UNIVERSITY *of York*

Department of Electronic Engineering : Programme Specification

MSc: Intelligent Robotics

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UNIVERSITY OF YORK
POSTGRADUATE PROGRAMME SPECIFICATION

This document applies to students who commence the following programme:
Awarding & Teaching institution: **University of York**
Department: **Electronics**
Award and programme title: **MSc in Intelligent Robotics**
Level of qualification: **Level 7 (Masters)**
Awards available only as interim awards: Postgraduate Diploma in Intelligent Robotics (exit point only for 120cu) Postgraduate Certificate in Intelligent Robotics (exit point only for 60cu)
Admissions criteria

Applicants are normally expected to hold (or expected to gain) the equivalent of a 2.1 honours degree or above from a university recognised by the University of York. This degree should either by in computer science, computer science/mathematics joint honours, electronic engineering or related subject. We are willing to consider applications from students with lower qualifications, particularly when the student has high marks in relevant modules and/or appropriate industrial experience.

For applicants whose native language is not English, the minimum University English language requirements of IELTS 6.0 (with at least 5.5 in each of the four language components) or the equivalent are required.

Length and status of the programme and mode of study:

Programme	Length (years) and status (full-time/part-time)	Start dates/months	Mode		
			Face-to-face, campus-based	Distance learning	Other
MSc in Intelligent Robotics	1 year full-time	October	Yes	No	N/A

Language of study: English

Programme accreditation by Professional, Statutory or Regulatory Bodies

Educational aims of the programme

For the Masters, Diploma and Certificate:

The MSc in Intelligent Robotics will provide the opportunity to learn about the growing area of mobile and autonomous robotics, and intelligent systems. You will gain experience in an exciting wide range of topics, providing you hands-on experience. You will learn about the development of embedded control systems for robots, intelligent algorithms and their application to robotics, communications and systems programming, all with a focus on the practical implementation, both in hardware and simulation. The MSc culminates in a large group project focussed on collective robotic systems, ranging from ground-based units to flying robots.

The MSc is intended for students who want to learn about robotic and autonomous systems for employment in related industries, or who are seeking a route into a PhD.

The broad aims of the programme are to provide:

- A thorough grounding in the use of scientific and engineering techniques as applied to intelligent robotic systems
- A detailed knowledge of the development and deployment of intelligent robotic systems
- A detailed knowledge of the latest developments in intelligent robotics and an ability to reflect critically on those developments
- A detailed understanding of engineering collective robotic systems with emergent behaviours
- Experience of undertaking a substantial group project, on a subject related to research in autonomous robotic systems

Additionally for the Diploma (if applicable):
Students will also have developed research skills and will be well-prepared to enter academic or industrial research, with communication ability developed to allow engagement with specialists and the general public.

To provide experience of undertaking substantial literature review and the development of a report

detailing issues related to autonomous robotics engineering.

Additionally for the Masters:
To provide experience of undertaking a sizeable group project, on a subject related to research in intelligent robotic systems.

- ‣ To prepare students for entry into research degrees or research projects.
- ‣ To expose the students to the issues and challenges of a group project.

Diagrammatic representation of the programme structure by stage, showing the distribution and credit value of core and option modules

Autumn Term	Spring Term	Summer Term	Summer Vacation
Control Systems Engineering for Robotics [ELE00093M] 20 CU, Level 7		**Group Robotics Project** [ELE00094M] 60 CU, Level 7	
Practical Robotics [ELE00095M] 20 CU, Level 7		**Critical Evaluation of Intelligent Robotic Systems** [ELE00096M] 30 CU, Level 7	
Swarm Intelligence [ELE00068M] 10 CU, Level 7	**Data Communication Techniques** [ELE00040M] 10 CU, Level 7		
C Programming for MSc [ELE00107M] 10 CU, Level 7	**Neural Networks for MSc** [ELE00058H] 10 CU, Level 6 P/F		
	Systems Programming for Embedded Devices [ELE00063M] 10 CU, Level 7		

| Intended learning outcomes for the programme – and how the programme enables students to achieve and demonstrate the intended learning outcomes |
|---|
| |
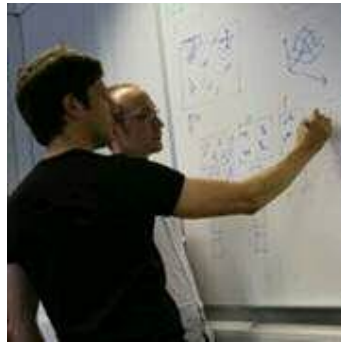
A: Knowledge and understanding

