OXFORD BROOKES UNIVERSITY

PROGRAMME SPECIFICATION

for the award of

BSc (Hons) Robotics

Managed by the Faculty of Technology, Design and Environment

Delivered by the School of Engineering, Computing and Mathematics

Date approved:	Feb 2019
Applies to students commencing study in:	September 2021

RECORD OF UPDATES

Date amended*	**Nature of amendment****	**Reason for amendment****
October 2020	Change of final year project module code to COMP6013. & change to Level 6 module offering – remove COMP6009	Subject specific project modules codes have been merged into a single module code. Level 6 module has been replaced with another compulsory module to better fit with the programme structure.
May 2020	Removal of compulsory module for ordinary degree to ensure the credits do no go over 60 credits at level 6. ROBO6002 removed for an Ordinary degree	Too many compulsory module credits were listed meaning 75 credits were needed to get an ordinary degree which is outside of regulations.
February 2020	Adjustment to New Academic Framework	New Academic Framework prohibits level 5 modules to be taken at level 6. Adjustment to one module to comply with the framework
January 2018	**Revalidation**	**To better focus the module offering and better align the programme with**

		market expectations.
July 2016	**Transferred to new template, Ordinary degree requirements.**	**CMA Compliance**
October 2016	**Checked for errors and amended by Subject Coordinator and Programme Lead.**	**Subject specialist knowledge.**
July 2017	**Amends to module U08007 and addition of U08013**	**Ma or and minor changes**

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SECTION 1: GENERAL INFORMATION

Awarding body:	Oxford Brookes University
Teaching institution and location:	Oxford Brookes University, Wheatley Campus
Language of study:	English
Final award:	BSc (Hons)
Programme title:	Robotics
Interim exit awards and award titles available:	CertHE, DipHE, BSc
Brookes course code:	RO
UCAS code:	7M23
JACS code:	I100
HECoS code:	See guidance note G2.2, section 1
Mode of delivery:	Full-time (face to face/on-campus) Part-time (face to face/on-campus)
Mode/s and duration of study:	Full-Time 3 years Part Time 6 years Sandwich Mode (Full-Time) (placement in year 3) 4 years Sandwich Mode (Part-Time) (placement in year 3) 7 years In all cases the maximum length of registration is 8 years
QAA subject benchmark statement/s which apply to the programme:	Computing (2016) Subject Benchmark Statement: Computing
Professional accreditation attached to the programme:	Applying for CITP and CEng (partial fulfilment)
University Regulations:	The programme conforms to the University Regulations for the year of entry as published/archived at: http://www.brookes.ac.uk/regulations/

SECTION 2: WHY STUDY THIS PROGRAMME?

Robotics is an exciting, and rapidly developing area driven by innovation that is radically changing the world we live in. This Robotics course provides a unique opportunity to develop highly marketable skills in the key areas that define modern robotics.

Modern robotic systems strongly depend on the e ective integration of computer science and robotic engineering. This course involves studying almost the entire robotic system; from the low-level hardware, through the middleware control systems, all the way up to cognitive robotics at the highest level. The integration of robotic systems engineering and computing will allow you to become a skilled computer scientist capable of developing advanced integrated robotic systems.

Our approach to teaching combines technical expertise with creativity and imagination. On this course you will make use of our modern well equipped workshops, laboratories, computer facilities, media studios, and of course, our state-of-the-art robotic systems that you will study and develop. These include the Baxter research robot[1], the Nao humanoid robot[2], and Robothespian[3]. This course has been developed to meet the requirements of the emerging robotics market, and is under- pinned by world leading robotics research in the department.

We are known for having a friendly, and inclusive community of sta and students on the Wheatley Campus.

Students completing the programme will initially learn the fundamental principles of computer science and robotic engineering. The theoretical components will be examined and the coursework will give students the opportunity to demonstrate competence in the practical application of the theoretical principles taught. Through project based learning and small scale robotic system development students will develop the problem solving skills needed to develop and integrate software and hardware components in a functioning robot. The final year project will provide an opportunity to put into practice the range of theory and practical skills that have been acquired by the creation of a robotics system to solve a significant problem.

