Faculty of
Computing, Engineering
and Mathematical Sciences
BRISTOL

Faculty of Computing, Engineering & Mathematical Sciences

BSc (Hons) Robotics

Definitive Documentation - December 2003

Programme Specification

Section 1: Basic Data

Awarding institution/body	University of the West of England
Teaching institution	University of the West of England
Faculty responsible for programme	Computing, Engineering and Mathematical Sciences
Programme accredited by	N/A
Highest award title	BSc (Hons) Robotics
Default award title	BSc Robotics
Interim award title	Diploma of Higher Education, Certificate of Higher Education
Modular Scheme title (if different)	
UCAS code (or other coding system if relevant)	BUWE B80 H671
Relevant QAA subject benchmarking group(s)	Computing Engineering
On-going/valid until* (*delete as appropriate/insert end date)	On-going
Valid from (insert date if appropriate)	1st September 2004

Authorised by… **Date:…**

Version Code: 2

For coding purposes, a numerical sequence (1, 2, 3 etc.) should be used for successive programme specifications where 2 replaces 1, and where there are no concurrent specifications. A sequential decimal numbering (1.1; 1.2, 2.1; 2.2 etc) should be used where there are different and concurrent programme specifications

Section 2: Educational Aims of the Programme

The award in Robotics has the following general aims:

1. To prepare students for careers in organisations with an innovative research and development culture especially in-house development of novel hardware and software.

2. To inculcate in students problem-solving and other transferable skills that will be valuable to them in any career.

3. To prepare students for progressing to study for higher degrees in Autonomous Robotics, Intelligent Systems, Artificial Intelligence and Embedded Microprocessor Systems.

4. To continue the development of those general study skills that will enable students to become independent, lifelong learners.

The award in Robotics has the following specific aims:

1. To provide insight into, and practical skills in, the creation of intelligent autonomous robotic systems. This involves understanding the nature of intelligence in natural and artificial systems, and using the resulting insights to build smart technologies.

2. To develop the students' ability to make an immediate contribution to organisations engaged in the design of intelligent technologies of various kinds.

3. To develop the students' ability to solve complex problems in any domain, though with particular reference to the development of hardware and software suitable for autonomous robots.

4. To encourage the discerning use of reference material and technical information from a variety of sources, but especially scientific journals and technical reports in the areas of robotics and artificial intelligence.

Section 3: Learning Outcomes of the Programme

The award route provides opportunities for students to develop and demonstrate knowledge and understanding, intellectual skills, subject-specific skills and transferable skills., as shown below.

A. Knowledge and Understanding

Knowledge and Understanding of:	***Teaching/Learning Methods and Strategies***	***Assessment***
1. Program design concepts, methods, and notations; algorithms; 2. Design principles of electronic systems 3. Communications principles, systems and devices 4. A wide range of control architectures for robotic systems. 5. The various uses to which robots may be put, including manufacturing, domestic service, medicine, warfare, and entertainment. 6. The application of biological principles to the design of smart technologies, including neural networks, fuzzy systems, evolutionary computation and swarm intelligence. 7. The principle techniques and tools of artificial intelligence, including symbolic and subsymbolic processing.	Acquisition of 1 is through UFSEHE-30-1, UFEE69-20-2. Acquisition of 2 is through UFEE73-30-1. Acquisition of 3 is through UFEE76-30-2. Acquisition of 4 and 5 is through UFEEK7-30-1. Acquisition of 6 is through UFEEK9-30-3 but also through various optional modules. Acquisition of 7 is through UFCE4D-20-2 and UFCE4E-20-2 Throughout the programme, the learner is encouraged to undertake the practical application of theory knowledge learnt in other modules. Independent learning through reading and use of appropriate software is encouraged both to supplement and consolidate what is being taught/learnt and to broaden the individual knowledge and understanding of the subject. This is further emphasised in the project modules, UFEEK8-30-2 (group project) and UFEE63-30-3 (individual project). The three core modules will make extensive use of the Blackboard online learning system.	The outcomes are assessed through a variety of methods, including exams under controlled conditions and coursework assignments, some of which are based on practical laboratory investigations