The MSc in Intelligent Robotics at York emphasises a practical focus on the development of intelligent robotic systems, in particular mobile autonomous systems, an area that increasing in use in everyday life. The course blends the practical with academic knowledge in state if the art approaches in artificial intelligence such a neural networks and swarm intelligence. The programme provides advanced knowledge and transferable skills in the design, modelling, implementation and evaluation of state-of-the-art robotic systems, enabling graduates to contribute effectively to the increasingly complex and rapidly evolving technologies that are increasing in industry and research. The programme therefore offers excellent job prospects to graduates who aim to work in areas related to robotic systems, autonomous systems, embedded systems as well as academic prospects for further research.

Our teaching and course content is informed by current research and industry collaborations. It will be delivered through a balanced mix of lectures, laboratory sessions and workshops, and will be assessed through a variety of continuous assessments and closed-book examinations.

Knowledge & Understanding	Module	Delivery & Assessment
A detailed knowledge of design, implementation and testing of software for the control of single and multiple robotic systems.	**Practical Robotics**	Lectures, laboratories and open assessment.
A detailed knowledge of control systems as applied to a robotic system. Study of fundamentals in control, transforms, PID control and appropriate software.	**Control Systems Engineering for Robotics**	Lectures, Workshops, closed examination.
Concepts of software design and the techniques of computer programming. Study the C programming language to allow for the understanding of basic programming principles.	**C Programming for MSc**	Lectures, Computer Laboratories. Programming Exercise.
Swarm and collective systems and associated biological concepts and their application to robotics. Focus on swarm robotics and simulation of multiple robot systems.	**Swarm Intelligence**	Lectures, laboratories and open programming assessment.
Real-time systems – definition, design and characterisation. Fault-tolerant design. Real-world case examples. Instruction pipelines. Memory systems. CPU architecture.	**Data Communication Techniques**	Lectures. Closed-book examination.
Neural processing and the development of artificial neural networks. Analysis skills and understanding how neural networks can be used as information processing systems.	**Neural Networks for MSc**	Lectures, workshops and closed assessment.
A detailed knowledge of the latest developments in a field of intelligent robotics and an ability to reflect critically on those developments.	**Critical Evaluation of Intelligent Robotic Systems**	Workshops, individual supervisions. Individual report.
Understanding of how taught and researched material is applied in an engineering setting.	**Group Robotics Project**	Lectures, supervisions. Group reports, Individual reports.
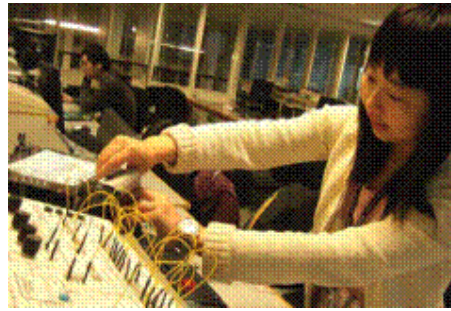
B: (i) Skills: Discipline-related

The programme combines hands-on experience with scientific theory to develop industry and research relevant skills in intelligent robotics, embedded systems, control systems and group working in order to prepare graduates for entry into research degrees or industry practice.

Modules taught range from fundamental topics (control systems engineering, systems programming and data communication) to advanced subjects (collective robotic systems, and intelligent systems). Students will acquire strong skills in developing a wide range of robotic control systems, adaptive and intelligent approaches to control and deployment of controllers on hardware.

