Resource Management • Energy from Waste • Environmental Engineering
N-BPE-EFB	Energy from Biomass and Waste: Thermochemical Processes	Biofuels Process Engineering	• Energy from Waste The module shares 3 days with "Fuels from Energy Conversion" which is attended by students in: • Materials for Energy Systems • Energy Supply for Low Carbon Futures • Gas Energy • Renewable Energy Technology
G-MTI	Management for Technology	School of Management	• Materials for Energy Systems • Advanced Mechanical Engineering • Design of Rotating Machines • Energy Supply for Low Carbon Futures • Gas Energy • Offshore and Ocean Technology with Pipeline Engineering • Offshore Materials and Engineering • Offshore and Renewable Energy • Offshore Risk Management • Offshore and Ocean Technology with Subsea Engineering • Renewable Energy Engineering • Renewable Energy Technology

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			• Flow Assurance for Oil and Gas Production • Carbon Capture and Storage • Energy Systems and Thermal Processes • Process Systems Engineering • Energy from Waste
I-EDI-A1127	Evaluating Sustainability through Lifecycle Approaches	Environment Programme	• Energy Supply for Low Carbon Futures • Environmental Management for Business • Environmental Risk Management • Waste and Resource Management • Biofuels Process Engineering
N-PSE-PPO	Process Plant Operations	Process Systems Engineering	• Carbon Capture and Storage • Flow Assurance for Oil and Gas Production • Biofuels Process Engineering • Cost Engineering
N-PSE-ACS	Advanced Control Systems	Process Systems Engineering	• Advanced Mechanical Engineering • Flow Assurance for Oil and Gas Production • Carbon Capture and Storage • Energy Systems and Thermal Processes • Biofuels Process Engineering
N-PSE-PSD	Process Design and Simulation	Process Systems Engineering	• Carbon Capture and Storage • Flow Assurance for Oil and Gas Production • Biofuels Process Engineering

7. **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 - 4 written examinations, 6 - 7 pieces of assessment by submitted work and 2 elements of assessment by presentation or viva.

This approach has been adapted to:

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- 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.

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that external examining is one of the principal means for maintaining UK threshold academic standards within autonomous higher education institutions.

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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.

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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.

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

Graduates from the course will be equipped with the advanced interdisciplinary skills required to design, optimise, and evaluate the technical and economic viability of sustainable bioenergy and biofuel processes. Graduates are likely to work in companies competing in the bioenergy sector. The interdisciplinary skills that are graduates develop also allow them to take a management career route in the bioenergy industry.

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 Carbon Capture and Storage

Date of first publication/latest revision: 08/01/16 – 13/09/16

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1. What is the course?

Course information

Course Title	Carbon Capture and Storage
Course code	MSCCSFTC, MSCCSPTC,
Academic Year	2016/17
Valid entry routes	MSc
Exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield
School(s)	School of Water, Energy & Environment
Theme	Energy & Power
Centre	Centre for Combustion, Carbon Capture & Storage
Course Director	Prof Vasilije Manovic
Awarding Body	Cranfield University
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
Course Start Month(s)	October

Institutions delivering the course

This course is delivered by the Centre for Combustion, Carbon Capture and Storage where the research interests include CO_2 capture and CO_2 transport, Process and Energy Systems Design, Simulation and Optimisation, Multi-Phase Flow, Flow Measurement, Process Control Technical and Economic Viability Assessments of Conventional and Renewable Energy Systems Environmental Protection.

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 engineering and applied science graduates with advanced theory and practice of the technical and managerial aspects of carbon capture, transport, and storage systems.

This programme is intended for the following range of students:

- Graduates with engineering or related science degrees keen to pursue a career in cleaner energy systems by specialising in CO_2 capture transport, and storage.
- 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. **MSc in Carbon Capture and Storage**

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

ILO 1.   Explain the current theory and practice of carbon capture process and carbon transport system

ILO 2.   Critically evaluate the technical, and economic issues involved in the design and operation of carbon capture plants and carbon transport systems

ILO 3.   Apply effectively the knowledge gained to the design and control of carbon capture plants and carbon transport system

ILO 4.   Make effective use of a range of software employed for modelling, optimisation and control of carbon capture, transport, and storage systems

ILO 5.   Demonstrate an ability to undertake independent learning, especially via the effective use of information retrieval systems

ILO 6.   Demonstrate a professional approach to problem solving

ILO 7.   Communicate effectively in writing

ILO 8.   Operate effectively in a team

ILO 9.   Gain an in-depth understanding of the technical, economic and environmental issues involved in the design and operation of CO_2 capture plants and CO_2 transport systems

ILO 10.   Demonstrate a knowledge of some key technical management principles, including project management, people management, technology marketing, product development and finance

ILO 11.   Use of the techniques appropriate for the management of a modern carbon capture plant and carbon transport systems;

ILO.14   Integrate knowledge, understanding and skills from the taught modules in a real-life situation.

ILO 15   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

ILO 16.   Develop a professional ability to undertake a critical appraisal of technical and/or commercial literature

ILO 17   Evaluate critically current research in selected topics in the area of carbon capture, transport, and storage

ILO 18   Demonstrate an ability to manage research studies, and plan and execute projects in carbon capture transport, and storage

ILO 19   Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 20   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:

- A dedicated electronic Blackboard site
- One-day workshop in MATLAB training
- 3-day OLGA training short course for students undertaking Individual research projects related to the flow control
- Arrangement of attendance of relevant modules offered by other MSc programmes

3

The taught programme is generally delivered from October to March. Each module is generally delivered over one to two weeks.

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 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 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:	
PSE06, PSE07	20
ELECTIVE MODULES:	
4 from PSE02, PSE03, PSE11, PSE16 & PSE13	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:	
PSE06, PSE07, PSE02, PSE03, PSE11, PSE16 & PSE13 Group project Dissertation for part time students in place of group project	70 40 40
ELECTIVE MODULES:	
1 from PSE10, PSE12, & PSE17	10
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:	
PSE06, PSE07, PSE02, PSE03, PSE11, PSE16 & PSE13	70
Group project	40
Dissertation for part time students in place of group project	40
Individual thesis project	80
ELECTIVE MODULES:	
1 from PSE10, PSE12, & PSE17	10
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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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).

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[1]   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).

[2]   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%).

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6. <u>How is the course structured?</u>

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

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

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

The Group Project generally includes a carbon capture plant for different power plants or a carbon transport system under certain conditions. Sometimes, this Group Project could use specific software.

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 [3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark [5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment [8]	Assessment Submission and/or exam date [9]	Assessment / Exam Retake date
1	I-ENE-INWK	Induction	G Drew	24		0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
2	N-PSE-PPO	PSE11 - Process Plant Operations	G Kopanos	30		10	Y		10/10/16	14/10/16	40	EX	100				W/C 12/12/16	
4	N-AME-RR	PSE03 - Risk and Reliability Engineering	A Kolios	30		10	Y		07/11/16	11/11/16	40	EX	100				W/C 02/01/17	