B. Intellectual Skills

Intellectual Skills	*Teaching/Learning Methods and Strategies*	*Assessment*
1. Critical Thinking 2. Analysis 3. Synthesis of different types of information 4. Evaluation 5. Problem Solving 6. Appreciate problem contexts 7. Balance conflicting objectives	Intellectual skills are developed through tutorials that stimulate the student's analytical and problem-solving abilities and through laboratory practical sessions that stimulate the student's ability to design systems to a required specification. Specific use is made of appropriate software such as Mathematica and Matlab to analyse and interpret results. At all levels students are required to bring together knowledge and skills acquired in several modules and hence determine new ways of working. As the student progresses, the need to synthesise (3) ever-greater volumes of information and approaches into a coherent approach is developed and consequently so is their critical thinking (1). The final year project consolidates the development of these skills and also promotes intellectual independence and self-confidence. At level 1 Analysis (2), Evaluation (4) and Problem Solving (5) are developed on small-scale problems in various activities in a number of modules. Here the focus is on understanding the problem and then solving it free from the environmental implications of real-world problems and without the need to examine alternatives and to balance conflicting goals. At level 2 there is a move away from small-scale problems to the design of larger scale systems. With this comes the need to evaluate (4) alternative methods and designs and to balance conflicting objectives (7). Level 3 sees the move to specific application examples and with it the need to appreciate problem contexts (6) is developed as well as striking the right balance when facing conflicting objectives (7).	Robotics requires demonstration of all of the intellectual skills. At level 1 the focus in laboratory and programming coursework assessment, undertaken in a number of modules, is on the skills of Analysis (2), Evaluation (4) and Problem Solving (5). At levels 2 and 3 this branches out to include all the remaining skills. Independent reading is used to enable students to focus on their own areas of interest and in the process assess skills 1-4 in the submitted reports, essays and exam answers. Design-work requires demonstration of skills 1,2,5,6,7 and a number of coursework assessments and exam questions are devoted to such work. Finally, all of the examinations assess skills 1-4 whilst skills 5-7 are covered in many exams. The project modules, UFEEK8-30-2 (group project) and UFEE63-30-3 (individual project), with their assessment based on substantial report, further enhances intellectual skills

C. Subject, Professional and Practical Skills

Subject/Professional/Practical Skills	***Teaching/Learning Methods and Strategies***	***Assessment***
Students will be able to: 1. design and commission mobile robots 2. understand and design electronic circuits and systems 3. develop software, particularly for embedded processors and mobile robots 4. create different kinds of user interfaces for computational systems 5. perform adequate tests on hardware and software to test their reliability and robustness 6. to use existing components and frameworks to build new computational and robotic systems	Use of the Lego Mindstorms robotic invention system will help students to link theory and practice and build a variety of robots from year one. Skills 1 and 6 are developed in UFEEK7-30-1 and UFEEK8-30-2. Skill 2 is developed in UFEE73-30-1 and UFEE74-30-1. Skill 3 is developed in UFSEHE-30-1 and UFEE69-20-2. Skills 4 and 5 are developed in a variety of modules but particularly UFEE73-30-1, UFEE74-30-1, UFEE73-30-1, UFEE69-20-2. Throughout the programme, the skills listed are developed through a combination of theoretical discussion, practical laboratory based work, classroom based tutorial exercises and directed self-study. Tutorials consolidate material introduced in the lecture environment, which together with laboratory practice using appropriate software, facilitate application of theory to practical problems. Many of the skills listed are introduced at level 1 and then drawn into sharper focus at levels 2 and 3. The general teaching/learning method is therefore to impart these practical/professional skills by a process of moving from an overview of what is required to a specific application of an individual skill at a higher level. Some very specific skills are introduced at level 3. These are underpinned by the more generalised capabilities that are practised throughout the levels in most of the modules that contribute to the programme.	The possession of these skills is demonstrated both by the development of a practical piece of coursework (software) and by examination. The practical nature of the skills to be acquired means that some are specifically addressed by particular modules (2, 3). The more generic skills (1, 4, 5, 6) are assessed across the modules. Skills such as conformance to design and requirements (1, 2, 3) and the construction of adequate testing strategies (5) are fundamental to professional electronics and software development of any sort and thus contribute to the assessment of all the practical work produced.

D. Transferable Skills and Other Attributes

The skills developed in parts B and C above are highly valued in other areas and as such are highly transferable, for example:

1. problem structuring and formulation;
2. the critical interpretation of results to problem solving and analysis ;
3. ability to synthesize practical solutions from abstract problem formulations;

Transferable Skills and Other Attributes	***Teaching/Learning Methods and Strategies***	***Assessment***
1. Communication skills**:** to communicate orally or in writing, including, for instance, the results of technical investigations, to peers and/or to "problem owners".	1. Skill one is developed through a variety of methods and strategies including the following: ♦ Students maintain laboratory log books ♦ Students participate in electronic conferences, workshops, and groupwork sessions. ♦ Students participate in discussion tutorials ♦ Students present research topic findings in tutorials ♦ Students participate in individual tutorials ♦ Students collaborate on group projects	These skills are demonstrated in a variety of contexts including • examination • poster presentation. individual and group projects • Practical assignments • Portfolio of exercises In addition skill two is assessed by both peers and tutors.
2. Self-management skills: to manage one's own time; to meet deadlines; to work with others having gained insights into the problems of team-based systems development.	2. Skill two is developed through a variety of methods and strategies including the following: ♦ Students conduct self-managed practical work ♦ Students participate in practically-oriented tutorial laboratory sessions ♦ Students work through practical work-sheets in teams ♦ Students practice design and programming	
3. IT Skills in Context (to use software in the context of problem-solving investigations, and to interpret findings)	3. Skill three is developed widely throughout the programme.	