Discipline-related Skills	Module	Delivery & Assessment
Control system design and implementation, communications and embedded systems programming.	Practical Robotics	Lectures, laboratories and open assessment.
Control systems, reactive control, embedded systems.	Control Systems Engineering for Robotics	Lectures, Workshops, closed examination.
Programming: assignment including design, implementation and testing, carried out during laboratories.	C Programming for MSc	Lectures, Computer Laboratories. Programming Exercise.
ollective robotics design and programming, communications, optimisation and control.	Swarm Intelligence	Lectures, laboratories and open programming assessment.
Understand practical digital communications techniques such as clock embedding and recovery, line coding, DC balancing, serialisation and de-serialisation, buffering and buffer control.	Data Communication Techniques	Lectures. Closed-book examination.
Neural networks for decision making, learning and adaptive systems.	Neural Networks for MSc	Lectures, workshops and closed assessment.
Robotic control, systems design and experimental development and analysis.	Critical Evaluation of Intelligent Robotic Systems	Workshops, individual supervisions. Individual report.
Design, reasoning and implementation skills in a specialist area of robotic systems. Analysis of a developed robotics system.	Group Robotics Project	Lectures, supervisions. Group reports, Individual reports.

B: (ii) Skills: Transferable

The programme offers a number of excellent opportunities to develop transferable skills with the aim to enable students to transfer their discipline-related knowledge and skills effectively to the working place. The most prevalent component is the final group project exposing students to issues related to working and resolving independently challenges of an extended research project, which is shaped in the form of a realistic design task designed to bring together

all taught aspects of the programme in a single project.

Industry's as well as our own experience shows that teams of several students working together in a coordinated environment are often considered an ideal way in which hardware, software and integrated systems can be developed.

Transferable skills of project management, interpersonal skills, presentation and technical writing are taught as part of the Group project. In addition to skills developed through academic programmes, the University's York Award can help students to plan and reflect on their experience and gain certification for many extra-curricular activities.

Transferable Skills	Module(s)	Delivery & Assessment
Design, problem solving, research skills.	**Practical Robotics**	Lectures, laboratories and open assessment.
Programming, mathematics.	**Control Systems Engineering for Robotics**	Lectures, Workshops, closed examination.
Critical reading, critical writing, research skills, report writing skills.	**Swarm Intelligence**	Lectures, laboratories and open programming assessment.
Critical reading, programming, mathematical analysis.	**Neural Networks for MSc**	Lectures, workshops and closed assessment.
Critical reading, critical writing, research skills, report writing skills.	**Critical Evaluation of Intelligent Robotic Systems**	Workshops, individual supervisions. Individual report.
Preparing and delivering presentations, effective group working skills (communication and collaboration), time management, project management.	**Group Robotics Project**	Lectures, supervisions. Group reports, Individual reports.

Overview of modules by stage

Core module table

Module Title	Module Code	Credit Level[1]	Credit Value[2]	Terms Taught	Pre-requisites	Assessment Rules[3]	Timing and format of main assessment[4]
C Programming for MSc	ELE00107M	7/M	10	AuT	Department of Electronic Engineering standard MSc entrance requirements or equivalent.		SpT Coursework
Control Systems Engineering for Robotics	ELE00093M	7/M	20	AuT & SpT			SuT week 1 Examinations
Critical Evaluation of					Modules detailed for MSc		SuT

Intelligent Robotic Systems	ELE00096M	7/M	30	SuT	in Intelligent Robotics		Coursework
Data Communication Techniques	ELE00040M	7/M	10	SpT	N/A		SuT week 1 Examinations
Group Robotics Project	ELE00094M	7/M	60	SuT	Critical Evaluation of Intelligent Robotic Systems		SuV Coursework
Neural Networks for MSc	ELE00058H	6/H	10	SpT	None	P/F	SuT week 1 Examinations
Practical Robotics	ELE00095M	7/M	20	AuT & SpT			SpT & SuT Coursework + SuT week 8 Examinations
Swarm Intelligence	ELE00068M	7/M	10	AuT			SpT Coursework + SuT week 8 Examinations
Systems Programming for Embedded Devices	ELE00063M	7/M	10	SpT	Core for MSc DSE, IWC & Autonomous Robotics. MSc students: None.		SuT Coursework

[1] The **Credit Level** is an indication of the module's relative intellectual demand, complexity and depth of learning and of learner autonomy (Level 4/Certificate, Level 5/Intermediate, Level 6/Honours, Level 7/Masters).

