# INFORMATION REQUIRED FOR A PROGRAMME SPECIFICATION

*Please note: the following information will be displayed in the publicly available programme catalogue*

| **ORGANISATION** | |
|---|---|
| Programme title | Robotics and Autonomous Systems |
| UCAS code (for undergraduate programmes only) | n/a |
| Final award | MRes (as exit point from PhD programme in FARSCOPE-TU CDT) |
| Programme director | Professor Arthur Richards |
| Department/School(s) | Aerospace Engineering/CAME School |
| Faculty | Engineering |
| Awarding institution/body | Joint: University of Bristol and the University of the West of England |
| Teaching institution | Joint: University of Bristol and the University of the West of England |
| Programme accredited by: | N/A |
| Relevant QAA subject benchmark group(s) | |
| Modes of study e.g.: FT/PT | FT and PT (min 50% attendance) |
| Programme length<br>Normal length of registration for<br>a) Full-time<br>b) Part-time | 1 year<br><br>1 year<br>2 years |
| Date programme specification written or revised | 22nd October 2018 |

## STRUCTURE

**Programme structure by year/level and unit**
Please use this section to describe any particular aspects of the programme that may not be clear from the structure. Please make sure you indicate in the 'Progression award/requirements' column the unit pass marks required for a student to progress (and the mark that constitutes a fail), for each year of study.

Please indicate the **must pass units** if applicable, in the relevant stage note of the structure below.

For **integrated masters programmes**[1], please indicate whether this is Type II (Advanced Study) or Type III (Professional):

| Year | Level[2] | Unit code | Unit title | Credit points[3] | Mandatory (M) Optional (O) or Open | Progression/award requirements[4] |
|---|---|---|---|---|---|---|
| *Stage Note:[5] Students will be given a two-week induction including a communications training course (partly as an ice-breaker as well), a research symposium, and specialist lab induction. During this time, they will also meet their personal tutor, who will be assigned from the CDT CoIs, with the CDT Director as Senior Tutor. In advance, they will be sent "joining instructions" to suggest self-study preparation options, including online courses from Bristol Futures, edX and other providers.* | | | | | | |
| Stage 1 | M | New | Robotics research preparation (1) | 10 | M | |
| | M | AENGM0029 | Robotics research preparation (2) | 15 | M | |
| | M | COMSM0012 | Robotics Systems | 10 | M | *An applicant who has already taken this unit as part of a prior MSc will be required to take an additional option from the list below instead.* |
| | M | EMATM0018 | Technology and context in Robotics and Autonomous Systems | 10 | M | |
| | M | EMATM0019 | FARSCOPE group project | 20 | M | |
| | M | New | Industry project | 20 | M | |
| | M | One M-level unit from the Faculty of Engineering or the Faculty of Science, excluding any innovation or enterprise unit, *or* one of the Bristol Futures Optional Units. | | 10 | M | *Subject to approval of Programme Director. May still be chosen from list below.* |
| | *Choose any one optional unit from:* | | | | | |

[1] Integrated Master's programmes must indicate which type they fall into, either type II: advanced study or type III: professional and whether they include a formal period of study abroad / in industry, in accordance with the QAA descriptors for Master's programmes. Please see the Regulations and Code of Practice for Taught Programmes for further information on this type of programme.

[2] See information on the Academic Quality and Partnership's website at: http://www.bristol.ac.uk/academic-quality/approve/approvalguidance/qainfo/levels.html

[3] Please see the University's Credit Framework http://www.bristol.ac.uk/academic-quality/assessment/regulations-and-code-of-practice-for-taught-programmes/programme-design/ for guidance on minimum amounts of credit at different levels required for each award of the University.

[4] Please state any progression requirements associated with this stage of the programme e.g. students have to gain a higher mark to progress to an MEng rather than a BEng

[5] This will appear above the structure for this year of the programme and should be used for things such as: 'Students transfer to this programme after successful completion of ...'

| | | | | | | |
|---|---|---|---|---|---|---|
| | M | AENGM2005 | Advanced techniques in multi-disciplinary design | 10 | O | *Subject to approval of Programme Director.* |
| | H | BIOL31132 | Sensory ecology | 10 | O | |
| | H | COMS30106 | Artificial intelligence and logic programming | 10 | O | |
| | H | COMS30121 | Image processing and computer vision | 10 | O | |
| | H | COMS31700 | Design verification | 10 | O | |
| | M | COMSM0109 | Advanced computer architecture | 10 | O | |
| | M | COMSM0009 | Interactive devices | 10 | O | |
| | M | EENGM2100 | Communication systems | 10 | O | |
| | M | EENGM4120 | Advanced DSP & FPGA implementation | 10 | O | |
| | M | EMATM0012 | Statistical pattern recognition | | O | |
| | M | EMATM1120 | Uncertainty modelling for intelligent systems | 10 | O | |
| | M | EMATM2700 | Control theory | 10 | O | |
| | M | EMATM0029 | Bio-inspired artificial intelligence | 10 | O | |