Please refer to the following link to view the staff profiles within the Department of Computing and Communication Technologies:

https://www.brookes.ac.uk/ecm/about/staff/

[1] http://www.rethinkrobotics.com/products/baxter

[2] http://www.aldebaran.com/en

[3] https://www.engineeredarts.co.uk/

SECTION 3: PROGRAMME LEARNING OUTCOMES

On successful completion of the programme, graduates will demonstrate the following Brookes Attributes:

3.1 ACADEMIC LITERACY

A1	Contribute to the creation of new software artefacts by applying the key concepts and ways of working derived from a deep understanding of the fundamental principles of computer science as informed by robotics engineering concepts and practices.
A2	Incorporate risk management and an understanding of security issues in the design, development, maintenance and use of information and robotic engineering systems.
A3	Apply principles and theoretical aspects of computer science, electronics, and mathematics to the analysis, construction and evaluation of software artefacts and robotic systems.
A4	Create integrated robotic systems from software, electronic and mechanical components.

3.2 RESEARCH LITERACY

R1	Apply the scientific method and report findings using accepted formalisms.
R2	Identify and utilise trustworthy information sources, such as the IEEE Digital Library to develop a coherent understanding of issues in computing and robotics.
R3	Apply active research skills to a small scale research project in the context of an existing research theme.

3.3 CRITICAL SELF-AWARENESS AND PERSONAL LITERACY

C1	Evaluate and reflect on the evolution of their strengths and weaknesses across the range of subject based competences involved in computing and robotic systems.
C2	Apply self-awareness in evaluating their impact in team based work and utilise appropriate communication and problem resolution strategies.

3.4 DIGITAL AND INFORMATION LITERACY

D1	Use appropriate technologies such as online libraries and databases to find, critically evaluate and utilise both non specialist (e.g. reports) and technical (e.g.

	APIs and Electronic and Mechanical Component Data sheets) information.
D2	Demonstrate proficiency in a range of formal and informal modes of communication such as giving presentations to groups, writing reports and writing appropriate documentation.

3.5 ACTIVE CITIZENSHIP

G1	Demonstrate an awareness of, and work in a manner guided by, the legal, professional, ethical and social issues relevant to the IT and Robotics industry.
G2	Evaluate the impact of the development, use and maintenance of integrated robotic engineering systems in commercial, economic and social contexts in both national and international settings.

SECTION 4: CURRICULUM CONTENT & STRUCTURE

4.1 PROGRAMME STRUCTURE AND REQUIREMENTS:

Code	Module Title	Credits	Level	Status	Coursework: Exam ratio
Level 4					
COMP4003	Information Systems	15	4	Compulsory	100:0
COMP4004	Problem Solving and Programming	30	4	Compulsory	100:0
COMP4005	Introduction to Object Oriented Programming	15	4	Compulsory	50:50
COMP4009	Foundations of Computing Systems	15	4	Compulsory	100:0
ROBO4001	Introductory Robotics	30	4	Compulsory	100:0
MATH4004	Mathematics for Computing	15	4	Compulsory	50:50
Level 5					
COMP5001	Foundations of Computation	15	5	Compulsory	0:100
COMP5004	Software Development with C and C++	15	5	Compulsory	50:50

COMP5022	Innovative Product Development	30	5	Compulsory	100:0
COMP5017	Data Structures and Algorithms	15	5	Compulsory	100:0
COMP5020	Foundations of Security	15	5	Compulsory	50:50
ROBO5003	Advanced Robot Control	15	5	Compulsory	100:0
ROBO5002	Robotic Systems Engineering	15	5	Compulsory	100:0
DIGP5014	Independent study Level 5	15	5	Optional	100:0
Level 6					
ROBO6004	Mobile Robotics	15	6	Compulsory	100:0
COMP6011	Machine Learning	15	6	Compulsory	100:0
COMP6031	Cloud Computing & the Internet of Things	15	6	Compulsory	100:0
ROBO6001	Cognitive Robotics	15	6	Compulsory	100:0
ROBO6002	Real-time Embedded Robotic Systems	15	6	Compulsory	100:0
COMP6013	BSc Computing Project	30	6	Compulsory	100:0
COMP6025	Machine Vision	15	6	Compulsory	50:50
Optional and additional to the compulsory level 6 modules. Students to elect when required.					
COMP6010	Independent Study Level 6	15	6	Optional	100:0

4.2 PROGRESSION AND AWARD REQUIREMENTS

The level 4 modules are compulsory for the BSc (Hons) Robotics, BSc Robotics, DipHE Robotics, and CertHE Robotics

All level 4 credits plus the following Level 5 modules are compulsory for a Named DipHE:
COMP5001, COMP5017, COMP5020, RBO5002, ROBO5003.
The remaining level 5 and level 6 modules are optional but the total number of credits must be equal to 240.

