University of Plymouth

Faculty of Science and Engineering
School of Engineering, Computing and Mathematics

Programme Specification

MSc Autonomous Systems

September intake: 6758
January intake: 7416

Approved from:
September 2022
1. **MSc Autonomous Systems**

   **Final award title**
   MSc Autonomous Systems (completion of 180 Level 7 credits)

   **Level 7 Intermediate award title(s)**
   Postgraduate Diploma (PgDip) (completion of 120 Level 7 credits)

   **Level 7 Intermediate award title(s)**
   Postgraduate Certificate (PgCert) (completion of 60 Level 7 credits)

   **UCAS code** N/A
   **HECoS code** 100188 (Systems Engineering- 50%) and 100757 (Intelligent Systems- 50%)

2. **Awarding Institution:** University of Plymouth
   **Teaching institution(s):** University of Plymouth

3. **Accrediting body(ies)**

   The MSc in Autonomous Systems is not yet accredited by any of the relevant professional engineering institutions. However, the programme has been designed with a view to being accredited with the Engineering Council soon. The earliest opportunity that an application for accreditation can be made is in the 2022/23 academic year. The intention is to have the MSc course accredited by Institution of Mechanical Engineers (IMechE) and Institution of Engineering and Technology (IET) in the first instance.

   Initially, graduates of the MSc programme seeking registration as a professional engineer will have to undergo an individual assessment of their qualifications by their chosen professional engineering institution. Accreditation of the MSc programme will enable graduates to be automatically considered for registration.

4. **Distinctive Features of the Programme and the Student Experience**
   - Unique programme in the UK to provide strong skills set both in marine and robotic autonomy.
   - Taught by world leading experts recognised nationally and internationally for our high-quality, research-led education, and professional teaching from the Autonomous Marine Systems (AMS) Research Group, the Centre for Robotics and Neural Systems (CRNS), the Maritime Cyber Threats research group and the Big Data Group.
   - Informed by the latest developments in autonomous systems techniques, making sure that all curricula include Plymouth research-based material, and that students have opportunities to generate knowledge in their programmes. Our seminar series with speakers from industry and academia gives you the opportunity to keep ahead in this fast moving field.
   - Guest lectures from the key people in companies working in autonomy, e.g. Thales, Metalectrique Battery Systems, Dynautics (H-Scientific), Sonardyne, MSubs, Furgo, PML, NOC, Babcock International, ORE catapult, Teledyne e2v, Seiche Ltd.
• Opportunity to work on industry-defined autonomous systems projects with the possibility to access industry-based laboratory and test facilities and increasing student’s prospects for future careers.
• Provide technology-enhanced learning by using modern laboratories, engineering workshops, and high-quality library and appropriate digital learning and information environments for students both within and beyond the campus boundaries.
• Advanced professional competency and workplace readiness, whilst providing eligibility requirements to register as a Chartered Engineer.

The Programme delivery is underpinned by the University of Plymouth Education and Student Experience Strategy 2018-2023, specifically:
1. Supporting all our students to succeed, to become potential leaders of the future in autonomous systems and to make a difference to society.
2. Providing globally relevant and well-designed programmes of learning for our students to be externally recognised for the high quality of our educational provision.
3. Providing opportunities to share the industrial experiences and contact with potential future employers to ensure programmes engage with, and are responsive to, external drivers and stakeholder views, and have external input and increasing student’s prospects for future careers.
4. To nurture a sustainable and collaborative community of scholars recognising the significance of research and evidence-based pedagogy.
5. To provide an infrastructure and inclusive learning environment that supports our students and staff.

5. Relevant QAA Subject Benchmark Group(s)

The most recent Quality Assurance Agency for Higher Education (QAA) published subject benchmark statements for master’s degrees in engineering can be found within the 2015 version of the Subject Benchmark Statement: Engineering1.

The QAA Subject Benchmark Statement for engineering describes the academic standards expected of graduates of bachelor’s degrees with honours and master’s degrees in engineering. It also describes the attributes and capabilities that engineering graduates will have, and the nature of teaching, learning and assessment in engineering.