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|---|---|---|---|---|---|---|
| | M | MENGM6049 | Virtual product development | 10 | O | |
| | M | MENGM6051 | Biomechanics | 10 | O | |
| | M | EMATM0042 | Intelligent information systems | 10 | O | |
| | *Choose any one optional unit from:* | | | | | |
| | M | EMATM0030 | Electromechanical systems and integration (UWE, UFMEEA-15-M) | 15 | O | *Subject to approval of Programme Director.* |
| | M | EMATM0031 | Advanced Control & Dynamics (UWE, UFME7F-15-M) | 15 | O | |
| | M | EMATM0033 | Robotic Fundamentals (UWE, UFMF4X-15-M) | 15 | O | |
| | M | EMATM0034 | Intelligent adaptive systems (UWE) | 15 | O | |
| | M | EMATM0040 | Medical Robotics and Image-Guided Surgery (UWE) | 15 | O | |
| | M | EMATM0043 | Human robot interaction (UWE, UFMFHP-15-M) | 15 | O | |
| *Stage Note: 120 credits must be passed to enable progression to the PhD phase of the FARSCOPE-TU CDT.* | | | | | | |
| Stage 2 | | EMATM0015 | Dissertation (UWE, UFMED4-60-M) | 60 | M | |
| *Stage Note: Students will not normally write up a dissertation at the end of the first-year exploratory project, which will instead be concluded with a formative assessment based on a conference-style paper and presentation. If a student exits the programme early, either by voluntary withdrawal or through unsatisfactory progress, the exploratory project can be written up according to the requirements for the established MSc Robotics Dissertation, and assessed for the award of an MRes.* | | | | | | |

## AIMS

**Educational aims of the programme**

This programme aims to develop the student's interest in and knowledge and understanding of robotics and autonomous systems (RAS), in order to prepare them for PhD research in that area through the FARSCOPE-TU Centre for Doctoral Training (CDT). The theme of the programme is ubiquity or robots everywhere enabling students to think beyond a robot's technology and about its environment. This looks to address the 4S challenges: requiring future robots to be: **Social**, able to interact naturally with humans; **Safe**, trusted on a technical and societal level to operate in unsegregated spaces; **Smart**, matching robust hardware with intelligent software to be effective in unstructured settings; and, **Scalable**, designed for large scale deployments and evolution of roles. The programme seeks to provide students with the breadth of technical knowledge and context awareness needed to go on and complete PhD research in RAS. The MRes year contains a wide range of detailed technical tools and topics designed to accommodate a variety of academic backgrounds, as well as cohort-based training activities.

Students will learn about industrial context through a dedicated mentoring programme run by the CDT and an Industrial Project in TB2. Research-led teaching in TB1 and TB2, including bespoke research preparation training, specialist options and a series of seminars on research topics, will prepare students to co-create their exploratory projects, which they will undertake over the summer of their first years, providing the full grounding and experience to finalize a PhD topic and supervisory team at the start of Year 2.

All students will have pastoral support from the outset from an individual personal tutor assigned from one of the CDT CoIs, with the CDT Director in the role of Senior Tutor. Once they begin the Exploratory Project, their supervisor becomes their personal tutor. Students will meet regularly with their personal tutors throughout, and with the senior tutor through research preparation group meetings and cohort events.

## OUTCOMES[6]

**Programme Intended Learning Outcomes**

*Reference points should include the subject benchmark (if one exists) qualification descriptors (see the Framework for Higher Education Qualifications), and professional body requirements etc.*
*You should indicate in each column the increasing intellectual demands on the student as he/she progresses through the programme.*

| **This programme provides opportunities for students to develop and demonstrate knowledge and understanding, qualities, skills and other attributes in the following areas:** | **Teaching, learning and assessment strategies that show how learning outcomes are achieved and demonstrated:** |
|---|---|
| **A. Knowledge and understanding** | |

[6] Reference points should include the subject benchmark (if one exists) qualification descriptors (see the Framework for Higher Education Qualifications), and professional body requirements etc.