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
3	N-PSE-PGRES	Power Generation Systems	G Di Lorenzo	30		10	Y		24/10/16	28/10/16	40	ICW	100				05/11/16 FT 12/11/16 PT	
7	N-CCT-CT	PSE07 - Carbon Transport Technologies	V Manovic	30		10	N		09/01/17	13/01/17	40	ICW	100				21/01/17 FT 28/01/17 PT	
6	N-PSE-CETIP	PSE17 - Computational Fluid Dynamics for Industrial Processes	P Verdin	30		10	Y		05/12/16	09/12/16	40	ICW	100				21/07/17 FT 28/01/17 PT	
5	N-PSE-ACS	PSE12 - Advanced Control Systems	Yi Cao	30		10	Y		14/11/16	18/11/16	40	ICW	100				26/11/16 FT 03/12/16 PT	
8	N-PSE-PSD	PSE13 Process Design and Simulation	G Kopanos	41		10	Y		23/01/17	27/01/17	40	GCW	100				04/03/17 FT 11/03/17 PT	
9	N-CCT-CCT	PSE06 Carbon Capture Technologies	V Manovic	26		10	Y		30/01/17	03/02/17	40	ICW	100				11/03/17 FT 18/03/17 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
11	G-MTI	PSE02 Management for Technology	S Carver	50		10	Y		13/02/17	17/02/17	40	EX GCW	50 50				20/03/17 25/03/17	
10	N-PSE-PMS	PSE10 Process Measurement Systems	L Lao	30		10	Y		06/02/17	10/02/17	40	ICW	100				18/03/17 FT 25/03/17 PT	
11	I-ENE-GRPP	Group Project	Supervisor	16		40	Y		27/02/17	05/05/17	50	GPROJ ICW	80 20				02/05/17 06/05/17	
12	I-ENE-DISS	Dissertation	Supervisor	10		40	Y		03/10/16	30/09/17	50	IPROJ	100				30/09/17	
13	I-ENE-THESIS	IRP Individual Research Project	Supervisor	20		80	Y		08/05/17	08/09/17	50	OR THESIS	10 90				04/09/17	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-PSE-ACS	Advanced Control Systems	Process Systems Engineering	• Advanced Mechanical Engineering • Biofuels Process Engineering • Flow Assurance for Oil and Gas Production • Process Systems Engineering • Energy Systems and Thermal Processes • Carbon Capture & Storage
N-PSE-CETIP	Computational Fluid Dynamics for Industrial Processes	Process Systems Engineering	• Energy Systems and Thermal Processes • Flow Assurance for Oil and Gas Production • Process Systems Engineering • Carbon Capture & Storage
G-MTI	Management for Technology	School of Management	• Materials for Energy Systems • Advanced Mechanical Engineering • Biofuels Process Engineering • Design of Rotating Machines • Energy Supply for Low Carbon Futures Gas Energy • Offshore and Ocean Technology With Offshore Materials Engineering • Offshore and Ocean Technology With Pipeline Engineering • Offshore and Ocean Technology With Offshore Renewable Energy • Offshore Ocean Technology With Risk Management • Offshore Ocean Technology With Subsea Engineering • Renewable Energy Engineering • Renewable Energy

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			Technology • Flow Assurance for Oil and Gas Production • Energy Systems and Thermal Processes • Process Systems Engineering • Energy from Waste • Carbon Capture & Storage
N-PSE-PGRES	Power Generation Systems	Process Systems Engineering	• Advanced Mechanical Engineering • Energy Systems and Thermal Processes • Carbon Capture & Storage
N-PSE-PSD	Process Design and Simulation	Process Systems Engineering	• Biofuels Process Engineering • Flow Assurance for Oil and Gas Production • Process Systems Engineering • Carbon Capture & Storage
N-PSE-PMS	Process Measurement Systems	Process Systems Engineering	• Flow Assurance for Oil and Gas Production • Energy Systems and Thermal Processes • Process Systems Engineering • Carbon Capture & Storage
N-PSE-PPO	Process Plant Operations	Process Systems Engineering	• Flow Assurance for Oil and Gas Production • Process Systems Engineering • Biofuels Process Engineering • Cost Engineering • Carbon Capture & Storage
N-AME-RR	Risk and Reliability Engineering	Advanced Mechanical Engineering	• Flow Assurance for Oil and Gas Production • Advanced Mechanical Engineering • Process Systems Engineering Renewable Energy Engineering • Carbon Capture & Storage

7. How are the ILOs assessed?

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The following assessment types are utilised:

Students can expect to have 3 written examinations, 10 pieces of assessment by submitted work and 2 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 skills

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. 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 Energy sector (mainly power generation), CO_2 capture, transport, and storage industries, research organisations or 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 Community Water and Sanitation

Date of first publication/latest revision: 11/01/16 -19/09/16

1. What is the course?

Course information

Course Title	Community Water and Sanitation
Course code	MSCTSFTC, MSCTSPTC, MTCTSFTC, PDCTSFTC, PDCTSPTC, PCCTSFTC, PCCTSPTC
Academic Year	2016/17
Valid entry routes	MSc, , PgDip, PgCert
Exit routes	PgDip, PgCert
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield
School(s)	School of Water, Energy and Environment
Theme	Water
Centre	Cranfield Water Sciences Institute
Course Director	Dr Alison Parker
Awarding Body	Cranfield University
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

Institutions delivering the course

This course is delivered by the School of Water, Energy and Environment . Water research in the Cranfield Water Science Institute focuses on the science, engineering and management of water in municipal, industrial and natural environments, encompassing treatment technologies, engineering, irrigation, socioeconomics and policy. Research 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.

Cranfield University actively engages external speakers from across the water sector to deliver the Community Water and Sanitation course, including from: RedR, Oxfam, Medicin Sans Frontier, Action Contre la Faim, WaterAid, WEDC and CAWST. 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: WaterAid, WSUP,, and Loowatt.

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 Community Water and Sanitation 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 until 2016

2. What are the aims of the course?

Cranfield University offers this course in order to:

- equip engineers and other development workers to plan and implement water supply and sanitation projects and programmes in any part of the world, particularly in low income countries.

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 Community Water and Sanitation**

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

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ILO 1. Plan and design water sources in rural areas of lower-income countries, so the quality and quantity of water available is sustained

ILO 2. Evaluate water resource management methods

ILO 3. Plan and design sanitation facilities in lower-income countries and appraise different management methods

ILO 4. Explain different management and finance models for water, sanitation and hygiene services and evaluate how these might ensure access for the poorest.

ILO 5. Assess how services might vary in different contexts, specifically rural, urban and emergencies.

ILO 6. Critically evaluate water, sanitation and hygiene programmes, research and technologies.

B. Postgraduate Diploma in Community Water and Sanitation

ILO 7. In addition to the intended learning outcomes outlined above, a diligent student would also be expected to:

ILO 8. Manage projects as an individual and in groups

ILO 9. Integrate knowledge, understanding and skills from the taught modules in a real-life situation.

ILO 10. 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 Community Water and Sanitation

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

ILO 11. Define a research question, develop aim(s) and objectives, select and execute a methodology, analyse data, and evaluate findings and draw appropriate conclusions.

ILO 12. To communicate their findings successfully via a thesis, written in an approved School style and in an oral presentation.ILO8. Communicate effectively orally, through written work and through designed presentation media.

4. How is the course taught?

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

- Being provided with the opportunity to undertake externally sponsored or supported thesis project research

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- Undertaking field and laboratory work to integrate and apply knowledge and skills

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:	
Induction Any 6 taught modules	0 60
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 8 Taught Modules Group Project Dissertation - in place of Group Project (Part Time)	0 80 40 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:	
Induction 8 Taught Modules	0 80

4

Group Project	40
Dissertation - in place of Group Project (Part Time)	40
Thesis 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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?**

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[1] 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).

[2] 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%).

Please see the course structure document for details on the individual elements of the course. Each module is taught over two weeks, with one week largely free of structured teaching to allow time for more independent learning and reflection. Group projects are located after the taught modules, between February and May. Individual thesis research projects are run from May till the end of August with thesis submission and oral assessment in early September.

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.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Multi-part Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Submission dates Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-WAT-INWK	Induction Week	A Parker	24		0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
2	I-WAM-A1163	Surface and Groundwater Hydrology	I Holman	27		10	Y		10/10/16	14/10/16	40	EX	100				W/C 03/01/17	
3	I-WAM-WWTD	Water and Wastewater Treatment for Development	A McLeod	37		10	N		24/10/16	28/10/16	40	ICW	100				FT 05/11/16 PT 12/11/16	

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar			**Assessment**						
												Independent Assessment		Multi-part Assessment			Submission dates	
4	I-WAM-A1170	Communities and Development	P Hutchings	33		10	N		07/11/16	11/11/16	40			100	ICW ICW	50% 50%	FT 19/11/16 PT 26/11/16	
5	I-WAM-A1162	Health, Hygiene and Sanitation	S Tyrrel	25		10	N	21/11/16	28/11/16	02/12/16	40	ICW	100				FT 03/12/16 PT 10/12/16	
6	I-WAM-ISC	Innovation for Sustainable Cities	A Parker	30		10	N		05/12/16	09/12/16	40	IPRES	100				FT/PT 06/01/17	
7	I-WAM-A1166	Water Source Engineering	D Haro-Monteagudd	30		10	N		09/01/16	13/01/16	40	ICW	100				FT 21/01/17 PT 28/01/17	
8	I-WAM-MGWS	Management and Governance for Water Sanitation	P Hutchings	33		10	N		23/01/17	27/01/17	40	ICW	100				FT 04/02/17 PT 11/02/17	
9	I-WAM-A1168	Emergency Water Supply and Environmental Sanitation	T Gould	30		10	N		06/02/17	10/02/17	40	ICW	100				FT 18/02/17 PT 25/02/17	
PROJECTS																		
10	I-WAT-GRPP	Group Project	Supervisors	16		40	Y		20/02/17	06/5/17	50	GPROJ	80				02/05/17 06/05/17	

