UNIVERSITY of BRADFORD

Faculty of Engineering and Informatics

MSc Satellite Systems Engineering Programme Specification

Academic Year: 2022-23

Degree Awarding Body: The University of Bradford

Final and interim awards at Higher Education Qualifications Framework (FHEQ) Level 7:

Degree of Master of Science in Satellite Systems Engineering;

Degree of Master of Science in Engineering (Satellite Systems);

Postgraduate Diploma in Satellite Systems Engineering;

Postgraduate Certificate in Satellite Systems Engineering

Programme Admissions: September and January

Programme duration: 1 year full-time

QAA Subject Benchmark: Engineering (2019)

Date approved by Senate: April 2022

Please note: This programme specification has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but changes may occur given the interval between publishing and commencement of teaching. Any change which impacts the terms and conditions of an applicant's offer will be communicated to them. Upon commencement of the programme, students will receive further detail about their course and any minor changes will be discussed and/or communicated at this point.

Minor Modification Schedule

1. April 2022: Initial publication of new programme. Specification reformatted and made accessible.

Introduction

4th October 1957 is the day that marked the beginning of the Space Age: the first man-made satellite, Sputnik, was launched into space by the Soviet Union and transmitted a signal to Soviet scientists on the ground for three weeks. More than 60 years on, space missions have been extended from purely scientific exploration to now providing indispensable navigation, environmental monitoring, communication and TV systems worldwide.

Satellites have been one of the government's eight great technologies since 2010. It is one of the UK's fastest growing sectors and a vital part of the UK's economy, with a projected annual income of over £16.4 billion and employing over 45,000 people in diverse and exciting roles as scientists, engineers, entrepreneurs and innovators in the UK. The global space economy is projected to grow to £490 billion by 2030.

The critical role that space plays in our daily lives has often been taken for granted. Satellites orbiting at a distance above 160 kilometres from the Earth connect us with our friends, families, and colleagues, monitor the climate and forecast the weather, enable road and ocean navigation, support homeland security and disaster relief and many more. By gathering CO2 emission data efficiently and routinely on a global scale, satellites can hold countries to their emissions promises made at COP26 summit.

Artificial intelligence (AI) is also gaining momentum and is impacting our daily lives. For example Twitter, Facebook, Instagram have all used AI to enhance customer experience, improve their products, fight cyberbullying and delete offensive comments. AI is identified as one of the most sought-after skills in many business sectors. It has become increasingly important in future satellite systems and space science development. Apart from applying AI into analysing data gathered by satellites, satellite payloads and design can also exploit AI to support the operation of large satellite constellations, including relative positioning, communication and end-of-life management.

The goal of this conversion course is to respond to the fast-growing satellite industry and the shortage of AI specialists to equip students with readily employable specialist knowledge and transferable skill sets needed to enhance their careers or to start a new career in the satellite/space industry.

Programme Overview

In this exciting course, students will acquire both technical and non-technical skills. Among the technical skills, students will learn the space dynamics to understand how a constellation of satellites can orbit the earth. In addition, students will also study the different principles, functions, components and applications of the three pillars of satellite systems: communications, earth observation and navigation, as well as the ground system that communicate with the satellites. How AI and machine learning can be applied to satellite system design and different satellite applications will be investigated.

Theoretical knowledge will be further consolidated through practical group projects to design and implement different satellite payloads for communications, earth observation and navigations, possibly with intelligent functions, on Pico satellites, or to design and implement a satellite ground station to receive satellite signals. Apart from group projects, students can further enhance their theoretical knowledge, practical experience, use of specialist software and simulation packages such as Matlab, CST, Weka, TensorFlow, Python with PyCharm, Arduino programming through research-based individual MSc projects. Students will have the opportunity to conduct MSc projects created and supervised by staff from Airbus and/or the Satellite Applications Catapult.

Students will also learn ethical and responsible use of satellite systems and AI for the good of humanity. Furthermore, how satellite systems improve the quality of lives in a global context will be studied and discussed through formal lectures and group discussions. Transferable soft skills such as interpersonal, communications, team working, analytical and problem solving, project management and entrepreneur skills are embedded into small group projects within the 20-credit modules. In addition Communications, presentation and project management skills will be further consolidated through individual MSc projects.

Why Bradford?