This Subject Benchmark Statement must be read in conjunction with the Engineering Council’s Accreditation of Higher Education Programmes: UK Standard for Professional Engineering Competence2 and UK-SPEC: UK Standard for

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Professional Engineering Competence\textsuperscript{3}, which set out the output standards required of accredited engineering programmes. The intention is to align these standards for the accreditation of the course in the 2022/23 academic year.

The UK is a member of international accords, comprising engineering degree accreditation bodies in several countries, who agree to recognise each other's accreditation decisions\textsuperscript{4}. Accredited UK programmes are aligned to the international EUR-ACE® framework\textsuperscript{5}, which makes it possible to compare international programmes for registration purposes and encourages mobility and diversity across the student body and the profession. They are important to employers to assure the skills and professionalism of engineering graduates.

6. Programme Structure

September start

<table>
<thead>
<tr>
<th>Timings</th>
<th>Modules</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>September -&gt; January</strong></td>
<td><strong>MECH556</strong> Autonomy Principles and Ethics</td>
<td>20 credits</td>
</tr>
<tr>
<td></td>
<td><strong>ROCO508Z</strong> Intelligent Sensors and Control for Autonomous Systems</td>
<td>20 credits</td>
</tr>
<tr>
<td></td>
<td><strong>MECH544</strong> Data Processing, Simulation and Optimisation of Engineering Systems</td>
<td>20 credits</td>
</tr>
<tr>
<td></td>
<td><strong>PROJ518</strong> MSc Dissertation and Research Skills</td>
<td></td>
</tr>
<tr>
<td>15 weeks</td>
<td>Guided Independent Study / Exams / Assessment 2 Weeks</td>
<td></td>
</tr>
<tr>
<td><strong>January -&gt; June</strong></td>
<td><strong>MECH557</strong> Soft Computing Techniques for Autonomous Systems</td>
<td>20 credits</td>
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<tr>
<td></td>
<td><strong>COMP5007</strong> Cyber-Physical Systems Security</td>
<td>20 credits</td>
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<tr>
<td></td>
<td><strong>Option Module</strong></td>
<td></td>
</tr>
<tr>
<td>15 weeks</td>
<td>Guided Independent Study / Exams / Assessment 2 Weeks</td>
<td>60 credits</td>
</tr>
<tr>
<td><strong>June -&gt; September</strong></td>
<td>Work on dissertation until hand in date through the summer</td>
<td></td>
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<tr>
<td></td>
<td>Submit September</td>
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</table>

Table 1: Programme Structure MSc Autonomous Systems – September start

January start


\textsuperscript{4} See for example, the Washington Accord for degree programmes leading eventually to registration as a Chartered Engineer \url{www.washingtonaccord.org/washington-accord}

Table 2: Programme Structure MSc Autonomous Systems – January start

The one-year programme (Table 1 – September start, Table 2 – January start) consists of 180 credits of study at Level 7 and will require students to study over two semesters and the summer.

Full-time students are normally expected to complete the programme in 12 months and part-time students within 24 months. Part-time study is allowed provided a minimum of 60 credits is studied in any one academic year and that the dissertation project is completed in a single academic year.

The core of the taught programme will be 120-credit modules in autonomous systems, engineering design, sensors, modelling and control, machine learning, data processing, and research methods, together with a 60-credit dissertation project (Table 3). During the January to June semester a choice of 1 option module should be taken from the options given in Table 3.

The dissertation project will develop research skills and demonstrate mastery of the autonomous systems subject; the topic of the project will be an individual choice in consultation with the programme team (or supervisor).