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
												ICW	20					
11	I-WAT-DISS	Individual Project (PT MSc and PgDip only)	Supervisors	10		40	Y		03/10/16	30/09/17	50	IPROJ	100				30/09/17	
12	I-WAT-THESIS	Individual Thesis	Supervisors	20		80	Y		08/05/17	08/09/17	50	THESIS OR	90 10				04/09/17	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-WAM-A1163	Surface Water & Groundwater Hydrology	Environment Water Management	Environmental Water Management

7. How are the ILOs assessed?

The following assessment types are utilised:

- 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) or examination in January;
- group projects (20%) are assessed by means of a written group report and presentations.
- the research project (40%), is assessed by a thesis and an oral examination

This approach has been adopted because:

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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 Community Water and Sanitation graduates are highly sought after by employers. Typical employers include:

- NGOs e.g. CAFOD, Concern Worldwide, ACTED, Pure Water for the World, Unicef, Medair, World Vision, WaterAid, MSF, CARE WSUP, World Toilet Organisation

- Government and pangovernment agencies e.g. the European Commission, JICA,

- Small sanitation companies e.g. SOIL, Loowatt
- Water utilities e.g. Anglian Water, United Utilities, Scottish Water
- International engineering consultancies (e.g. Atkins, Mott MacDonald)

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. Courses are under constant review, however, and the University reserves the right, without notice, to withdraw, update or amend this course specification at any time.

COURSE TITLE:	MSc in Computational and Software Techniques in Engineering

Date of first publication/latest revision:	October 2016

1. What is the course?

Course information

Course Title	MSc in Computational and Software Techniques in Engineering with options in: Computer Aided Engineering (CAE) Digital Signal Image Processing (DSIP) Software Engineering for Technical Computing (SETC)
Course code	MSCSTFTC, MSCSTPTC, MSSTBFTC (ESTIA variant),
Academic Year	2016/17
Valid entry routes	MSc
Additional exit routes	None
Mode of delivery	Full-time, Part-time
Location 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 Karl Jenkins
Awarding Body	Cranfield University
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 Fluid Mechanics & Computational Science where the research interests include:

- Computer Vision
- Vibroacoustics for Condition Monitoring
- Computational Engineering
- Distributed Computing

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) have been sending students to study the Cranfield MSc in Computational and Software Techniques in Engineering since 1989. The ESTIA variant allocates 110 credits for the thesis module as opposed to 100 credits for the Cranfield option. This is balanced by ESTIA students not taking the management for technology module since the ESTIA thesis option is different requiring the students to undertake industrial internships. 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 EU Erasmus 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 CAE and DSIP options.

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:

- 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.

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

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

A. MSc

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

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

ILO 2. Create original software solutions to engineering problems using industry standard libraries, packages, and software engineering tools

ILO 3. Compose written reports and prepare and deliver oral presentations that effectively communicate proposals, technical developments, and results

ILO 4. Plan and implement assigned projects under time pressure, and undertake self-directed learning when necessary.

ILO 5. Assemble a body of relevant technical literature and discuss and evaluate each work with respect to a technical problem.

ILO 6. Propose, plan, and implement an independent research project on a relevant technical topic, with limited supervision

ILO 7. 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 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 speaker 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.   MSc

Students must successfully complete the thesis. An MSc will be awarded on successful completion of 200 credits as outlined below:

Computer Aided Engineering option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
Core Modules 1-4 CAE Option Modules 5-11 Individual Research Project (25)	35 65 100
ELECTIVE MODULES:	
None	
TOTAL:	200

Computer Aided Engineering option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	
Core modules 1, 2, 4 CAE option modules 5-11 Individual Research Project (26)	25 65 110
ELECTIVE MODULES:	
None	
TOTAL:	200

Digital Signal Image Processing option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
Core modules 1-4 DSIP option modules 11-17 Individual Research Project (25)	35 65 100
ELECTIVE MODULES:	
None	
TOTAL:	200

Digital Signal Image Processing option, based at ESTIA

Description	Credits
COMPULSORY MODULES:	

Core modules 1, 2, 4	25
DSIP option modules 11-17	65
Individual Research Project (26)	110
ELECTIVE MODULES:	
None	
TOTAL:	200

Software Engineering for Technical Computing option, based at Cranfield

Description	Credits
COMPULSORY MODULES:	
Core modules 1-4	35
SETC option modules 18-24	65
Individual Research Project (25)	100
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);[1] [2]
- **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:
  o 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);
  o 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);

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[1] 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).

[2] 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 <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. <u>How is the course structured?</u>

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.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-CST-C++P04	C++ Programming	Dr Irene Moulitsas	30		10	N		27/09/16	07/10/16	40	ICW	100				05/12/16	At the next available opportunity which may not be until the course runs the following year
2	N-CST-CM	Computational Methods	Dr Irene Moulitsas	30		10	N		27/09/16	07/10/16								
3	G-MTI Occ B16	Management for Technology	Steven Carver	30		10	Y		16/01/17	20/01/17	40 40	EX GCW	50 50				23/01/17 20.03.16	24.03.2016 20.03.16