[2] The **Credit Value** gives the notional workload for the module, where 1 credit corresponds to a notional workload of 10 hours (including contact hours, private study and assessment).

[3] **Assessment rules**

   P/F = the module marked on a pass/fail basis (NB pass/fail modules cannot be compensated).
   NC = the module cannot be compensated.
   NR = there is no reassessment opportunity for this module. It must be passed at the first attempt.

[4] **Timing and format of main assessment**

   AuT = Autumn Term.
   SpT = Spring Term.
   SuT = Summer Term.
   SuV = Summer Vacation.

Relevant Quality Assurance Agency benchmark statement(s) and other relevant external reference points (e.g. National Occupational Standards, or the requirements of Professional, Statutory or Regulatory Bodies)
Framework for Higher Education Qualifications in England, Wales and Northern Ireland – August 2008 http://www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/FHEQ08.pdf IET Accreditation – October 2014: http://www.theiet.org/academics/accreditation/policy-guidance/

University award regulations

To be eligible for an award of the University of York a student must undertake an approved programme of study, obtain a specified number of credits (at a specified level(s)), and meet any other requirements of the award as specified in the award requirements and programme regulations, and other University regulations (e.g. payment of fees). Credit will be awarded upon passing a module's assessment(s) but some credit may be awarded where failure has been compensated by achievement in other modules. The University's award and assessment regulations specify the University's marking scheme, and rules governing progression (including rules for compensation), reassessment and award requirements. The award and assessment regulations apply to all programmes: any exceptions that relate to this programme are approved by University Teaching Committee and are recorded at the end of this document.

Departmental policies on assessment and feedback

Detailed information on assessment (including grade descriptors, marking procedures, word counts etc.) will be available in the written statement of assessment which applies to this programme and the relevant module descriptions. These will available in the student handbook and on the Department's website prior to commencement of the programme.
https://www.elec.york.ac.uk/

University Regulations:

https://www.york.ac.uk/about/organisation/governance/corporate-publications/ordinances-and-regulations/regulation-5/#5.7

Information on formative and summative feedback to students on their work will be available in the written statement on feedback to students which applies to this programme and the relevant module descriptions, which will be published online through the Department's website:
https://www.elec.york.ac.uk/

Transfers out of or into the programme

None.

Exceptions to University Award Regulations approved by University Teaching Committee

Exception	Date approved

Quality and Standards

The University has a framework in place to ensure that the standards of its programmes are maintained, and the quality of the learning experience is enhanced.
Quality assurance and enhancement processes include:

- The academic oversight of programmes within departments by a Board of Studies, which includes student representation
- The oversight of programmes by external examiners, who ensure that standards at the University of York are comparable with those elsewhere in the sector
- Annual monitoring and periodic review of programmes
- The acquisition of feedback from students by departments.

More information can be obtained from the Academic Support Office:
https://www.york.ac.uk/about/departments/support-and-admin/academic-support/

Date on which this programme information was updated:	31/07/2017 TH
Departmental web page:	https://www.elec.york.ac.uk

Please note

The information above provides a concise summary of the main features of the programme and learning outcomes that a typical students might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the leaning opportunities that are provided.

Detailed information on learning outcomes, content, delivery and assessment of modules can be found in module descriptions.

The University reserves the right to modify this overview in unforeseen circumstances, or where processes of academic development, based on feedback from staff, students, external examiners or professional bodies, requires a change to be made. Students will be notified of any substantive changes at the first available opportunity.

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