4. Problem formulation: To express problems in appropriate notations.	4. Skill four is developed through a variety of methods and strategies including the following: ♦ Students develop problem solving programs ♦ Students practice design and programming ♦ Students sketch designs of larger systems	
5. Progression to independent learning: To gain experience of, and to develop skills in, learning independently of structured class work. For example, to develop the ability to use on-line facilities to further self-study.	5. Skill five is developed through a variety of methods and strategies including the following: ♦ Students are encouraged to practice programming to extend their skills ♦ Students develop problem-solving programs ♦ Students are encouraged to research relevant topics ♦ Students are encouraged to use online facilities to discover information	
6. Awareness of professional literature: to read and to use literature sources appropriate to the discipline to support learning activities.	6. Skill six is developed through a variety of methods and strategies including the following: ♦ Students are encouraged to access online material	
7. Working with Others**:** to be able to work as a member of a team; to be aware of the benefits and problems which teamwork can bring.	7. Skill seven is developed through a variety of methods and strategies including the following: ♦ Students develop a database system in laboratory sessions	

Section 4: Programme Structure ***Note: This structure is indicative and subject to change***

BSc (Hons) Robotics

Bio-robotics New Module UFEEK9-30-3	Individual Project (Electronics) UFEE63-30-3	60 credits Option 1

Year 2P (Industrial Placement Year)

Robotics Group Project New Module UFEEK8-30-2	Symbolic Processing UFCE4D-20-2	Subsymbolic Processing UFCE4E-20-2	Introduction to Communication Systems & Signals UFEE76-30-2	Embedded Microprocessor Systems UFEE69-20-2
Introduction to Robotics New Module UFEEK7-30-1	Digital Design and Instrumentation UFEE73-30-1	Digital Systems Development UFEE74-30-1	Programming in C UFSEHE-30-1	

Core modules Option modules

Option 1

UQC137H3	UFCE4R-10-3	Intelligent Systems	UFE006S3	UFEE78-20-3	Mobile Communications
UFE023H3	UFEE7Q-10-3	Neural Networks & Fuzzy Systems	UEE008S3	UFEE5L-20-3	Digital Signal Processing
UEE062H3	UFEE6D-10-3	Project Management	UFC008S3	UFCE3K-20-3	Machine Learning
New Module	UFEEKB-20-3	Microcomputer Control Systems	UEE018S3	UFEE5S-20-3	VLSI Circuit and System Design
UQI141S3	UFIE9S-20-3	Multimedia Systems: Contexts & Applications			

PLEASE NOTE: REFER TO THE FACULTY ON-LINE INFORMATION SYSTEM FOR UP-TO-DATE STRUCTURE INFORMATION

http://www.cems.uwe.ac.uk/exist/index.xql

Section 5: Entry Requirements

The university's minimum requirements for entry to a degree apply to this programme. In addition entrants are required to have evidence of achievement in Mathematics at GCSE Grade C or equivalent and an 'A' Level or equivalent in a design, technology or science based discipline.

Section 6: Assessment Regulations

The Modular Assessment Regulations apply to this programme

Section 7: Student Learning: Distinctive Features and Support

Within the Faculty of Computing, Engineering and Mathematical Sciences, student learning will be supported in the following distinctive ways :

- Through provision of Open Access and other available computer laboratories that provide access to a range of relevant computer based applications
- Through provision of the CEMS System Support Helpdesk that provides a range of support for learning to students including :
    - Support for a wide range of applications used by the students;
    - Help in the form of Assistants who are trained to resolve many common student problems
    - And help in the form of a large set of 'help-sheet documents', developed over a number of years, that cover a variety of common student requests for information.
- Through specialist electronics, microprocessor development and autonomous robots laboratories.
- Technical support staff are available in laboratory sessions and during project work.
- Through active engagement with the Intelligent Autonomous Systems (IAS) Laboratory in CEMS, a leading-edge robotics research lab, students will gain access to developments at the cutting-edge of contemporary research in robotics. This engagement will take the form of provision for level-3 students to do project work in the IAS lab, joint seminars given by invited speakers, and the occasional contribution to undergraduate teaching by postgraduate students and postdoctoral researchers based in the IAS lab.