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice
[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)
[5] 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.
[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.
[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.
[8] 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.
[9] 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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	N-CST-CG	Computer Graphics Occ B (ESTIA)	Dr Karl Jenkins	15		5	N		14/11/16 23/01/17	16/11/16 25/01/17	40	ICW	100				27/01/17 08/03/17	At the next available opportunity which may not be until the course runs the following year
5	N-CST-CSM04	Geometric Modelling and Design	Dr Karl Jenkins	30		10	N		17/10/16	21/10/16	40			100	EX ICW	50 50	08/01/16 02/12/16	At the next available opportunity which may not be until the course runs the following year
6	N-CST-CAEA	CAE Applications and PLM	Dr Karl Jenkins	30		10	N		24/10/16	28/10/16	40	ICW	100				16/12/16	At the next available opportunity which may not be until the course runs the following year
7	N-CST-CAEAA	CAE Advanced Applications Occ B (ESTIA)	Dr Karl Jenkins	30		10	N		13/02/17 06/02/17	17/02/17 10/02/17	40	ICW	100				31/03/17 07/04/17	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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		the course runs the following year
8	N-CST-CEDO	Applications of Computational Engineering Design Optimisation (Group Project) Occ B (ESTIA)	Dr Karl Jenkins	30		10	N		27/02/17 30/01/17	03/03/17 03/02/17	40			100	GCW GPRES	50 50	18/04/17 18/04/17	At the next available opportunity which may not be until the course runs the following year
9	N-CST-AEA	Advanced Engineering Analysis	Dr Karl Jenkins	30		10	N		10/10/16	14/10/16	40	EX	100				13/01/17	At the next available opportunity which may not be until the course runs the following year
10	N-CST-CE	Computational Engineering (Fluids) Occ B (ESTIA)	Dr Karl Jenkins	30		10	N		20/02/17 16/01/17	24/02/17 20/01/17	40	ICW	100				07/04/17 13/02/17	At the next available opportunity which may not be until the course runs the following year
11	N-CST-AG	Advanced Graphics	Dr Karl Jenkins	15		5	N		16/01/16	18/01/16	40	ICW	100				01/03/17	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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers [4]	Credits	Is the module shared? Y/N	Calendar				Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment		Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments [7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date [9]	Assessment / Exam Retake date
		Occ B (ESTIA)							25/01/17	27/01/17							22/02/17	opportunity which may not be until the course runs the following year
12	N-CST-SA04	Signal Analysis	Dr Zeesham Rana	30		10	N		10/10/16	14/10/16	40	EX	100				08/01/17	At the next available opportunity which may not be until the course runs the following year
13	N-CST-DSP	Digital Signal Processing	Dr Yifan Zhao	30		10	N		17/10/16	21/10/16	40 40	EX ICW	70 30				11/01/17 02/12/16	At the next available opportunity which may not be until the course runs the following year
14	N-CST-DIP1	Image Processing	Dr Yifan Zhao	30		10	N		24/10/16	28/10/16	40 40	EX ICW	70 30				13/01/17 16/12/16	At the 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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		which may not be until the course runs the following year
15	N-CST-DIP2	Image Analysis Occ B (ESTIA)	Dr Zeeshan Rana	30		10	N		23/01/17 06/02/17	27/01/17 10/02/17	40	ICW	100				10/03/17 07/04/17	At the next available opportunity which may not be until the course runs the following year
16	N-CST-ADSIP	Applications of DSP and Computer Vision (Group Project) Occ B (ESTIA)	Dr Zeeshan Rana	30		10	N		27/02/17 31/01/17	03/03/17 03/02/17	40			100	GCW GPRES	50 50	18/04/17 18/04/17	At the next available opportunity which may not be until the course runs the following year
17	N-CST-ML	Machine Learning	Dr Irene Moulitsas	30		10	N		06/03/17	10/03/17	40 40	EX ICW	80 20				28/04/17 12/05/17	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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		be until the course runs the following year
18	N-CST-SSPP	Small-scale Parallel Programming	Dr Salvatore Filippone	30		10	N		23/01/17	27/01/17	40	ICW	100				10/03/17	At the next available opportunity which may not be until the course runs the following year
19	N-CST-GPAPHE	Applications in Practical High-End Computing (Group Project) Occ B (ESTIA)	Dr Irene Moulitsas	30		10	N		27/02/17 / 30/01/17	03/03/17 / 03/02/17	40			100	GCW GPRES	50 50	18/04/17 / 18/04/17	At the next available opportunity which may not be until the course runs the following year
20	N-CST-CC	Cloud Computing	Dr Salvatore Filippone	30		10	N		21/11/16	25/11/17	40	ICW	100				13/01/17	At the next available opportunity which may not be until 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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		course runs the following year
21	N-CST-HPTC	High Performance Technical Computing	Dr Irene Moulitsas	30		10	N		09/11/15	13/11/15	40	ICW	100				15/01/16	At the next available opportunity which may not be until the course runs the following year
22	N-CST-RASD	Requirements Analysis and System Design	Dr Salvatore Filippone	30		10	N		10/10/16	14/10/16								At the next available opportunity which may not be until the course runs the following year
23	N-CST-STQA	Software Testing and Quality Assurance	Dr Salvatore Filippone	30		10	N		19/10/15	23/10/15	40	ICW	100				02/12/16	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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module[6] (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		following year
24	N-CST-AJ	Advanced JAVA	Dr Irene Moulitsas	15		5	N		20/02/17	22/02/17	40	ICW	100				05/04/17	At the next available opportunity which may not be until the course runs the6following year
25	N-CST-THESIS	Individual Research Project (Cranfield)	Dr Karl Jenkins	20		100	N		04/04/17	18/08/17		THESIS IPRES	90 10				18/08/17	
26	N-CST-THEBAY	Individual Research Project (ESTIA**)**	Dr Karl Jenkins	20		110	N		04/04/17	18/08/17		THESIS IPRES	90 10				18/08/17	

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

SATM Computational and Software Techniques in Engineering Course Specification V1.5 November 2016

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
G-MTI	Management for Technology	School of Management	Energy Programme - SWEE MScThermal Power

7. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have between five and seven written examinations, between eight and nine pieces of assessment by submitted work and two to three elements of assessment by presentation or viva.

This approach has been adopted in order to provide the student with a balanced mix of theory and application. Since in this course practical application is key to development of understanding and skills acquisition, the majority of subjects are assessed by a combination of assignment and written exam or purely by assignment. A few subjects that have large theory content are assessed solely by exam. 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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. MSc

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

Award ILOs / Module No.								

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

Title	Modules Covered	Assessment	
		Type	Weight (%)
Two modules with a combined assessment	C++ Programming (1) Computational Methods (2)	ICW	100
Two modules with a combined assessment	Requirements Analysis and System Design (22) Software Testing and Quality Assurance (23)	ICW	100

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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 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.

COURSE TITLE: MSc in Computational Fluid Dynamics

Date of first publication/latest revision: October 2016

1. What is the course?

Course information

Course Title	MSc in Computational Fluid Dynamics
Course code	MSCFDFTC, MSCFDPTC, PDCFDFTC, PDCFDPTC, PCCFDFTC, PCCFDPTC
Academic Year	2015/16
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time, Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Aerospace
Centre	Centre for Fluid Mechanics and Computational Science
Course Director	Dr Panagiotis Tsoutsanis
Awarding Body	Cranfield University
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)	October

1

Institutions delivering the course

This course is delivered by the School of Aerospace, Transport and Manufacturing, Aerospace Theme, Centre for Fluid Mechanics and Computational Science, 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 2020and 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. Demonstrate a critical awareness of the governing equations of fluid mechanics, and their mathematical properties, in various formulations for compressible and incompressible inviscid and viscous flows.

ILO 2. Demonstrate a critical awareness of the underlying principles of numerical analysis, concepts of stability, approximation and convergence and the numerical solution of systems of algebraic equations.

ILO 3. Demonstrate a critical awareness of different state-of-the-art CFD methods as used in engineering practice and research and development for both incompressible and compressible flows.

ILO 4. Demonstrate a systematic application of the principles and understanding of limitations of techniques for the simulation of turbulent and transitional flows and thus be able to apply these in a critical manner to practical applications.

ILO 5. Recognise the potential sources of, and discriminate between, error and uncertainty in numerical simulations. Be aware of the tools that are available for the quantification of error and uncertainty in computational simulations. Be able to plan and perform credible computational simulations.

B. Postgraduate Diploma

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

ILO 6. Demonstrate a systematic application of the requirements of grid generation for CFD applications and alternative techniques for the visualisation and interpretation of CFD results.

ILO 7. Demonstrate their acquired skills in applying commercial CFD software packages to practical engineering applications.

ILO 8. Demonstrate a systematic application of the use of CFD to practical scientific and engineering fluid flow problems with the focus on planning, conducting and reporting upon a critical analysis of 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. Demonstrate a systematic approach of research and application, where the challenges associated with a particular topic of research are addressed with novelty arising from the taught material, and through state 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 assignments the students are required to complete (15 in total) 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.

3

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 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

Group assignments and lab sessions are designed to enhance transferable skills related to teamwork and communication.

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 1,2,5,6,7,8,9,10	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: 1-11 Dissertation (20)	75 20
ELECTIVE MODULES:	
Modules: 12-18 (choice of 5)	25
TOTAL:	120

4

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: 1-11 Research Project (19)	75 100
ELECTIVE MODULES:	
Modules: 12-18 (choice of 5)	25
TOTAL:	200

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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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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.

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[1] 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).

[2] 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. <u>How is the course structured?</u>

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 May. Individual research project runs from November until August.

Part-time students register for the course in October and are expected to complete the course within 2 or 3 years selecting the modules to be taken each year in consultation with the Course Director.

A 10 credit module or two 5-credit modules are usually taught over a week leaving the next week free for assignments and independent learning and reflection.