The University of Bradford has a long and established track record in satellite research and applications that started in the 1980s, being a member of the European Space Agency funded Satellite Network of Experts, pioneered and developed the Automated Solar Activity Prediction system for space weather prediction in collaboration with NASA and the European Space Agency.

The university academic team has extensive experience and expertise in RF engineering, antenna design, satellite imaging, satellite integration with terrestrial mobile networks. They will be joined by world leaders with over 30 years' satellite industrial experience to deliver this exciting programme. Students will benefit from state-of-the-art facilities provided by the Bradford-Renduchintala Centre for Space AI including a teaching lab, a project lab, a cleanroom, nano and pico satellite engineering models together with a suite of software platform and packages.

The programme is endorsed by the Satellite Applications Catapult. The Catapult will co-supervise up to two 3-6 month student placement(s) per annum to support the programme (cash contribution of up to £18k per annum, paid as stipend directly to the student). In addition, students from this programme will have access to the Catapult's Internship programme, which will offer MSc graduates the opportunity to apply for a graduate placement at the Catapult for up to 18 months (up to £40k per annum, paid directly to the student). Similarly, Airbus also supports this MSc programme, providing possibility for placements for students who select projects proposed by Airbus. Dedicated workshop with invited speakers from relevant industries will be held to inform students of potential employment opportunities from their companies. In addition, there are also seminar talks delivered by other satellite experts from different industrial companies or by professionals from other business sectors on innovation and entrepreneurship. All these are designed to help increase students' employment prospects.

Students will further be able to develop their employability skills via timetabled careers sessions delivered by the Faculty Link Career Consultant – these sessions will focus on supporting students in their placement/graduate applications. Students will also be able to access various services provided by Career and Employability Services through their platform 'Handshake' e.g. events (fairs and webinars/workshops), jobs, development resources and one-to-one appointments.

Programme Aims

The MSc Satellite Systems Engineering programme is intended to:

- provide telecommunication and satellite/space professionals, physicists, mathematicians, graduate analysts, AI technologists with specialist and transferable knowledge and skill sets needed to enhance their careers or to start a new career in the satellite/space industry
- provide students with specialist understanding of artificial intelligence, relevant AI tools and its applications in satellite systems and missions
- provide students with specialist understanding of the different functions, components architecture of three pillars of satellite systems: Communications, Earth Observation and Navigation
- provide students with hands-on experience to design satellite payloads and to programme using nano and pico satellite engineering models for potential satellite missions
- stimulate students with entrepreneurial thinking in satellite innovations

- equip students with the advanced technical skills and associated as well as the associated tools and skills to be readily employable in this exciting and growing area.

Programme Learning Outcomes

To be eligible for the FHEQ Level 7 award of Postgraduate Certificate, students will be able to:

1. Apply knowledge and new insights of key engineering principles underpinning satellite system design
2. Exercise initiative and personal responsibility, which may be as a team member or leader to meet the professional and technical objectives.
3. Demonstrate critical understanding of and apply a high level of professional and ethical conduct in engineering, evidencing business and management practices relevant to engineering and IT professionals.
4. Communicate effectively outcomes of practical work, draw conclusions from and present the results to specialist and non-specialist audiences.
5. Demonstrate self-directed and independent learning, as well as originality of thought to generate innovative system designs to fulfil new needs.

Additionally, to be eligible for the FHEQ Level 7 award of Postgraduate Diploma, students will be able to:

6. Evident the consideration of the key design parameters, constraints (e.g. regulatory, technical, computational resources) and applications requirements for intelligent and/or satellite systems to deliver different services for communications, earth observation and navigation.
7. Select, apply and/or combined advanced engineering methods and/or software tools including those for AI and Distributed Computing, to help generate innovate and optimized solutions
8. Critically appraise the vulnerabilities and ethics involved in the application of satellite and/or AI technologies
9. Integrate engineering knowledge and insight to make system trade-offs to determine payload architecture
10. Critically evaluate current problems, synthesise knowledge of engineering design principles and techniques, formulate and implement a programme of work to tackle the problem and allocate different roles within an engineering team

Additionally, to be eligible for the FHEQ Level 7 award of Degree of Master, students will be able to:

11. Plan, implement, monitor and adjust on an on-going basis, a self-directed individual research programme of work, demonstrating skills in information or data collection and critical analysis of research data, use or adaptation of appropriate analysis tools to tackle unfamiliar problems (e.g. those with uncertain or incomplete data or

specification), innovation, and application of relevant skills, reflection, and research methodologies in the production of an advanced technical report.