Class Activities The mode of delivery of a module is determined by its Module Leader, and typically involves a combination of one or more lectures, tutorials, 'lectorials', laboratory classes, group activities and individual project work. Modules which require laboratory classes are commonly delivered by means of a combination of lecture and practicals or tutorials. Other modules are often delivered by means of 'lectorials', classes for groups of 20-30 students with no distinction between lectures and tutorials, and this has proved to be an effective mechanism for modules at Level 0 and 1.

Academic Support Academic advice and support is the responsibility of the staff delivering the module in question. Staff are expected to be available outside normal timetabled hours, either by appointment or during published "surgery" hours, in order to offer advice and guidance on matters relating to the material being taught and on its assessment.

Pastoral Care The faculty's offers pastoral care through its Student Advisers, a team of staff who provide comprehensive, full-time student support service on a drop-in basis or by appointment. All students on the same route are allocated to the same Adviser, who is trained to provide advice on matters commonly of concern, including regulatory and other matters; the Adviser will, when necessary, advise the student to seek advice to from other professional services including the university's Centre for Student Affairs or from members of academic staff.

Progression to Independent Study

Many modules require students to carry out independent study, such as research for projects and assignments, and a full range of facilities are available at all sites to help students with these. The philosophy is accordingly to offer students both guided support and opportunities for independent study. Guided support, mainly in the form of timetabled sessions, takes the form of lectures, tutorials, seminars and practical laboratory sessions. Students are expected to attend all sessions on their timetable, and this is especially important because of the high content of practical work in the programme.

The progression to independent study will also be assisted by the nature of the support offered in individual modules. Typically, module leaders will provide a plan for the module indicating the activities to be carried out and the forms of learning to be undertaken during the delivery of the module, with a view to encouraging students to plan ahead and to take responsibility for managing their time and resources.

Computing Facilities The Faculty offers a specialised computing facility along side the general University provisions. There are nine general PC computing laboratories of 20 plus seats all running Windows2000, along with four Unix based laboratory and 10 specialist computing labs. The specialist laboratories are equipped with the specific software for CEMS students; including Software Design Tools development environment, CAD, finite element analysis, mathematics and statistics packages to support the taught program. The specialist Computing laboratories are designed to target the discipline taught in that area. Amongst these, is the Computer Systems Architecture and Linux laboratory. The Unix labs offer the latest web development and programming tools.

One of the most popular areas within the Faculty is the Open Access laboratory. This area is never time-tabled and gives students the opportunity to access machines at all times during opening hours. This is a mixed environment consisting of PCs and Unix workstations.

Due to the extensive computing facility provided within the Faculty, and the specialist nature of this facility, the need for user support is necessary. The Faculty provides a user support Helpdesk. The Helpdesk provides fist line support to the user base, uniquely supported by both permanent staff and students that are in their second or final year of study (employed on a part time basis) until 20.00hrs every day. These general purpose and specialist laboratories are available to students up until midnight, seven days per week.

Mathematics & Statistics Learning Centre
The MSLC offers a drop-in support centre for students studying mathematics or statistics from across the university. Within a dedicated room, it provides access to a variety of learning resources, including mathematics / statistics software, course handouts, software documentation and textbooks. The Centre is open-access until midnight during term-time, and is staffed for part of each day by a member of academic staff, who is available to help students on a drop-in basis.

Section 8 Reference Points/Benchmarks

In designing this programme, the faculty has drawn upon the following external reference points:

1. The QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland
2. The QAA Benchmark Statement for Engineering
3. The QAA Benchmark Statement for Computing
4. UWE's Learning & Teaching Strategy

The QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland describes the attributes and skills expected of Honours graduates. It is our view that the learning outcomes of this programme are fully consistent with the qualification descriptor in the Framework, and hence that graduates will be able to demonstrate that they meet the expectations of the Framework.

The **QAA Subject Benchmark Statement for Engineering** outlines a set of skills expected of a graduate in an engineering discipline (Section 4 of the Statement refers), while noting that they should be interpreted in the context of the particular engineering discipline which is being studied. These skills map closely to the skills contained in the learning outcomes for this programme, and hence we have confidence that the programme is in accordance with the precepts of the Statement.

The **QAA Subject Benchmark Statement for Computing** (para 2.1) identify a range of types of degrees in computing, from (at one extreme) a programme which "*covers a wide range of topics spanning the entire area of computing"* to (at another extreme) programmes which "*take one very specific aspect of computing and covers it in great depth"*. This proposal is closer to the second of these extremes but is important to recognize that this is in the context of a programme whose aims are primarily focussed in engineering. Hence the study of computing is carried out only to the level which is required to meet the needs of this programme.

UWE's Learning & Teaching Strategy has informed the faculty's policy for the delivery of its programmes, whose main features are described in section 7.