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	N-CFD-IFM	Introduction to Fluid Mechanics and Heat Transfer	Dr Laszlo Konozsy	20		10	N		24.10.16	28.10.16	40 40	ICW EX	33.3 66.6				28.11.16 14/12/16	
2	N-CFD-NMPDE	Numerical Methods for PDE's	Dr Antonios Antoniadis	20		10	N		31.10.16	4.11.16	40	ICW	100				16.01.17	
3	N-CFD-GG	Grid Generation / CAD	Dr Antonios Antoniadis	10		5	N		10.10.16	12.10.16	40	ICW	100				16.01.17	
4	N-CFD-DAPP	Data Analysis, Data Fusion and Post	Dr Antonios Antoniadis	10		5	N		30.11.16	2.12.16	40	ICW	100				1.02.17	

[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
		Processing																
5	N-CFD-NMCF	Numerical Modelling for Steady and Unsteady Compressible Flows	Dr Panagiotis Tsoutsanis	20		10	N		23.01.17	27.01.17	40 40	ICW EX	33.3 66.6				03.04.17	
6	N-CFD-NMIF	Numerical Modelling for Steady and Unsteady Incompressible Flows	Dr Laszlo Konozsy	20		10	N		21.11.16	25.11.16	40	ICW	100				6.02.17 6.01.17	
7	N-CFD-MUS	Managing Uncertainty in Simulations: Validation and Verification	Dr Zeeshan Rana	10		5	N		18.01.17	20.01.17	40	ICW	100				20.03.17	
8	N-CFD-HPC	High Performance Computing for CFD	Dr Antonios Antoniadis	10		5	N		7.11.16	9.11.16	40	ICW	100				7.12.16	
9	N-CFD-CTM	Classical Turbulence Modelling	Dr Laszlo Konozsy	10		5	N		28.11.16	30.11.16	40	ICW	100				16.01.17	
10	N-CFD-ATMS	Advanced Turbulence Modelling and Simulation: LES and DNS	Dr Zeeshan Rana	10		5	N		30.1.17	1.02.17	40	ICW	100				21.04.17	
11	N-CFD-RED	The Role of Experimental Data in CFD	Prof Kevin Garry	10		5	N		13.02.17	16.02.17	40	ICW	100				13.03.17	

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date[9]
									Calendar			Independent Assessment		Multi-part Assessment			Submission dates	
12	N-CFD-CFDMF	CFD for Multiphase Flows and Combustion	Dr Laszlo Konozsy	10		5	N		6.3.17	8.03.17	40	ICW	100				8.05.17	
13	N-CFD-CFDAE	CFD for Aerospace Applications	Dr Panagiotis Tsoutsanis	10		5	Y		22.3.17	24.03.17	40	ICW	100				8.05.17	
14	N-CFD-CFDRW	CFD for Rotating Wings	Dr Antonios Antoniadis	10		5	N		4.04.17	6.04.17	40	ICW	100				8.05.17	
15	N-CFD-CFDMS	CFD for Micro and Nano Flows	Dr Laszlo Konozsy	10		5	N		8.03.17	10.03.17	40	ICW	100				8.05.17	
16	N-CFD-CFDEF	CFD for Environmental Flows	Dr Zeeshan Rana	10		5	N		6.04.17	7.04.17	40	ICW	100				8.05.17	
17	N-CFD-CFDAF	CFD for Automotive Flows	Dr Panagiotis Tsoutsanis	10		5	N		20.3.17	22.03.17	40	ICW	100				8.05.17	
18	N-CFD-CFDFI	CFD for Fluid-Structure Interaction	Dr Zeeshan Rana	10		5	N		3.04.17	4.04.17	40	ICW	100				8.05.17	
19	N-CFD-RP	Research Project (for MSc)	Dr Panagiotis Tsoutsanis	10		100			05/17	08/17	50	THESIS OR	85 15				? ?	
20	N-CFD-D	Dissertation (for PgDip)	Dr Panagiotis Tsoutsanis	5		20			05/17	08/17	40 40				IPROJ OR	85 15	? ?	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
N-CFD-CFDAE	CFD for Aerospace Applications	Computational Fluid Dynamics	Autonomous Vehicle Dynamics and Control

7. How are the ILOs assessed?

The following assessment types are utilised:

The course uses a range of assessment types. In the MSc route, students are assessed through 5 written examinations, 15 assignments and 1 element of assessment by presentation or viva.

This approach has been adopted in order to achieve a careful balance between the delivery of fundamental knowledge which is better assessed through a written examination and development of CFD skills and expertise through practical assignments.

Majority of the assignments utilised in the course are based on practical CFD problems with emphasis on developing CFD skills and critical evaluation capability. Group assignments are designed to facilitate development of team working 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.)

For Example:

Award ILOs / Module No.	ILO 1.	ILO 2.	ILO 3.	ILO 4.	ILO 5.	ILO 6.	ILO 7.	ILO 8.	
98	ICW				EX	EX	ICW		
99	ICW1		ICW1	ICW2					

A. Postgraduate Certificate

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5				
1	ICW/EX								
2		ICW							
5	ICW	ICW	ICW						
6	ICW/EX	ICW/EX	ICW/EX						
7					ICW				
8	ICW	ICW	ICW						
9				ICW					
10				EX					

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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
3						ICW		
4					ICW	ICW		
12						ICW	ICW	ICW
13						ICW	ICW	ICW
14						ICW	ICW	ICW
15						ICW	ICW	ICW
16						ICW	ICW	ICW
17						ICW	ICW	ICW
18						ICW	ICW	ICW
20					IPROJ OR	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
19								THESIS OR	THESIS OR

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

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10

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(Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

9. **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.
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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: PgCert in Cost Engineering

Date of first publication/latest revision: July 2016

1. What is the course?

Course information

Course Title	PgCert in Cost Engineering
Course code	PCCSEPTC
Academic Year	2016/17
Valid entry routes	PgCert
Additional exit routes	Not Applicable
Mode of delivery	Part-time
Location of Study	Cranfield University
School(s)	School of Aerospace, Transport and Manufacturing
Theme	Manufacturing
Centre	Through-life Engineering Service Institute
Course Director	Dr Yuchun Xu
Awarding Body	Cranfield University
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 to three years part-time
Course Start Month(s)	Throughout the year

Institutions delivering the course

This course is delivered by The School of Aerospace, Transport and Manufacturing, Manufacturing Theme, Through-life Engineering Service Institute where the research interests include:

- Product Service Systems
- Product Life Cycle Costing
- Lean Production and Product Deployment
- Mathematical Modelling and Optimisation
- New Manufacturing Technologies
- Integrated Maintenance

Teaching and/or assessment is also provided by external institutions such as Rolls-Royce (UK) and BAE Systems (UK).

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:
- Develop cost engineers for industry.
- Provide help to the companies across sectors for cost reduction and management.

This programme is intended for the following range of students:
- Engineers, buyers and people with a commercial background eager to further their skills and knowledge in cost engineering.
- Graduates currently working in industry keen to extend their qualifications.
- Mid-career professionals who want to boost their career.
- Individuals with other qualifications 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 Cost Engineering**

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

ILO 1.   Understand the cost engineering principles and cost estimation techniques and procedures.
ILO 2.   Appreciation of how cost engineering is practiced within industry.
ILO 3.   Obtain the skills in conducting cost estimation and related work for real industry projects.
ILO 4.   Have the knowledge and understanding of parametric cost estimation.
ILO 5.   Have the knowledge and understanding of whole life cost.
ILO 6.   Understand how to model cost estimates for assessing the impact of risk.
ILO 7.   Understand how to estimate the cost of obsolescence.

4. How is the course taught?

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

- Interactive role plays.
- Students will be provided with pre-course and post-course reading and assessment as dictated by the individual course modules. It is intended that all lecture material will be made available through the University's virtual learning environments (VLEs).
- Research and private study is necessary for the successful completion of dissertation projects which also enhances knowledge and individual study abilities.
- Formative feedback on assessed assignments enhances the learning process and informal feedback on non-assessed individual exercises are also used.

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:

Manufacturing Industry Stream

Description	Credits
COMPULSORY MODULES:	
Module 1 Individual Dissertation Project (14)	10 20
ELECTIVE MODULES:	
Modules 2-10 (Select 3)	30
TOTAL:	60

Process Industry Stream

Description	Credits
COMPULSORY MODULES:	
Module 1 Individual Dissertation Project (14)	10 20
ELECTIVE MODULES:	
Modules 3-8, 11-13 (Select 3)	30
TOTAL:	60

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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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. <u>How is the course structured?</u>

This course is offered on a 3 years part-time basis. Students can register for the course at any time around a year, and they are encouraged to complete the course within 12 calendar months or as soon as possible.

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[1] 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).

[2] 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%).

