Programme Specification

MSc Space Systems Engineering (2020-21)

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of Study	Full-time
Duration in years	1
Accreditation details	Royal Aeronautical Society (RAeS) and Institution of Mechanical Engineers (IMechE)
Final award	Master of Science (MSc)
Name of award	MSc Space Systems Engineering
Interim Exit awards	Postgraduate Certificate
	Postgraduate Diploma
FHEQ level of final award	Level 7
Programme code	3893
QAA Subject Benchmark or other external reference	Engineering 2015
Programme Lead	Zhiwei Hu

Programme Overview

Brief outline of the programme

The multidisciplinary nature of space systems engineering requires people with a range of skills. The MSc in Space Systems Engineering incorporates the design of all the elements that make up a space mission providing a solid grounding for those seeking a career in the space industry.

The taught element of the programme consists of 8 modules totalling 60 ECTS/120 CATS and is followed by a substantial research project leading to a dissertation (30 ECTS/60 CATS). The specific educational aims are outlined in Educational Aims of the Programme, below.

Please note: As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our Disclaimer to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's programme validation process which is described in the University's quality handbook.

Your contact hours will vary depending on your module/option choices. Full information about contact hours is provided in individual module profiles.

Teaching and learning

The different subject matter of the modules lends itself to different teaching and learning techniques. These include lectures, tutorials, individual and group projects and practical exercises. You are encouraged throughout to contribute your own professional experiences and thoughts to the learning of the whole class through a free exchange of ideas.

Many modules include assessed coursework assignments, which require you to carry out a substantial study of selected topics, either as individuals or in groups, leading to considerable depth of understanding and specialist knowledge. Assessment is designed to show that you can rationally use taught material and have a fundamental understanding of the subject matter. Feedback on progress is given to students on all submitted work.

Assessment

Testing of the knowledge base is through a combination of unseen written examinations and assessed coursework in the form of problem solving exercises, assignments, design exercises, and individual and group projects.

The assessment on the programme is undertaken through a variety of methods, enabling students to experience different ways to demonstrate their learning and understanding.

Special Features of the programme

As a student of this programme you will be integrated into the Aeronautics and Astronautics Department and will, for example, be encouraged to attend research seminars and guest lectures related to astronautics and spacecraft engineering. The programme includes a module (SESA6068 Concurrent Engineering Design) in which you will conduct a spacecraft design exercise as a group project activity.

This programme has been accredited by the Royal Aeronautical Society (RAeS) and the Institute of Mechanical Engineers (IMechE) on behalf of the Engineering Council as meeting the requirements for Further Learning for registration as a Chartered Engineer (CEng). Candidates must hold a CEng accredited BEng/BSc (Hons) undergraduate first degree to comply with full CEng registration requirements.

As an accredited programme in the field of aerospace engineering it qualifies for the UK Government's Aerospace MSc Bursary Scheme. For further details of this scheme please see: http://www.raeng.org.uk/.

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Educational Aims of the Programme

We aim to enable you to develop a thorough professional knowledge of space systems engineering. The programme has been configured for graduates, or similarly qualified individuals, with an engineering or scientific background, who desire to specialise in the area of space systems engineering for further research or career-based reasons.

This programme will focus on the design of all the elements that make up a space mission. The programme uses an integrated approach to the complete design of a total space system and shows how the various component subsystems function and interface with each other. The detailed aims of the programme are to:

- develop an advanced knowledge of space systems engineering.
- develop an understanding of the use, and an appreciation of the limitations, of computational analysis and design tools in the development of a space mission and related hardware.
- enable you to acquire advanced knowledge and practical skills needed for a professional career in the space industry providing you with relevant specialist knowledge and skills.
- enhance your transferable skills, including critical analysis, problem solving, project management, decision making, leadership, and communication by oral, visual and/or written means.
- equip you with specialist knowledge, scientific and technical expertise and research skills for further research and/or application in the design of Space Systems.

The MSc programme provides the opportunities for you to achieve and demonstrate the learning outcomes described below.

Programme Learning Outcomes

The programme provides opportunities for you to develop and demonstrate knowledge and understanding, qualities, skills and other attributes in the areas detailed below. The programme learning outcomes have been developed with reference to the Subject Benchmark Statement for engineering and the Characteristics Statement for Master's Degrees. The former of these is aligned with the Engineering Council publication Accreditation of Higher Education Programmes (AHEP): UK Standard for Professional Engineering Competence (third edition)

Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

Science and Mathematics

Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). On graduation you will have achieved:

SM7. A comprehensive understanding of the relevant scientific principles of Space Systems Engineering

SM8. A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of Space Systems Engineering

SM9. Understanding of concepts relevant to Space Systems Engineering, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects

Engineering analysis

Engineering analysis involves the application of engineering concepts and tools to the solution of practical problems. On graduation you will have achieved:

EA5. Ability to use fundamental knowledge to investigate new and emerging technologies

EA6M. Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations

EA7. Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods

Design

Design at this level is the creation and development of an economically viable product, process or system to meet a defined need. It involves significant technical and intellectual challenges and can be used to integrate all engineering understanding, knowledge and skills to the solution of real and complex problems. On graduation you will have:

D9. Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies

D10. Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations

D11. Ability to generate an innovative design for products, systems, components or processes to fulfil new needs

Economic, legal, social, ethical and environmental context

Engineering activity can have impacts on the environment, on commerce, on society and on individuals. Graduates therefore need the skills to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including:

EL8. Awareness of the need for a high level of professional and ethical conduct in engineering.