All level 4 credits plus the following modules are compulsory for a BSC Ordinary Degree in Robotics: COMP5001, COMP5017, COMP5020, RBO5002, ROBO5003, COMP6011, COMP6025, ROBO6001, ROBO6004.
The remaining level 5 and 6 modules are optional but the total number of credits must be equal to 300

4.3 PROFESSIONAL REQUIREMENTS

Successful completion of the course meets the professional requirements.

SECTION 5: TEACHING AND ASSESSMENT

Formally scheduled teaching is generally in the form of lectures, tutorials, computer labs, robotics labs or apprentice mode sessions. Each 15 credit module has 150 learning hours associated, with it, and of these, 36 (3 hrs x 12 weeks) are formally scheduled teaching. These figures are doubled for a double module, such as U08008. As students generally take 4 modules per semester, they are thus expected to attend 12 formally scheduled teaching hours per week.

The 3 contact hours per week on a module are broken down into either a 1 hour lecture and 2 hour practical session, or a 2 hour lecture and a 1 hour practical session, depending on the module. Lectures are attended by all the students on the module, and give students the opportunity to acquire knowledge and understanding of the key concepts in the subject. Practical sessions and tutorials are smaller groups of 1 tutor, with less than 20 students, and enable students to practice essential skills in a variety of contexts, as well as, build a wide set of experiences on which to reflect, and develop professional expertise. For more technical skills, including robotics and programming, the practical elements will be based around laboratory classes, allowing students to experiment with the technology in a controlled environment.

Some of our core programming modules and some robotics modules are taught in an apprentice style. These use a different format which involves a 3 hour session where the time is made up of repeating a sequence of

- the lecturer giving a short presentation from slides,
- the lecturer working through examples where they use the technique or concept being taught
- the students carrying out exercises to practice the technique or concept for themselves with the lecturer providing help and feedback.

This style of teaching for programming takes place mainly in computer labs with 1 tutor and less than 20 students but sometimes in a larger computer lab with 2 tutors and less than 35 students. For robotics it takes place in a dedicated robotics lab with 1 tutor and less than 20 students.

Outside of the 36 hours scheduled teaching, the remaining 114 hours associated with a module are split up roughly along the lines of a third of the module time being involved in directed work, or independent study, with the remainder used to prepare for assignments, background reading, research etc. The actual breakdown varies on a module by module basis.

Outside of formally scheduled teaching hours, all teaching staff provide 3 to 4 hours of “Office Hours”, which are times that they schedule each week for students to turn up without an appointment to get help and advice with their work when needed. Appointments can also be made if a student wants to see a tutor outside of their “Office Hours”, usually via email.

Coursework provides the majority of the assessment on this course in a ratio of approximately 85:15 coursework: exam. This can vary slightly depending on which optional modules are chosen. It should be noted that timed computer based tests, such as write a piece of software to solve this problem, are regarded as coursework rather than exam, and these class tests take place on some of the programming related modules.

Several modules will include an element of team working, enabling students to collaborate with their peers, developing an awareness of their own abilities as reflected by feedback from others. Team work will also be used to assess the students’ acquisition of personal and inter-personal skills, so

important for this degree, and equally important for most career paths in the industry.

Compulsory modules provide a balance of assessments, appropriate to the learning outcomes of the programme. In particular, early modules are assessed on the basis of key technical, professional and learning skills, chosen to enable and enhance a student's aptitude for life-long learning. As students master key skills, the issues associated with quality products and processes will play an increasingly important part of the module content.

The assessment strategy on this programme implements the Oxford Brookes University Assessment Compact. The assessments on this programme have been designed to ensure that graduates possess the necessary technical skills, shaped by the underlying theory, that are required by the robotic engineering industry. Feedback on the assessment tasks will emphasise the achievements of the learning outcomes of the modules and the programme. In addition, continuous formative feedback will be given to students through the problem based learning modules, either through laboratory sessions or individual tutorial guidance. Students will be encouraged to relate the assessment tasks with professional activities, and to relate their achievements with professional standards.

A year's industrial placement is an optional part of the programme and if chosen is taken in the third year of study before returning to Brookes for a final year to complete the degree.