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Course modules

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment							
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates		
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	I-TLS-CENG	Cost Engineering	Dr Yuchun Xu	32		10	Y		17/10/16	21/10/16	40	EX	100				12/12/16	Manufacturing resit exams will be during week commencing 18/09/17
2	I-CE-A2012	Information Management	Dr Christos Emmanouilidis	32		10	Y		05/12/16	09/12/16	40	EX	100				13/01/17	Manufacturing resit exams will be during week commencing 18/09/17
3	I-ICI-A1019	Technology and Prototyping	Matthew Collins	38		10	Y		10/10/16	14/10/16	40	ICW	100				29/10/16	Re-assessment date to be set by agreement of Course Director and

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Calendar			Minimum Mark[5] - 40% or 50%	Assessment						
								Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date		Independent Assessment		Multi-part Assessment			Submission dates	
												Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
																		Module Leader as/when required.
4	I-MNU-A1031	Enterprise Systems	Dr Essam Shehab	32		10	Y		17/10/16	21/10/16	40	EX	100				02/12/16	Manufacturing resit exams will be during week commencing 18/09/17
5	I-DFS-A1028	Whole System Design	Dr Mariale Moreno	27		10	Y		24/10/16	28/10/16	40	ICW	100				FT-19/11/16 PT-26/11/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required
6	I-KME-A1075	Knowledge System Design	Dr Ahmed Al-Ashaab	32		10	Y		31/10/16	04/11/16	40	GCW	100				09/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required
7	I-MNU-A1074	Business Process Analysis and Engineering	Dr Ip-Shing Fan	32		10	Y		31/10/16	04/11/16	40	ICW	100				16/12/16	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
8	I-GPD-A1507	Decision Engineering	Dr John Ahmet Erkoyuncu	32		10	Y		23/01/17	27/01/17	40	EX	100				17/02/17	Manufacturing resit exams will be during week commencing 18/09/17

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

Module Number	Module code	Title	Module Leader	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
9	I-MNU-A1034	Operations Management	Prof Charalampos (Harris) Makatsoris	32		10	Y		10/10/16	14/10/16	40	EX	100				11/11/16	Manufacturing resit exams will be during week commencing 18/09/17
10	I-MNU-A1021	Management of Technology and Innovation	Dr Leon Williams	32		10	Y		05/12/16	09/12/16	40	ICW	100				16/01/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required
11	I-OOT-A1085	Subsea Oil and Gas Exploitation	Dr Fuat Kara	32		10	Y		07/11/16	11/11/16	40	EX	100				06/12/16	September 2017
12	I-MNU-A1037	Project and Programme Management	Dr Ip-Shing Fan	32		10	Y		23/01/17	27/01/17	40	ICW	100				03/02/17	Re-assessment date to be set by agreement of Course Director and Module Leader as/when required.
13	N-PSE-PPO	Process Plant Operations	Dr Giorgos Kopanos	30		10	Y		10/10/16	14/10/16	40	EX	100				03/01/17	September 2017
14	I-CE-DISS	Individual Dissertation Project	Dr Yuchun Xu	20		20	N		01/03/17	31/08/17	40	ICW	100				31/08/17	

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-TLS-CENG	Cost Engineering	Through-life System Sustainment	Through-life System Sustainment
I-CE-A2012	Information Management	Through-life System Sustainment	Knowledge Management for Innovation, Through-life System Sustainment
I-ICI-A1019	Technology and Prototyping	Innovation and Creativity in Industry	Innovation and Creativity in Industry, Global Product Development and Management
I-GPD-A1507	Decision Engineering	Global Product Development and Management	Global Product Development and Management
I-MNU-A1031	Enterprise Systems	Management and Information Systems	Engineering & Management of Manufacturing Systems, Management and Information Systems, Knowledge Management for Innovation, Manufacturing Consultancy
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, Manufacturing Consultancy, Aerospace Manufacturing, Cyber-Secure Manufacturing
I-DFS-A1028	Whole System Design	Design and Innovation for Sustainability	Design and Innovation for Sustainability, Digital Design and Strategic Communication, Innovation and Creativity in Industry, Design Strategy and Leadership
I-MNU-A1021	Management of Technology and Innovation	Engineering and Management of Manufacturing Systems	Engineering & Management of Manufacturing Systems
I-KME-A1075	Knowledge System Design	Knowledge Management for Innovation	Knowledge Management for Innovation
I-MNU-A1074	Business Process Analysis and Engineering	Management and Information Systems	Management and Information Systems
I-OOT-A1085	Subsea Oil and Gas Exploitation	Offshore and Ocean Technology	Offshore and Ocean Technology with Subsea Engineering, Offshore and Ocean Technology with Materials Engineering, Offshore and Ocean Technology with Risk Management, Offshore and Ocean Technology with Pipeline Engineering, Offshore and Ocean Technology with

			Renewable Energy
I-MNU-A1037	Project and Programme Management	Management and Information Systems	Management and Information Systems
N-PSE-PPO	Process Plant Operations	Process Systems Engineering	Process Systems Engineering, Carbon Capture and Storage, Flow Assurance for Oil and Gas Production, Biofuels Process Engineering

7. **How are the ILOs assessed?**

The following assessment types are utilised:

The course uses a range of assessment types. Students can expect to have exams for one compulsory module, and exams or assignment for three optional modules. The course is assessed as two elements:

- Taught modules (67%) are assessed by assessment (including coursework, which focuses on application of principles studied) or examination;
- Individual dissertation project (33%) is assessed by a dissertation.

This approach has been adopted because:

Each taught module justifies the effective way for assessing the module either as exam or assignment; and the individual dissertation project is assessed by dissertation, which is sufficient and effective to reflect the learning outputs from students.

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**

Manufacturing Industry Stream

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	IIO7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
14							

Process Industry Stream

Award ILOs / Module No.	ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	IlO7
1							
3							
4							
5							
6							
7							
8							
11							
12							
13							
14							

<u>**CROSS-MODULAR ASSESSMENT**</u> (including any assessment which rests outside an individual module)

Title	Modules Covered	Assessment	
		Type	Weight (%)

8. <u>How will the University assure the quality of the provision?</u>

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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7

(External Examining) which emphasises that 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.

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

The course is designed to equip the students with necessary knowledge and key skills to work successfully for cost management in real project environments. The course normally can help students to move up to a higher position in Cost Engineering or related topics. The close collaboration of the course with industry also improves the employability of the students immediately.

In addition, the qualification obtained will support their professional development.

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:	PgCert Cyber Defence and Information Assurance – Chevening Cyber Policy Course

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Date of first publication/latest revision: 20/01/17

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1. What is the course?

Course information

Course Title	PgCert Cyber Defence and Information Assurance – Chevening Cyber Policy Course variant
Course code	PCCDIPTR
Academic Year	2016/17
Valid entry routes	PgCert Cyber Defence and Information Assurance (CDIA)
Additional exit routes	N/A
Mode of delivery	Part-time Flexible learning
Location of Study	Shrivenham
School(s)	Cranfield Defence and Security
Theme	Defence and Security
Centre	Electronic Warfare, Information and Cyber
Awarding Body	Cranfield University
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.
UK Qualifications Framework Level	QAA FHEQ level 7 (Masters)
Benchmark Statement(s)	N/A
Registration Period(s)	Part-time PgCert - two years,

available	
Course Start Month(s)	March

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 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 Sir Edmund Burton, and is supported by the Cabinet office and the Office of Cyber Security and Information Assurance.
- The Chevening PgCert programme is delivered with the sponsorship of the Foreign and Commonwealth Office and Tata Consulting Service.

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 body.

2.   What are the aims of the course?

Cranfield University offers this programme in order to achieve the following aim:

- To develop professionals who can effectively manage and exploit the threats and opportunities of cyberspace at the organisational level.

This programme is intended for the following range of students:

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

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 an organisation's Information Security and Information Assurance policy, strategy and plans, with a view to improvement.
- ILO 2.   Critically appraise approaches to measuring risk.

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ILO 3.   Evaluate the opportunities and limitations afforded by emergent security technologies.

ILO 4.   Develop security requirements in the context of acquisition.

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 technologies, processes and behavioural change programmes and plan for improvement in an organisational context.

4. <u>How is the course taught?</u>

The students will take six compulsory modules associated with the PgCert CDIA. Each module is structured around 18 hours residential and 80 hours of private study - some of which will be self-directed learning on the VLE. Online interaction will be assessed as described in section 3 and 5.

Knowledge and skills will be taught through a mix of classroom teaching and exercises utilising cases and scenarios. Opportunities for personal development in respect of skills will be developed from the outset. The main vehicle for developing skills will be through tutorial, online collaborative activity and coursework where skills will be incrementally developed.