EL9. Awareness that engineers need to take account of the commercial and social contexts in which they operate

EL10. Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of Space Systems Engineering

EL11. Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate

EL12. Awareness of relevant regulatory requirements governing engineering activities in the context of Space Systems Engineering

EL13. Awareness of and ability to make general evaluations of risk issues in the context of Space Systems Engineering, including health & safety, environmental and commercial risk

Engineering practice

This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. On graduation you will have achieved:

P9. A thorough understanding of current Space Systems Engineering practice and its limitations, and some appreciation of likely new developments

P10. Ability to apply engineering techniques taking account of a range of commercial and industrial constraints

P11. Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader

P12. Advanced level knowledge and understanding of a wide range of engineering materials and components

Additional general skills

On graduation you will have developed transferable skills, additional to those set out in the other learning outcomes, that will be of value in a wide range of situations, including the ability to:

G1. Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities

G2. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

G3. Monitor and adjust a personal programme of work on an on-going basis

G4. Exercise initiative and personal responsibility, which may be as a team member or leader

Teaching and Learning Methods

Intellectual skills are developed through teaching and learning activities. Analysis and problem-solving skills are further developed through regular problem sheets issued by module lecturers and through small group teaching. Experimental, research and design skills are further developed through coursework exercises, laboratory work, and design and research projects. Individual feedback is provided on all work submitted. Appreciation of the practical applications of these skills is provided by interaction with industry through visiting lectures and industrial visits.

Assessment methods

Analysis and problem-solving skills are assessed through unseen written examinations and problem-based exercises. Experimental, research and design skills are assessed through laboratory reports, coursework exercises, project reports and oral presentations. Skills are formatively assessed through written reports and oral presentations, practical and laboratory reports. Summative assessment is through unseen examinations, extended essays, written reports and oral presentations, and completion of a research project.

Programme Structure

The programme structure table is below:

Information about pre and co-requisites is included in individual module profiles.

Where optional modules have been specified, the following is an indicative list of available optional modules, which are subject to change each academic year. Please note in some instances modules have limited spaces available.

The list below reflects the modules that are planned to be offered in 2020/21 and is subject to minor alteration from year to year. Each module has an ECTS/CATS value of 7.5 ECTS/15 CATS or 15 ECTS/30 CATS at level 6 or 7. A maximum of 15 ECTS/30 CATS can be taken at level 6.

A 7.5 ECTS/15 CATS module has a total load of 150 notional hours, typically made up of 36 lectures, laboratory work, self-learning and assessment. Some modules are assessed based solely on examinations; others involve significant project work. Syllabuses indicate the broad outline of content for each subject. Detailed elements of content may change from year to year depending on the emphasis deemed necessary by the lecturer and the need to keep modules up to date.

Over Semester 1 and 2, students must study modules totalling 60 ECTS/120 CATS, with a minimum of 45 ECTS/90 CATS credits at level 7.

Note: It is possible that module prerequisites may be omitted at the discretion of the module lecturer depending on previous experience. Modules may be taken from Faculties other than the Faculty of Engineering and Physical Sciences only by prior arrangement with the Programme Coordinator.

Compulsory modules

The following modules are compulsory for this theme and total 82.5 ECTS/165 CATS. All modules are level 7 except as indicated.

Code	Module Title	ECTS	Type
SESA3039	Advanced Astronautics	7.5	Compulsory
SESA6080	Concurrent Engineering Design	7.5	Compulsory
SESA6079	Space Systems Engineering	7.5	Compulsory
SESA6081	Spacecraft Instrumentation	7.5	Compulsory
SESA6076	Spacecraft Orbital Mechanics	7.5	Compulsory
SESA6071	Spacecraft Propulsion	7.5	Compulsory
SESA6059	Spacecraft Structural Design	7.5	Compulsory

Core modules

Code	Module Title	ECTS	Type
FEEG6012	MSc Research Project	30	Core

Optional modules

Please select a total of 7.5ECTS/15 CATS from the following lists of level 7 modules. Please bear in mind the balance of modules between the semesters (note most mandatory modules are in Semester 1).

The following is an indicative list of available optional modules, which are subject to change each academic year. Please note in some instances modules have limited spaces available.