The department is committed to inclusivity and diversity in its teaching. By the very nature of the discipline, virtually all of our teaching material is available in an accessible format, for which we follow best practice guidelines, and make our electronic material available before the lectures. We also use electronic references and ebooks to further enhance accessibility. Inclusivity and diversity is also embedded in what we teach. As such all new students have a lecture on inclusivity and diversity as part of their induction and important inclusivity and diversity topics such as the need for accessibility and internationalisation and how to achieve them are taught on a variety of modules throughout the degree.

SECTION 6: ADMISSION TO THE PROGRAMME

6.1 ENTRY REQUIREMENTS

Prior qualifications necessary for entry to the programme, including English language requirements.

From 2017 entry, typical offers:

A-LEVEL BBC or equivalent
IB 30 points, preferably including science
BTEC National Diploma with a DDM profile, preferably in a science subject
UCAS 112 points

Points may be counted from qualifications equivalent to 3 A-levels only.

Please follow this link for details of the new UCAS Tariff: _https://www.brookes.ac.uk/studying-at-brookes/how-to-apply/entry-requirements/ucas-tariff/achieving-112-points/_

Specific entry requirements

- GCSE: Mathematics at grade C minimum, and English Language at grade C minimum.

SECTION 7: PREPARATION FOR EMPLOYMENT

Graduates from this programme will develop a career in a dynamic and emerging market for advanced robot systems across a broad spectrum of application areas. The programme gives

students a thorough grounding in the practice of computer science and integrates this with the theory and practice of robotic systems. Graduates will be well positioned to take up careers in industry such as Robotics Engineer, Control Engineer, and Software Engineer, with the ability to specialise in Systems Integration.

There are very strong international trends in the field of robotics, major corporations such as Apple, Amazon and Google are investing heavily in the field beyond the already existing interest of manufacturers and defense industries. The European Research Council has opened two new calls for research in robotics next to the existing research targets for ICT. Growth of the robotics field, both in terms of employment and expenditure, has been significant even through the current recession. It is also recognised as a UK essential growth market by the British government.[4,5,6]

The external technological factors are based on the industrial technology and governmental forecasts. The growth of the robotics market is continuing in the industrial sectors but has seen significant growth in precision manufacturing and service sectors. A recent study of the International Federation of Robotics has shown that the robotics industry itself is responsible for the creation of close to three million jobs world- wide with an expected growth of another million by 2016.[7]

Many modules use guest speakers from industry to illustrate the practical application of the module material.

All students may take a year out in industry. Employers are keen to promote their companies and the opportunities o ered. Even for students who do not take a placement year, this can provide a good insight into the type of jobs available, and the skills employers are looking for. Students who do take a work placement may bring ideas for final year projects back with them, and are noticeably more able to contribute in- sights into industrial applications to the modules they take in their final year.

The department maintains close links with the university Careers Office. Themed 'mini' careers fairs are organised by this o ce with technology being a common theme. Students are encouraged to use the facilities o ered, including CV workshops, and practice interviews and assessment centre activities.

An Industrial Advisory Board is run within the department, with senior employees of regional and representative organisations (including robotics companies) as members. The board is consulted on major initiatives within the department, including programme revalidation, possible research partnerships, future trends and directions, and the feasibility of new course o erings.

An alumni organisation has recently been formed in the department. The aim is to invite ex-students who are now in a variety of technical and managerial roles, to network with each other, and with our current students. It is anticipated that this organisation will be of great benefit to students starting out on their careers, as well as for more senior alumni looking to exploit the skills and expertise of the sta and students in the department.

Research centres within the department are actively involved with Knowledge Transfer Partnerships, and other links with employer organisations. For example, we have formed research links with Engineered Arts Ltd, who make Robothespian, Sony, Clearview Tra c, UKP World- wide, Nominet, WildKnowledge, and Omnima. One of the spin-o s from these activities is the on-campus presence of industrial-based experts in fields closely related to our degree o erings.

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[4] http://spectrum.ieee.org/automaton/robotics/industrial-robots/apple-amazon-and-now-google-an-exciting-time-for-robotics

[5] http://horizon-magazine.eu/article/robotics-2020-challenge-and-target-europe_en.html

[6] http://roboticsnews.co.uk/permalink/5986.html

[7] www.ifr.org/robots-create-jobs

The department has strong links with the leading manufacturers of robotics systems in the United Kingdom, and work closely with them on robotic system research and development.