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

- Within the 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.
- Guidance on personal development planning and access to a course coach and learning support officer
- Full 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. <u>What do students need to achieve in order to graduate?</u>

Notwithstanding University Regulations and the authorities and powers exercised by examiners, students will normally need to demonstrate achievement in the following elements of the course. 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:	
Understanding Risk	10
Cyber Defence - Governance and Management	10
Cyber Attack – Threats and Opportunities	10
Social Technologies	10
The Human Dimension	10
Critical networks and Process Control	10
ELECTIVE MODULES:	
N/A	
TOTAL:	**60**

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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1][2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> 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 <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).

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[1] 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).

[2] 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%).

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6. How is the course structured?

 Chevening Cyber Policy Variant. The Chevening TCS Cyber Policy Course has the PgCert in Cyber Defence and Information Assurance as its core element. The course will be offered on a part-time basis and delivered in a flexible learning style over a period of 6 months, twelve weeks of which will be run in the UK in a concentrated period. The other weeks will be delivered with the support of the VLE, accessible from India.

Course modules

The following modules outline all parts of the programme leading to a **PgCert**.

Module Number	Module code	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Independent Assessment		Multi-part Assessment			Submission dates	
										Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
1	R-DEFCY-UR Occ B	Understanding Risk	36	36	10	N/a	03 Apr 17	07 Apr 17	40			100	RP* ICW	30 70	29 May 17 22 May 17	05 Dec 17 02 Jan 18
2	R-DEFCY-CD Occ B	Cyber Defence - Governance and Management	36	36	10	N/a	24 Apr 17	28 Apr 17	40			100	RP* ICW	30 70	29 May 17 4 Sep 17	05 Dec 17 02 Jan 18

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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

Module Number	Module code	Title	Contact hours[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
3	R-DEFCY-CA Occ B	Cyber Attack – Threats and Opportunities	36	TBC	10	N/a	1 May 17	5 May 17	40			100	RP$ ICW	30 70	04 Jul 17 25 Sep 17	27 Mar 18 10 Apr 18
4	R-DEFCY-CN	Critical Networks and Process Control	36	0	10	24 Apr 17	15 May 17	17 May 17	40			100	RP+ ICW	30 70	11 Jul 17 01 Aug 17	10 Jul 18 31 Jul 18
5	R-DEFCY-HD	The Human Dimension	36	0	10	01 May 17	17 May 17	19 May 17	40			100	RP+ ICW	30 70	11 Jul 17 08 Aug 17	10 Jul 18 07 Aug 18
6	R-DEFCY-ST Occ B	Social Technologies	36	0	10	N/a	29 May 17	02 Jun 17	40			100	RP$ ICW	30 70	04 Jul 17 17 Jul 17	27 MAR 18 17 APR 18

Reflective Portfolios:
 * = One RP to cover both modules

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

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$ = One RP to cover both modules

+ = One RP to cover both modules

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

Please list all modules that are shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
R-DEFCY-CD	Cyber Defence - Governance and Management	MSc CDIA	DCMP
R-DEFCY-UR	Understanding Risk	MSc CDIA	DCMP
R-DEFCY-CA	Cyber Attack – Threats and Opportunities	MSc CDIA	DCMP
R-DEFCY-CN	Critical Networks and Process Control	MSc CDIA	DCMP
R-DEFCY-HD	The Human Dimension	MSc CDIA	DCMP
R-DEFCY-ST	Social Technologies	MSc CDIA	DCMP

7. 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: As per the module descriptors, each 10-credit taught module will require two pieces of course work consisting of one large assignment and one smaller relating to their learning journey. As part of each reflective portfolio the student will undertake a self-marking exercise, where they will be asked to highlight the strengths and weaknesses of their work and any areas on which they need specific feedback. This exercise contributes to the persistent requirement for self-reflection throughout the course and is both beneficial as an educational tool and as a personal reflective skill to be used in their professional practice.

Please note that the maximum classification level for assignment submission is Secret.

Assessment and ILO Mapping

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

A. Postgraduate Certificate

Award ILOs Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7
1:UR		ICW					

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Award ILOs Module No.	ILO 1	ILO 2	ILO 3	ILO 4	ILO 5	ILO 6	ILO 7
2: CDGM	ICW			ICW			
3: CATO			ICW				
4: CNPC						ICW	
5: HD							ICW
6: ST					ICW		

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

Title	Modules Covered	Assessment	
		Type	Weight (%)
Reflective Portfolio	Cyber Defence Governance and Management	RP	30%
	Understanding Risk	RP	30%
Reflective Portfolio	Cyber Attack - Threats and Opportunity	RP	30%
	Critical Networks and Process Control	RP	30%
Reflective Portfolio	The Human Dimension	RP	30%
	Social Technology	RP	30%

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

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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.

9. **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.

COURSE TITLE:	MSc in Cyber-Secure Manufacturing

Date of first publication/latest revision:	30/06/2016

1. What is the course?

Course information

Course Title	MSc in Cyber-Secure Manufacturing
Course code	MSCMIFTC, PDCMIFTC, PCCMIFTC
Academic Year	2016/2017
Valid entry routes	MSc, PgDip, PgCert
Additional exit routes	Not Applicable
Mode of delivery	Full-time
Location of Study	Cranfield Campus
School(s)	School of Aerospace, Transport, and Manufacturing
Theme	Manufacturing
Centre	Manufacturing Informatics Centre
Course Director	Dr Hongmei He
Awarding Body	Cranfield University
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, Full-time PgCert - one year, Full-time PgDip - one year
Course Start Month(s)	October

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 research areas in the Manufacturing theme. Dr Hongmei He, Dr Jorn Mehnen, Prof Ashutosh Tiwari, Professor Raj Roy, etc. have been engaging the research of cybersecurity and IoT 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)

This course is expected to be accredited after the first year. It is the intention to extend the manufacturing programme accreditation for the Institution of Mechanical Engineers (IMechE), Institution of Engineering and Technology (IET) and the Royal Aeronautical Society (RAes), British Computer Society (BCS). We also plan to seek accreditation for GCHQ and the Institute of Information Security Professionals.

2. <u>What are the aims of the course?</u>

The aim of the course is to develop the next generation of manufacturing engineers who are able to protect manufacturing systems and machines against cyber threats.

The objective is to enable students to use cutting-edge technologies in IoT, Big Data, 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 academically at Masters Level.

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 completing this course, and achieving the associated award, a diligent student should be able to:
- ILO 1. Analyse traditional and modern manufacturing environments and their operations, and evaluate their engineering challenges with regards to cybersecurity.
- ILO 2. 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.
- ILO 3. Evaluate cloud architecture, properties, management services, security challenges and risks associated with different cloud deployment models.

ILO 4. Evaluate advanced technologies to retrieve data from cloud and discover new information from big data, and manage data protection in cloud manufacturing.

ILO 5. Setup up-to-date technologies and simulations to detect and prevent system intrusion, improve incident response and disaster recovery, assess cyber risks.

ILO 6. Estimate the cost of cyber security solutions for the protection of machines and equipment in manufacturing systems.

B. Postgraduate Diploma

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

ILO 7. 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.

ILO 8. 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.

ILO 9. Identify research questions, develop project objectives and deliverables, and plan and execute a work programme with reference to key project management processes.

ILO 10. Select and justify methodologies to solve real world problems in manufacturing and/or cyber security for manufacturing, and collect and 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:

ILO 11. 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?

Students will be supported in their learning and personal development through joining different types of learning activities, including lectures, industry seminars, course work, lab experiments, group project and individual project. In order to improve the learning performance, Enquiry-Based Learning (EBL) activities will be introduced in some lectures, such as group discussion, group poster, group presentation, and case study.

- 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.

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, 4 and 7	40
ELECTIVE MODULES:	
Modules: 2, 5, 6 and 8	20
RECOMMENDED MODULE:	
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:

Description	Credits
COMPULSORY MODULES:	
Modules: 1-8 Module 9: Group Project for Full Time Students	80 40
RECOMMENDED MODULE:	
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:

Description	Credits
COMPULSORY MODULES:	
Modules: 1-8 Module 9: Group Project for Full Time Students Module 10: Individual Research Project	80 40 80
RECOMMENDED MODULE:	
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 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 <u>not</u> have discretion to overrule this limit, but can refer a case to Senate's Education Committee);[1] [2]
- **For Taught Assessments,** the minimum mark for each individual taught assessment <u>on the first attempt</u> for the significant majority of the taught assessments, noting that:
  - o 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);
  - o 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);
  - o 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?