Curriculum

Students will study 180 credits over an academic year, starting either in the Autumn or in the Spring. All taught modules are core to the programme and studied sequentially "in blocks" alongside the MSc Project. Autumn starts will study periods in the order 1,2,3 and Spring starts will study periods in the order 2,3,1.

Autumn Semester 1 Modules

Module Code	Module Title	Module Credits	FHEQ Level
ELE7033-B	Space Dynamics & Systems Design	20	7
ELE7034-B	Navigation Satellite Systems	20	7
ELE7035-B	Communication Satellite Systems	20	7

Spring Semester 2 Modules

Module Code	Module Title	Module Credits	FHEQ Level
ELE7036-B	Earth Observation Satellite Systems	20	7
ELE7037-B	Ground Satellite Systems	20	7
ELE7038-B	AI & Distributed Computing	20	7

Summer Semester 3 Modules

Module Code	Module Title	Study Period	Module Credits	FHEQ Level
ENG7002-E	MSc Project	Full Year	60	7

Students will be eligible to exit with the award of Postgraduate Certificate if they have successfully completed 60 credits and achieved the award learning outcomes.

Students will be eligible to exit with the award of Postgraduate Diploma if they have successfully completed at least 120 credits and achieved the award learning outcomes.

Students will be eligible to exit with the award of Degree of Master in Engineering (Satellite Systems) if they have successfully completed at least 180 credits and achieved the award learning outcomes.

Students will be eligible for the award of Degree of Master in Satellite Systems Engineering if they have successfully completed at least 180 credits, achieved the award learning outcomes and met the additional requirements in the Assessment Regulations section.

Please note: These awards do not automatically confer eligibility to register with the Institute of Engineering and Technology (IET) or provide or contribute to Chartered Engineer (CEng) status.

Learning and Teaching Strategy

The MSc programme is designed in line with the University's Learning, Teaching and Student Experience Strategy (LTSES), which is committed to equality and diversity,

inclusion, and social mobility, and to empower students to realise their potentials, fulfil their ambitions and make a positive impact to the world. This is achieved through the highest level of inclusivity in curriculum design, learning experience activity and learning community environment.

The programme is jointly delivered by university academics and external experts, who have ample research and industrial experience in this field to ensure that the curriculum is led by research and engaged with the latest research outcomes in this area. For example in the satellite communications systems module, high throughput satellites and AI & Distributed Computing for Satellite Systems will follow the latest research and industrial trends. In addition, research elements are integrated into each module through which students will be assessed on their research, technical and professional skills (teamwork, report writing, presentation, etc.) through group projects, which evolve around the payload design for nano and pico satellite development and launch missions.

Because the programme benefits from the expertise of external satellite engineering professionals, the module delivery mode is in the form of 3-week teaching blocks, which also facilitates individual modules to be studied for CPD purposes.

Students will benefit from a suite of digital teaching and collaborative platforms supported by the University including CANVAS, Horizon, Teams. They will also benefit from being taught by a team of top industrial experts, who have ample experience in satellite systems. Student experience will be further enhanced by facilities provided in the state-of-the-art teaching laboratory, where a cleanroom for the construction of cubesat/pocket cube and a small-scale Telemetry, Tracking and Command system will be developed. Group projects will be created in various modules to consolidate understanding of how technologies have evolved and contributed to the next generation of satellite systems.

Assessment Strategy

Assessment is a key part of the student learning process and is designed to incorporate a wide range of different methods to meet the needs of students and industry as well as the accrediting bodies. Our diverse assessment prepares students for work in a professional and industrial environment, academic research, or entrepreneurship.

There are two forms of assessment: formative and summative. Formative assessment provides an opportunity for students to receive feedback during their learning. This promotes reflective thinking leading towards an enhanced knowledge. All the modules have some formative assessment, and this may take different forms such as discussions or questioning from their tutors, class tests, presentations, and practical activities. These formative activities are crucial if students are to make best use of their learning experience and they are designed to prepare students for their summative assessment.