<table>
<thead>
<tr>
<th>Timings</th>
<th>Modules</th>
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<tbody>
<tr>
<td><strong>January → June</strong></td>
<td><strong>MECH557</strong> Autonomy Principles and Ethics 20 credits 13 Weeks</td>
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<tr>
<td></td>
<td><strong>COMP5007</strong> Cyber-physical Systems Security 13 Weeks 20 credits</td>
</tr>
<tr>
<td></td>
<td><strong>Option Module</strong></td>
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<td></td>
<td><strong>PROJ518a</strong> MSc Dissertation and Research Skills</td>
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<tr>
<td></td>
<td><strong>15 weeks</strong> Guided Independent Study / Exams / Assessment 2 Weeks</td>
</tr>
<tr>
<td><strong>Summer</strong></td>
<td><strong>Work on dissertation</strong></td>
</tr>
<tr>
<td><strong>June → September</strong></td>
<td><strong>Submit January</strong></td>
</tr>
<tr>
<td><strong>September → January</strong></td>
<td><strong>MECH556</strong> Autonomy Principles and Ethics 20 credits 13 Weeks</td>
</tr>
<tr>
<td></td>
<td><strong>ROCO508Z</strong> Intelligent Sensors and Control for Autonomous Systems 13 Weeks 20 credits</td>
</tr>
<tr>
<td></td>
<td><strong>MECH544</strong> Data Processing, Simulation and Optimisation of Engineering Systems All Year 60 credits</td>
</tr>
<tr>
<td></td>
<td><strong>15 weeks</strong> Guided Independent Study / Exams / Assessment 2 Weeks</td>
</tr>
</tbody>
</table>

Table 2: Programme Structure MSc Autonomous Systems – January start
7. Programme Aims

The aim of the programme is to train a world-class cohort of students in the theory and practice of a new generation of autonomous intelligent systems. The programme will look at applications including IT, aerospace, automobiles, marine, robotics, banking and education, and will cover essential aspects of specialist knowledge for autonomous systems including; artificial intelligence in decision-making, navigation, guidance, control and sensor fusion, machine learning, security, communication & networking, and data management. This content will be delivered by globally-leading academics at the University, and leading figures from our industrial partners at the cutting edge of autonomous system development.

The programme aims to:
- Advance autonomous capability by deepening knowledge and skills in artificial intelligence in decision-making, navigation, guidance, control and sensor fusion, machine learning, security, communication and networking and data management.
- Broaden knowledge of new and emerging technologies and professional practice through tutorials and via acquisition of relevant software skills
- Challenge students to solve complex or novel engineering problems through projects that are practice-based or have industrial involvement.
- Develop professional competency, work-place readiness, and personal self-development skills.
- Develop the skills necessary to pursue academic research and scholarship in engineering at a high level.

8. Programme Intended Learning Outcomes

8.1. Knowledge and understanding

On successful completion graduates should have developed:

K1) Deep, systematic knowledge and critical understanding of the current state of the theory and practice relating to Autonomous Systems.
K2) The ability to synthesise and present complex data at a standard that would be acceptable for an industry/government report, presentation or scientific publication.
K3) Thorough understanding of the underlying engineering technologies required for designing autonomous systems.
K4) Knowledge of methods of research and enquiry used to create, interpret and critically evaluate research and advanced scholarship.
K5) Awareness of the commercial, social and technical challenges for safeguarding sustainable development in the areas of autonomous systems.

8.2. Cognitive and intellectual skills

On successful completion graduates should be able to:

C1) Select appropriate theories, methodologies or practices and critically evaluate their effectiveness.
C2) Analyse and evaluate complex, incomplete or contradictory evidence/data and deduce appropriate conclusions.
C3) Think critically and creatively to produce a diversity of alternative solutions to complex problems in engineering.
C4) Synthesise ideas at a high level of abstraction into more concrete and detailed technical solutions.
C5) Design and carry out substantial investigations into autonomous systems theory and/or practice and suggest new or alternative approaches.

8.3. Key and transferable skills

On successful completion graduates should have developed the ability to:

T1) Exercise initiative and take personal responsibility.
T2) Manage complex issues and work with incomplete information and data.
T3) Communicate views professionally and confidently to a range of audiences using a variety of media including poster and/or oral presentation.
T4) Reflect upon continuing professional development needs and plan independent learning activities.

8.4. Employment related skills

On successful completion graduates should have developed an ability to:

E1) Create original concepts for innovative solutions in engineering systems, or processes.
E2) Self-evaluate performance, adapt, and implement improvements to their work practice in a variety of situations.
E3) Work effectively in teams.

8.5. Practical skills

On successful completion graduates should be able to:
P1) Solve complex autonomous systems problems by applying systematic approaches to AI techniques, machine learning and using original and creative thinking.

P2) Work safely and undertake appropriate assessments of risks and threats in varied environments.

9. Admissions Criteria, including APCL, APEL and Disability Service arrangements

This programme primarily aims to recruit graduate engineers with a degree to honours level at 2:2 or above in engineering, mathematics, robotics, marine, computing and physical science related subjects. Applicants will aspire to become Chartered Engineers by advancing their skills, knowledge and understanding of autonomous systems related techniques. Applicants without a 2.2 or higher may be considered if they have significant relevant experience.

Ideally, candidates will need to demonstrate that they hold an appropriate IEng accredited first degree. Candidates with non-UK qualifications will need to demonstrate that their first degree is accredited by their local professional body.

Candidates with considerable professional experience, who can evidence an academic ability equivalent to undergraduate degree levels, may also be considered.

All applicants must have GCSE (or equivalent) Maths and English at Grade C or above. If your first language is not English then evidence of English proficiency is required. The minimum IELTS score for acceptable English proficiency for entry is normally 6.5 and not less than 5.5 in all components.

The University of Plymouth is fully compliant with the National SENDA requirements for the accommodation of disabled students within its degree programmes. All applications will be assessed on academic criteria as described above. Once accepted the students will be put into contact with the Disability Services who will liaise with the course leader to identify actions, which need to be taken. Where necessary alternative assessments will be provided.

Graduates of the University’s MEng Mechanical Engineering, MEng Mechanical Engineering with Composites, MEng Marine Technology, MSc Advanced Engineering Design, MEng Robotics, MSc Robotics degrees are not eligible to enrol on this programme.

10. Progression criteria for Final and Intermediate Awards

The MSc Autonomous Systems programme generally follows the University’s Regulatory Framework for Taught Postgraduate Awards.

<table>
<thead>
<tr>
<th>Post Graduate Certificate (PgCert)</th>
<th>Requires the successful completion of modules worth 60 credits at level 7</th>
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<tbody>
<tr>
<td>Post Graduate Diploma</td>
<td>Requires the successful completion of modules worth 120 credits at level 7.</td>
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</table>
Table 2 shows the requirements for progression to final and intermediate awards, including the award of the MSc degree with merit or distinction.

Successful completion of a module:
- The pass mark for a module at Level 7 is 50%.

The maximum period of registration allowed will be:
- Three years.
- Five years for part-time students.

11. Non Standard Regulations

N/A

12. Transitional Arrangements

N/A

Appendices
Programme Specification Mapping (PGT)
Programme Specification Mapping (PGT): module contribution to the meeting of Award Learning Outcomes

Tick those Award Learning Outcomes the module contributes to through its assessed learning outcomes.

| Module   | Credits | C | C | C | C | C | C | C | C | T1 | T2 | T3 | T4 | E1 | E2 | E3 | P1 | P2 | Compensation | Assessment element(s) and weightings |
|----------|---------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----------------|--------------------------------------|
| MECH556  | 20      | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | C1-100%                             |
| ROCO508Z | 20      | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | T1-50%, C1-50%                       |
| MECH544  | 20      | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | C1-100%                             |
| MECH557  | 20      | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | C1-100%                             |
| COMP5007 | 20      | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | C1-100%                             |
| MATH501  | 20      | E | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | Y             | C1-100%                             |
| MAR537   | 20      | E | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | Y             | C1-60%, P1-40%                       |
| **Learning Outcomes 120 credits** |          |   | * | * | * | * | * | * | * | *  | *  | *  | *  | *  | *  | *  | *  | *  | **Confirmed Award LOs** |                                           |
| **PROJ518** | **60** | C | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | N             | C1-100%                             |
| **Learning Outcomes 180 credits** |          |   | * | * | * | * | * | * | * | *  | *  | *  | *  | *  | *  | *  | *  | *  | **Confirmed Award LOs** |                                           |