MSc/ PgDip/PgCert students register for the course in 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). Each taught module will take one week, and will be assessed by exam or coursework.

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[1] 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).

[2] 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%).

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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7](100%)	Type of Assessment	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
									Calendar				**Independent Assessment**		**Multi-part Assessment**		**Submission dates**	
0	I-MAN-INWK	Induction	Dr Konstantinos Salonitis	22		0	Y		03/10/16	07/10/16	N/A	AO	N/A				N/A	
1	I-CMI-MMSC	Modern Manufacturing and Security Challenges	Prof Tetsuo Tomiyama	32	4	10	N		1010/16	14/10/16	50	EX	100				w/c 02/01/17	September 2017
2	I-MNU-A1034	Operations Management	Prof Charalampos (Harris) Makatsoris	32		10	Y		17/10/16	21/10/16	50	EX	100				11/11/16	September 2017
3	I-CMI-SSA	Secure IoT and System Architecture	Dr Jorn Mehnen	32	12	10	N		31/10/16	04/11/16	50	ICW	100				30/11/16	September 2017

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[3] Please note that all contact hours are indicative and represent scheduled teaching, which is subject to minor changes and variation at short notice

[4] Visiting Lecturer = a member of staff (with RTS) but not on a permanent contract (does not include those acting as occasional guest speakers)

[5] 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.

[6] For **independent assessments** please record type and weighting of each separate piece of assessment individually.

[7] For **multi-part assessments** please record the overall weighting of module which should be 100%.

[8] 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.

[9] 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[3]	Total hours delivered by Visiting Lecturers[4]	Credits	Is the module shared? Y/N	Module Start Date (eg Pre-course task)	'Residential' Start Date	'Residential' End Date	Minimum Mark[5] - 40% or 50%	Type of Assessment (Independent)	Weighting within module6 (%) of Independent assessments	Weighting within module of multi-part assessments[7] (100%)	Type of Assessment (Multi-part)	Weighting of individual elements of multi-part assessment[8]	Assessment Submission and/or exam date[9]	Assessment / Exam Retake date
4	I-CMI-SCM	Secure Cloud Manufacturing	Dr Yifan Zhao, Dr Christopher Turner	32	6	10	N		14/11/16	18/11/16	50	ICW	100				16/12/16	September 2017
5	I-MNU-A1027	Manufacturing Systems Engineering	Prof Charalampos (Harris) Makatsoris	32		10	Y		21/11/16	25/11/16	50	ICW	100				09/01/17	September 2017
6	I-CMI-DMT	Data Mining Technology for Cyber Threat Identification	Dr Hongmei He	32	2	10	N		28/11/16	02/12/16	50	EX	100				w/c 09/01/17	September 2017
7	I-CMI-SMTS	Security of Machine Tool Systems	Dr Hongmei He	33	9	10	N		16/01/17	20/01/17	50	ICW	100				16/02/17	September 2017
8	I-CMI-CTPM	Cyber Thinking and Practice in Manufacturing	Jeremy Hilton, Lorraine Dodd	32	0	10	N		12/12/16	16/12/16	50			100 MULTI	GPRES ICW	30 70	14/12/16 16/01/17	September 2017
9	I-MNU-GRPP	Group Project for Full Time Students	Dr David Ayre	20		40	Y		06/02/17	28/04/17				80 MULTI 20 MULTI	GPRES GPROJ ICW observed behaviour	80 MULTI 20 MULTI	28/04/17	
10	I-MNU-THESIS	Individual Research Project	Dr Yuchun Xu	20		80	Y		02/05/17	04/09/17		THESIS OR	90 10				04/09/17	

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 shared with another existing course.

Module code	Module title	Course that owns the module	Course(s)/programme(s) that share the module
I-MAN-INWK	Induction	Engineering and Management of Manufacturing Systems	Engineering and Management of Manufacturing Systems, Management and Information Systems, Manufacturing Consultancy, Knowledge Management for Innovation, Aerospace Manufacturing, Global Product Development and Management
I-MNU-A1034	Operations Management	Engineering and Management of Manufacturing Systems	Engineering and Management of Manufacturing Systems, Manufacturing Technology and Management, Global Product Development and Management, Management and Information Systems, Manufacturing Consultancy, Cost Engineering, Aerospace Manufacturing
I-MNU-A1027	Manufacturing Systems Engineering	Engineering and Management of Manufacturing Systems	Engineering and Management of Manufacturing Systems, Manufacturing Consultancy, Aerospace Manufacturing
I-MNU-GRPP	Group Project for Full Time Students	Manufacturing Systems and Management Programme	Engineering and Management of Manufacturing Systems, Management and Information Systems, Knowledge Management for Innovation, Aerospace Manufacturing, Global Product Development and Management, Manufacturing Consultancy
I-MNU-THESIS	Individual Research Project	Manufacturing Systems and Management Programme	Engineering and Management of Manufacturing Systems, Management and Information Systems, Knowledge Management for Innovation, Aerospace Manufacturing, Global Product Development and Management, Manufacturing Consultancy

7. 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", "Security 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.
1	EX					
2	EX					
3		ICW			ICW	ICW
4			ICW	ICW		
5	ICW				ICW	
6				EX		
7		ICW	ICW		ICW	ICW
8	MULTI			MULTI		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.	ILO7.	ILO8.	ILO9.	ILO10.
4	ICW			
6	EX			
7		ICW		
8		MULTI		
9		MULTI	MULTI	MULTI

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			

8. 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 acts as advisor to the Panel. Proposals are reviewed in line with the Quality Assurance Agency for Higher Education (QAA) Quality Code, in particular Chapter B1 (Programme Design and Approval) and in the case of partnership arrangements in accordance with Chapter B10 (Managing Higher Education with Others). 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. For collaborative partnerships, in addition to the Annual Reflective Review there is an Annual Operating Statement and a 5 year review known as a Focussed Review which looks at each course in depth. In addition occasional site inspection visits are made.

Each course has at least one External Examiner who monitors all aspects of the assessment process. This is in line with the guidance provided by the QAA particularly in Chapter B7 (External Examining) which emphasises that 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.

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

With the capacity and ability of our graduates, our graduates have a diversity of job opportunities, mainly in the following job markets**:**

Jobs in Manufacturing Informatics and Manufacturing Engineering: conducted by labour market analytics and consulting firm Burning Glass[10], in the future, engineering and advanced manufacturing is one of main job markets that graduates are looking to. 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 cybersecurity experts grew 73% during the five years from 2007 to 2012, according to Burning Glass[11]. Also, 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[12]. The global Cyber Security market size is estimated to grow from $106.32 Billion in 2015 to $170.21 Billion by 2020, at a Compound Annual Growth Rate (CAGR) of 9.8%[13].

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 whopping 4.5 million developers by 2020, reflecting a 57% compound annual growth rate and a massive market opportunity[14].

Jobs in cloud computing: One of the most evident effect of the shift to cloud is that there is growing demand for a more balanced focus among 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".

Jobs in Big Data Analytics: Cloud computing will get even more importance in the future, where massive storage capacity and calculating capacity will be required by Big Data, a field that many IT Executives agrees as being a major trend in 2014.

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[10] http://www.burning-glass.com/in-the-news/

[11] Steve Rosenbush, Demand for Cyber Security Jobs Is Soaring, The Wall Street Journal, March 4, 2013, 3:18 PM ET

[12] http://cybersecuritychallenge.org.uk/education/university-mentoring-and-cyber-camps/

[13] Cyber Security Market by Solution (IAM, Encryption, DLP, Risk and Compliance Management, IDS/IPS, UTM, Firewall, Antivirus/Antimalware, SIEM, Disaster Recovery, DDOS Mitigation, Web Filtering, and Security Services) - Global Forecast to 2020, marketsandmarkets.com, June 2015, Report Code: TC 3485.

[14] 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.

Cyber-Secure Manufacturing COURSE SPECIFICATION
QA&E Version: 2.0 October 2016   Course / SAS Version: