PROGRAMME SPECIFICATION (V1)

Degrees:

Programme Title	Final Award	duration of study/ years	Programme & Route code	Level
Data Centric Systems Engineering	MSc	1	PMSF-QMENNG1/ PSSYE	7

Ownership	
Awarding institution:	Queen Mary University of London
Teaching institution	Queen Mary University of London
Academic Department(s) involved in programme delivery	School of Engineering and Materials Science
Main location(s) of study	Mile End Road, London
External references	
QAA Benchmark Group	Engineering
External Accreditor (if applicable)	
Accreditation received	
Accreditation renewal	

Specification Details	
Programme Lead	Dr Jun Chen
Student cohorts covered by specification	2022 entry
Date of introduction of programme	September 2022
Date of programme specification / amendment	17 November 2023
Approval by School	22 November 2023
Approval by Taught Programmes Board	

1. Programme Overview

Systems Engineering is a transdisciplinary approach that is required to address the development of complex products or solutions, which are also known as systems. Systems Engineering principles and practices are essential for the development of large, complex, and reliable systems, whether these are products, services, or enterprises. Modern designs demand systems thinking in order to support the integration of technical systems and organisations required to supply the kinds of services that are now expected from society as a whole.

Systems Engineering integrates both technical, business and managerial inputs which are needed to take a set of customer needs, expectations, and constraints to a solution and to support that solution throughout its life cycle. The discipline focuses on defining customer needs and the required functionality early in considering a product, documenting these requirements, then developing a way to generate both the design and its validation whilst always being aware of the whole system. This process requires consideration of operations, performance, testing, manufacturing, costing, training & support as well as disposal at the end of the products' life. Systems engineering provides the means for the integration of all the specialist disciplines providing a structured development process that evolves from concept through production to operation or delivery.

Systems engineering considers the goal of providing a quality product that meets the user needs, through the development of a coherent and effective solution to the system need. Systems engineers are responsible for ensuring that the correct development tasks are performed for the delivery of high quality, sustainable systems. Systems engineers work with a range of other professionals to create and support systems throughout their whole life cycle. The role of a systems engineer includes:

- Understanding the intended purpose, context and use of the proposed system.
- Appreciating the interests, purposes, and values of all stakeholders and combining these into a coherent representation of the system requirements.
- Understanding the technology that may be applied in the system.
- Appreciating the life cycle implications of systems and incorporating life cycle perspectives into systems design.
- Evaluating, selecting, and synthesising system solutions to satisfy customer needs and project objectives.

The MSc degree in Systems Engineering offered in SEMS at Queen Mary University of London is a 1 calendar year programme. MSc programmes are aimed at students who already have an in depth knowledge of an area of Science and Engineering, and who wish to develop further. This programme covers the core of systems engineering, consisting foundational topics with a focus on engineering design and development. The Systems Engineering degree programmes at QMUL are delivered by a large number of engineering specialist academic staff, who, in addition to their teaching, are involved in internationally recognised research in a wide range of topics, including energy generation and conversion, alternative and sustainable sources, aerospace engineering, computational modelling, simulation and optimisation, transportation, chemical engineering, control engineering, robotics, materials science and biomedical engineering.

The programme structure is designed to appeal to students with engineering, sciences or mathematics backgrounds, and is modular in format. A 90 credit research project provides the integrative experience, as systems engineering is a practical discipline requiring students to be able to integrate their acquired theory into practice. This will also be developed in small projects within individual modules. The emphasis of the research will enable you to apply

systems engineering approaches to an area of interest to you. Several high performance computing clusters owned by the university support a full spectrum of computational research. Our well-equipped laboratories include a wide range of IC engines, heat transfer facilities, wind tunnels, a Flight Simulator and Induction Jet engine test bench, tissue engineering, human performance, mechanical testing, materials synthesis, robotics and characterisation labs.

Upon completing this programme, you will be able to provide technical and programme leadership roles within capability planning and system acquisition organisations as well as in a diverse range of specialist industries. You will have been provided with a foundation that prepares you for roles related to research, design, development, procurement, integration, maintenance, and life cycle management of systems. You will have knowledge at the level required to become an Associate Systems Engineering Professional (ASEP) within the INCOSE certification programme, and have the necessary capabilities to work towards the Certified Systems Engineering Professional (CSEP).

The aim of this master's programme is to provide training for future system architects and project leaders in the field of specification, design, deployment, and maintenance of complex systems. At the end of this degree you will be equipped to take up roles to address the main challenges of these systems, such as safety, efficiency, delay, cost, ethics and environmental impact. Careers in areas, including aerospace, software, biomedical and transport engineering, will include development engineer, engineering consultant and project leader.