Summative assessment is how we grade the work on a module and the details of this assessment are available from the beginning of the module so that students understand how their grade is determined. Summative assessment is mostly by a combination of formal individual/group report for group projects, presentations, examination viva voce, and written examinations depending on the module. For group projects, peer assessment will be applied. These methods of assessment not only assess subject-specific knowledge and skills, but also a suite of transferable skills that provide students with a competitive edge when they graduate.

Because of the nature of the 'block' module delivery, the final summative assessments for the modules may not necessarily be at the end of the semester.

Assessment Regulations

This Programme conforms to the standard University Taught Postgraduate Assessment Regulations, which are available at the link: www.bradford.ac.uk/regulations/ . If the below requirements are not met, but these regulations are complied with, then eligible students may be awarded the MSc in Engineering (Satellite Systems).

To be eligible for the named award of MSc Satellite Systems Engineering, the following variation to these regulations applies:

- Students must pass 160 credits at 50% or higher and the other 20 credits at 40% or higher.
- Students must also achieve 30% or more in qualifying assessment components leading to these marks. Students who achieve a mark of 40% or more for a module but who fail to achieve 30% in a qualifying component will be permitted to take supplementary assessment.
- Students who achieve a mark between 40% and 49% in up to 60 credits will be permitted to take 1 supplementary assessment attempt to support them to remain on the named MSc route with no more than 2 attempts in any module.

Placement and/or Study Abroad

This programme provides the competitive opportunity for students to undertake a paid work placement with the Satellite Applications Catapult or an alternative competitive opportunity with Airbus Defence and Space. Further contemporary details on how to apply for these opportunities will be given in workshops on the programme.

Due to the structure of the programme, this programme is not eligible for International Study Abroad Opportunities.

Admission Requirements

We take into consideration a number of factors when assessing your application. It's not just about your grades; we take the time to understand your personal circumstances and make decisions based on your potential to thrive at university and beyond. Considerations of applications will be based on a combination of formal academic qualifications and other relevant experience.

The standard entry requirements are a lower second class (2:2) Bachelor's degree with honours or equivalent in Electrical/Electronics Engineering, Telecommunications Engineering, Computer Science, Physics or Mathematics from an accredited degree awarding body.

Students whose first language is not English should check the standard University language requirements at: https://www.bradford.ac.uk/international/entry-requirements/

International students without the required English language proficiency can apply to take a pre-sessional language course with us to improve their English to the standard required for postgraduate study: https://www.brad.ac.uk/language-centre/requirements/

Access and Recognition of Prior Learning

Applications are welcome from students with non-traditional qualifications, and/or significant personal/industrial experience in related professions (RF engineers, programmers, satellite engineers etc.). For such applicants, evidence of their interests and work experience would be required and this would likely take the form of a portfolio of work and/or an interview with the programme.

If applicants have prior certificated learning or professional experience which may be equivalent to parts of this programme, the University has procedures to evaluate and recognise this learning in order to provide applicants with exemptions from specified modules or parts of the programme. For more details on RPL, visit the webpage: https://www.bradford.ac.uk/teaching-quality/prior-learning/

The University of Bradford has always welcomed applications from disabled students. To discuss adjustments or to find out more about support and access, you may wish to contact Disability Services before you apply online: www.bradford.ac.uk/disability/before

Applications are particularly welcomed from women, adult learners (those aged 26+ at the start of the programme), armed forces families, carers and care leavers, estranged or orphaned learners, refugees and asylum seekers, and Romani or Traveller families.

The Bradford-Renduchintala Scholarship fund offers a limited number of scholarships worth £10000 each to suitably qualified students applying to join the programme in the Autumn. In addition to having either an unconditional or conditional offer for a place on the programme starting in September 2022, applicants will need to have at least a 2:1 degree or equivalent and/or extensive and relevant industrial experience (3+ years) to be considered for a scholarship. In the event of oversubscription to the scholarship fund, women applicants will be preferred to promote greater representation in engineering.

Please note: This information is relevant to the contemporary recruitment cycle and therefore may be different now to when this document was originally published. The current tariff for the programme, as well as accepted equivalent qualifications and details of scholarship eligibility, is published online at the course page: https://www.bradford.ac.uk/courses/pg/satellite-systems-engineering/