<table>
<tr><td rowspan="2">Programme Intended Learning Outcomes:<br>Knowledge and understanding of:<br>1. The fundamental chain of components in a robotic system: perception; cognition; action.<br>2. Theory and implementation of multi-degree of freedom robotic mechanisms and their control.<br>3. Algorithmic and operational principles of perception.<br>4. Foundational and mathematical aspects of computer decision making and autonomous systems.<br>5. Integration of software and hardware to design and realise autonomous robotic solution to meet requirements.<br>6. Application of a selection of advanced methods in robotics and autonomous systems<br>7. Research topics and challenges within robotics and autonomous systems.<br>8. Applications and implications of robotics and autonomous systems, including societal and industrial context.</td><td>Learning/teaching methods and strategies:<br>Technical concepts and methods will be taught through short courses at induction followed by ‘traditional’ lecture courses (1,2,3,4,6). Skills will be taught through intensive short courses and project work (4,5). Applications and research topics (7,8) will be taught through small group (cohort) seminars. Context (7,8) will be taught through case study work and seminars by external speakers. Additional multidisciplinary context (8) covered through option Bristol Futures optional units.</td></tr>
<tr><td>Methods of assessment:<br>Lecture material will be assessed by examinations and coursework. (Note that most of the lecture material in the course is in options drawn from existing provision.)<br>Projects and short courses will be assessed through reflective accounts, presentations and in-class exercises to enable fast efficient assessment and feedback. Seminar material will be assessed by participation monitoring and reflective accounts.</td></tr>
<tr><td colspan="2">B. Intellectual skills and attributes</td></tr>
<tr><td rowspan="2">Programme Intended Learning Outcomes:<br>Able to:<br>9. Conduct research in the field of robotics and autonomous systems<br>10. Analyse a problem to derive requirements and design of an autonomous robotic solution, if applicable.<br>11. Critically evaluate developments in robotics and autonomous systems.<br>12. Critically evaluate the potential for robotics and autonomous systems across a range of potential applications.</td><td>Learning/teaching methods and strategies:<br>Research preparation (9) and evaluation (11,12) will be taught through a mixture of lectures, seminars and reading groups (“journal clubs”). Problem solving (10) will be covered in group project work.</td></tr>
<tr><td>Methods of assessment:<br>Reflective accounts; presentations; assessment of technical project work; monitoring of participation in seminars and reading group, including in a journal club wiki.</td></tr>
<tr><td colspan="2">C. Other skills and attributes (practical/professional/transferable)</td></tr>
<tr><td rowspan="2">Programme Intended Learning Outcomes:<br>Able to:<br>14. Identify, access and interpret state-of-the-art research literature.<br>15. Communicate research findings, orally and in written form, to both specialist and general audiences.<br>16. Plan, execute and manage an extended individual research project.<br>17. Work effectively in a multidisciplinary team.</td><td>Learning/teaching methods and strategies:<br>Literature skills (14) will be introduced in research methods lectures and reinforced in the reading group.<br>Communication (15) will be taught in an externally-delivered short course. Individual and team working (16, 17) will be taught experientially through the group, industry and individual projects. Bristol Futures online courses will be exploited to support study skills development.</td></tr>
<tr><td>Methods of assessment:<br>Journal club participation; presentations; assessment of technical work.</td></tr>
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| **Intellectual development**<br>Please provide a statement of expectations from the students at each level of the programme as it/they develop year on year. | |
|---|---|
| **Undergraduate Programmes** | |
| Level C/4 - Certificate | n/a |
| Level I/5 - Intermediate | n/a |
| Level H/6 - Honours | n/a |
| Level M/7 - Masters | n/a |
| **Postgraduate Programmes** | |
| Level M/7 - Postgraduate Certificate | 60 credits to be completed in the taught modules, to include at least one of the two "Robotics Research Preparation" modules. Students will have the initial foundations needed to perform individual research in robotics and autonomous systems (RAS), including fundamental mechanical and computational skills and selected specialist knowledge. They will be able to state common applications, challenges, and contextual issues appropriate to RAS and to study and evaluate related research. |
| Level M/7 - Postgraduate Diploma | 120 credits to be completed in the taught modules, to include at least one of the two "Robotics Research Preparation" modules and at least one of "Robotic Systems" and "FARSCOPE Group Project". Students will have the initial foundations needed to perform individual research in robotics and autonomous systems (RAS), including fundamental mechanical and computational skills and in selected specialist topics related to RAS. They will be able to state common applications, challenges, and contextual issues appropriate to RAS and to study and evaluate related research. They will also be able to combine their skills to deliver an integrated robotic solution to a problem. |
| Level M/7 - Masters | 180 credits from the taught modules plus the dissertation. Note that the MRes degree will only be awarded to students electing to exit the CDT programme early, before completion of their PhD. Students will now be able to perform their own research at an internationally publishable standard. They will also be able to document and communicate their findings to peers and expert practitioners in the field. Their individual capabilities will be enhanced by teamwork and system integration skills. |
| Level D/8 - Doctoral | n/a |

## OTHER INFORMATION

**Additional relevant information (e.g. study abroad, information on placements, matters specific to professional courses).** Please mention any distinctive attributes of the programme that are special to Bristol.

The programme is delivered jointly by the University of Bristol and the University of the West of England. The 2 new units for this programme (robotics research preparation 1 and industry project) will be delivered by University of Bristol.

**Source for further information:**
*I.e. School website*

**http://farscope.bris.ac.uk** (not yet updated to reflect revised content)