Teaching advanced computational, experimental and analytical techniques applicable to Systems Engineering will provide an advanced base of knowledge and skills. Including advanced computational and experimental techniques applicable to modelling and simulation of Systems Engineering will be a particular focus of this degree programme, whilst also including design procedures used by Systems Engineering research and implementing materials into research/design projects. This will enable students to participate in advanced research and industrial developments in Systems Engineering.

2. Learning outcomes for the programme

In this degree programme we place strong emphasis not only on the technical content of our modules, but also on cross disciplinary skills vital for an engineer to be effective in the work place and within the field of Systems Engineering. We embed these skills in the technical modules on the programme, to ensure that the technical knowledge and understanding works as you progress through your degree, and also to allow you to graduate with skills you can apply to a range of future careers. Students who complete this programme will be equipped to work in a wide range of industries.

2.1 Academic Content

- Gain in-depth knowledge into developing solutions to engineering system problems using advanced computational, experimental and theoretical methods.
- Have in-depth understanding of the development cycle of novel technologies within engineering systems.
- Apply Systems Engineering principles in order to address process safety and loss prevention.
- Gain quantitative skills to optimise conflicting requirements, finding acceptable compromises within limitations of cost, time, knowledge, risk, existing systems, and organisations, as well as to evaluate alternative system solution strategies.

- Understand new models, techniques, and technologies, and appreciate the necessity of such continuing professional development.
- Gain advanced knowledge on significant and rapidly emerging needs and trends in practicing systems engineering in areas of model-based systems engineering, digital engineering and artificial intelligence, and research capability.

2.2 Discipline specific

By the end of this degree programme you will be able to

- Demonstrate an ability to perform Systems Engineering activities in a specialist area, appreciating how differences may occur in different areas from both a system perspective and the engineering of that system.
- Apply System Engineering principles in order to address a specialty, such as safety, affordability, security or safety in critical or embedded systems. This will include an understanding of how differences in specialties present themselves in both engineering a system and in the function of the system itself.
- Understand the relationships between System Engineering and other disciplines, such as project management, industrial engineering and software engineering, acquiring basic knowledge related to these disciplines. This will include an understanding of the fundamental concepts of these disciplines, their relationship with System Engineering, and the ways in which complexity can be managed in projects.
- Demonstrate an understanding and appreciation of the level of software engineering necessary to develop current and future products, services, and enterprise systems.
- Comprehend and appreciate the challenges of applying System Engineering to realistic problems throughout the system life cycle.
- Apply advanced engineering methods to a range of applications in Systems Engineering.
- Select analysis techniques for Systems Engineering and system performance assessment.
- Critically assess feasibility of analytical, computational and experimental techniques in use and propose practical methods for their improvement.

2.3 Attributes

- Perform as an effective member of a multi-disciplinary team, effectively communicate, lead in an area of system development, such as project management, requirements analysis, architecture, construction, or quality assurance.
- Demonstrate knowledge of professional ethics and the application of professional ethics in decision making and System Engineering practice.
- Engage critically with knowledge.
- Be able to assess both the application and limitation of mathematical, computational and experimental techniques available to an engineer.
- Undertake independent research using state of the art computing, processing, characterisation and testing facilities.
- Develop research capacity and Information expertise.

3 Learning and teaching approaches

Teaching methods are tailor-made to suit the size of classes and the nature of the subject. Each module has a combination of methods including lectures, tutorials, laboratory sessions,

industrial visits, workshops and individual/group work. QMUL degrees combine face to face teaching and practical experiences with supported and structured on-line learning. Our virtual learning platform is referred to as QMplus. Through this platform you will be able to find details about your modules, assessments, timetables and other activities. Projects throughout the programme are designed for you to exercise independent thinking, research and problem solving skills. Group work enhances your communication, organisational as well as technical skills.

3.1 Employers Links

The school has an active Industrial Liaison forum (ILF). This forum has a direct impact on the programmes by encouraging employers to sponsor and support the students and to provide real design case studies to engage the students throughout the curriculum. Recent case studies that have been taught and assessed were delivered by Bridgestone, DePuys, Baxter, Artis, Corus, BAe, DSTL, Rolls Royce. The ILF meets twice a year.

3.2 Assessment methods

You can expect a variety of different types of assessment methods:

Written assessment
- Examinations
- Progress tests
- Online assignments and quizzes
- Report and other writing
- Peer assessment

Practical assessment
- Laboratory/workshop practicals

Design work
- Programming tests
- Modelling & simulation tool tests

Oral assessment
- Oral presentations
- Poster presentations
- Group presentations
- Design presentations

Assessments allow you to demonstrate that you have met the intended learning outcomes for each module and contribute towards your achievement of the programme learning outcomes. There are summative (formal) assessments during and/or at the end of each module as well as ongoing formative (informal – no marks) assessments through the degree. Examinations are intended to assess understanding rather than recall. Group assessments may incorporate peer marking.

Assessments operate in accordance with QMUL Regulations and established procedures.
Feedback is provided through a number of formats, including:

- Oral (e.g. face to face during or after face-to-face sessions, video)
- Personal (e.g. discussion with staff)
- Interactive (e.g. Team Based Learning, peer-to-peer, online quizzes)
- Written (e.g. solutions, model answers, comments on work)

You will receive feedback on intermediate, developmental assessments such as project plan and progress reports and on coursework assessments. This feedback may be summarised for the whole cohort or be directed towards your work individually.

The final project thesis will be assessed in September and the student will also complete a presentation as well as an oral examination.

Feedback is intended to help you learn and you are encouraged to engage with it, reflect upon it and discuss it with your module organiser. Feedback will be provided on coursework and practical assessments within an appropriate time. Feedback on examination performance is available upon request from the module leader and overall class performance feedback on a question-by-question basis may also be provided.

QMUL's Policy on Assessment and Feedback and guidance on issuing provisional marks to students is available at:

http://www.arcs.qmul.ac.uk/media/arcs/policyzone/Code-of-Practice-on-Assessment-and-Feedback_amended-2016.01.18.pdf

3.3 Support of students

We aim to support all students throughout their time with us. We encourage students to develop independently but this does not mean that you need to be alone. We know that support and encouragement from staff and fellow students is very important throughout your degree.

The Student Support Officer for SEMS is the first contact for any personal support; they can be contacted by email: semsstudents@qmul.ac.uk with any questions or to arrange an appointment.

3.3.1 Academic Advisor arrangements

Your project supervisor should be your Academic Advisor.

3.3.2 Central support services

Disability and Dyslexia Service

QMUL has a central Disability and Dyslexia Service (DDS) that offers support for all students with disabilities, specific learning difficulties and mental health issues. The DDS supports all QMUL students: full-time, part-time, undergraduate, postgraduate, UK and international at all campuses and all sites. You can access advice, guidance and support in the following areas:

- Finding out if you have a specific learning difficulty like dyslexia
- Applying for funding through the Disabled Students' Allowance (DSA)
- Arranging DSA assessments of need
- Special arrangements in examinations
- Accessing loaned equipment (e.g. digital recorders)
- Specialist one-to-one "study skills" tuition
- Ensuring access to course materials in alternative formats
- Providing educational support workers (e.g. note-takers, readers, library assistants)
- Mentoring support for students with mental health issues and conditions on the autistic spectrum

Advice and Counselling

QMUL offers a wide range of advice, guidance and self-help material. These free and confidential professional services are available to all students. Details can be found at:

https://www.welfare.qmul.ac.uk/student-advice-guides/

3.4 Interruption of Study

The University's Policy on a student's interruption of study is available at:

http://www.arcs.qmul.ac.uk/media/arcs/policyzone/academic/Interruption-of-Study-Policy-(June-2020).pdf

4 Programme structure

45 credits of taught modules will be taught in the first semester from September until December plus an additional 15 credits of taught material associated with the research project. A further 45 credits of taught modules will be taught in the second semester from January until April. All taught module examinations will be in the standard examination periods during January and May. The 90 credit Research Engineering project will be completed over 3 semesters.

module	semester	title		credit
EMS715P	A,B,C	Extended Research Project	core	90
EMS740P	A	Machine Learning and Artificial Intelligence for Engineering	compulsory	15
EMS726P	A	Engineering Design Optimisation and Decision Making	compulsory	15
EMS703P	A	Introduction to Systems Engineering	compulsory	15
EMS705P	B	Environment, Ethics and Economics in Engineering Design	compulsory	15
EMS704P	B	Simulation and Model Based Systems Engineering	compulsory	15
1 from:				
EMS711P	B	Renewable Fuels	elective	15
EMS772P	B	Operations and Supply Chain Management in Engineering	elective	15
EMS732P	B	Digital Manufacture for Healthcare Innovations	elective	15
EMS774P	B	Business Strategy and Technology Entrepreneurship	elective	15
EMS707P	B	Digital Signal Acquisition and Processing	elective	15

Note: The modules, structure and assessments presented in this Programme Specification are correct at time of publication but might change as a result of student and staff feedback and the introduction of new or innovative approaches to teaching and learning. You will be consulted and notified in a timely manner of any changes to this document.

5 Progression and Classification

5.1 Classification

The marks from modules contribute towards the final degree classification. In order to be considered for an award, you must have met all of the following requirements:

i) take 180 credits, including a minimum 150 credits at level 7.

ii) either: a pass 180 credits; or, b pass a minimum 150 credits and meet the requirements for condoned failure in the remaining credits

iii) achieve a Classification Mark of 50.0 or higher.

Failure may be condoned in up to 30 credits of modules where all of the following conditions are met:

i) the module mark for each failed module is 40.0 or higher

ii) the mean average mark across all modules, including the failed module(s), is 50.0 or higher
iii) a failed module is not designated as 'core' (must be passed outright) in the programme regulations.

The Classification Mark is the mean average mark for the full programme of study

Classification Mark	Classification
70.0 – 100.0	Distinction
60.0 – 69.9	Merit
50.0 – 59.9	Pass

5.2 Exit awards

An exit award is an award at a lower level than that for which a student initially registered. An exit award may be recommended where a student meets the requirements for the lower level award and where the student has either withdrawn or been deregistered. Exit awards for the postgraduate programmes have the following hierarchy. A student will be awarded the highest linked award for which they meet all requirements: i Master of Science (MSc). ii Postgraduate Diploma (PgDip). iii Postgraduate Certificate (PgCert).

6 Entry requirements

Students will be admitted according to the entry requirements found at:

https://www.qmul.ac.uk/postgraduate/taught/coursefinder/courses/systems-engineering-msc/

7 Quality assurance

7.1 Student-Staff Liaison Committee (SSLC) meetings

The School has a Student-Staff Liaison Committee and students on this programme are represented on this committee. The committee meets twice during each semester and is made up of the following members:

- Director of Student Support (Chair)
- Student Support Officer (Secretary)
- Directors of the relevant programmes
- At least one student representing each of the relevant programmes

The elections for the undergraduate representatives are organised through the Student Union. SSLC agendas and minutes are found on the SEMS QMplus landing page (https://qmplus.qmul.ac.uk/course/view.php?id=13091). Relevant items on the minutes are referred to the appropriate School committees for consideration and feedback.

7.2 Evaluating and improving the quality and standards of teaching and learning

We assess our provision of teaching by:

- Module review by means of student feedback questionnaires and course organisers' reports.
- Annual staff appraisal.
- Peer observation of teaching.
- External examiners' reports.
- Periodic Internal Review by the College involving external panel members.
- Periodic Institutional Audit of the College by the Quality Assurance Agency.

The Committees within SEMS that have responsibility for monitoring and evaluating quality and standards are

- Education Board
- Education Coordination Group
- Student Experience Committee
- Academic Standards Committee
- Teaching Development and Scholarship Committee
- Student-Staff Liaison Committee
- Subject Examination Boards – meet in January, June and September to confirm marks and prizes, and to consider progression and awards
- Degree Examination Boards – meet in July and October to confirm progression and awards
- University Quality Enhancement Committee.

The ways we receive student feedback on the quality of teaching and your learning experience are:

- Annual National Student Survey
- Student-Staff Liaison Committee
- Student feedback questionnaire evaluation
- Student forums on the School's website, including module and programme specific forums as well as ones covering more general topics
- Discussions with Academic Advisors.

7.3 Staff development

Our staff are continuously engaging with professional development activities, including courses and workshops related to teaching and learning.

8 Supporting Information

QMUL's Academic Regulations can be found at:
http://www.arcs.qmul.ac.uk/media/arcs/policyzone/academic/Academic-Regulations-2020-21-FINAL.pdf

QMUL's Assessment Handbook can be found at:
http://www.arcs.qmul.ac.uk/media/arcs/policyzone/Assessment-Handbook-2020-21-FINAL-(WEB).pdf
QMUL's Academic Credit Framework can be found at:
http://www.arcs.qmul.ac.uk/media/arcs/docs/quality-assurance/Queen-Mary-Academic-Credit-Framework-(June-2017).pdf

QMUL's admission policy can be found at:
https://arcs.qmul.ac.uk/media/arcs/docs/admissions-policy-documents/Admissions-Policy-2021-22.pdf

QMUL is regulated by the Office for Students (OfS) www.officeforstudents.org.uk/advice-and-guidance/the-register/

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is primarily intended as a reference point for prospective and current students, academic and support staff involved in delivering the programme and

enabling student development and achievement, for its assessment by internal and external examiners, and in subsequent monitoring and review.