Code	Module Title	ECTS	Type
FEEG6005	Applications of CFD	7.5	Optional
SESA6074	Hypersonic & High Temperature Gas Dynamics	7.5	Optional
FEEG6007	Principles of Photovoltaics, Fuel Cells and Batteries	7.5	Optional
SESA3038	Space Environment	7.5	Optional
FEEG6006	Systems Reliability	7.5	Optional
SESA6061	Turbulence	7.5	Optional

Progression Requirements

The programme follows the University's regulations for ***Progression, Determination and Classification of Results : Undergraduate and Integrated Masters Programmes*** and ***Progression, Determination and Classification of Results: Postgraduate Master's Programmes*** Any exemptions or variations to the University regulations, approved by AQSC are located in ***section VI of the University Calendar***.

Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area.

The University provides:

- library resources, including e-books, on-line journals and databases, which are comprehensive and up to date; together with assistance from Library staff to enable you to make the best use of these resources
- high-speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices; laptops, smartphones and tablet PCs via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations.
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- standard ICT tools such as Email, secure filestore and calendars.
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move.
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Hartley Library.
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling. Support includes daily Drop In at Highfield campus at 13.00 – 15.00 (Monday, Wednesday and Friday out of term-time) or via on-line chat on weekdays from 14.00 – 16.00. Arrangements can also be made for meetings via Skype.
- assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia).
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards
- Career and Employability services, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV
- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls and in the local community, (18.00-08.00)
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University.
- opportunities for extracurricular activities and volunteering

- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline.

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular School or discipline area.

Associated with your programme you will be able to access:

- Induction programme for orientation, introduction of the programme and staff, and dissemination of materials.
- Student Coursebook, including guidance on selection of study programmes.
- Administrative and academic material on the School, Programme and individual module web sites and/or Blackboard.
- A personal academic tutor to assist with organisational and personal matters. This role is taken over by the project supervisor when the research project starts.
- Careers advice and dissemination of available job advertisements. Personal email account and email access to staff via University system.
- Relevant specialist software on University clusters of computers.
- Formal progress monitoring during research project.
- Support for international students.

Career Opportunities

This programme will prepare you well for a career in a research and development across a range of industries, including aerospace, either in the UK or abroad. Alternatively, the programme provides an excellent platform for further study leading towards a PhD in this area of research.

Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

- Completing student evaluation questionnaires for each module of the programme.
- Acting as a student representative on various committees, e.g. Staff/Student Liaison Committees, School Programmes Committee OR providing comments to your student representative to feedback on your behalf.
- Serving as a student representative on Faculty Scrutiny Groups for programme validation.
- Taking part in programme validation meetings by joining a panel of students to meet with the Faculty Scrutiny Group.

Further details on the University's quality assurance processes are given in the *Quality Handbook.*

External Examiner(s) for the programme

Name: Dr Matthew Stickland - University of Strathclyde

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality

assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their Personal Academic Tutor in the first instance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if they take full advantage of the learning opportunities that are provided. More detailed information can be found in the programme handbook.

Appendix 1:

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme also have to pay for:

Additional Costs

Type	Details
Anything else not covered elsewhere	Additional Costs Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.
Approved Calculators	Students will require a scientific calculator. This will need to be purchased by the student. Students may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University specifies permissible models from time to time and these may be purchased from any source.
Design equipment and materials	Standard construction/modelling materials will be provided where appropriate, unless otherwise specified in a module profile. For customisation of designs/models calling for material other than standard construction/ modelling materials, students will bear the costs of such alternatives.
Field Equipment and Materials	A number of essential items will be provided to you e.g.: field notebook(s); compass-clinometer; geological hammer; steel tape measure; map case; pocket lens (x 10); safety helmet; safety goggles; bottle of dilute hydrochloric acid. If items provided are lost replacements can be purchased from: However, you will need provide yourselves with a ruler; a pair of compasses; set squares; protractor; pencils (including coloured); eraser; calculator, penknife. These can be purchased from any source.
Optional Visits (e.g. museums, galleries)	Some modules may include additional optional visits. You will normally be expected to cover the cost of travel and admission, unless otherwise specified in the module profile. For costs related to study abroad please see the relevant module profile.
Printing and Photocopying Costs	In some cases, coursework and/or projects may be submitted electronically. Where it is not possible to submit electronically students will be liable for printing costs, which are detailed in the individual Module Profile and can be found in Appendix 2. Reasonable expenses for travel and materials of up to £300 may be reclaimed through the Faculty Student Office. For project costs in excess of £300 students should discuss possible sources of funding with their supervisor and should not proceed with any expenditure until a further funding source has been agreed. The printing costs associated with dissertation are the responsibility of the student (FEEG6012) Students are expected to cover the costs associated with the printing and binding of reports, including any drawings and graphic presentations. Two copies will need to be submitted. Depending on the quality of printing and

	binding chosen students can expect to pay approximately £25-30 per copy, totalling approximately £50-60 for both copies.(FEEG6012)
Stationery	You will be expected to provide your own day-to-day stationary items, e.g. pens, pencils, notebooks, etc.).
Textbooks	Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as optional background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.