Submission for Validation November 2001

BSc & BSc (Hons) Computer Systems Engineering

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Part 1: Programme Specification

Section 1: Basic Data

1.1.1. Awarding Institution: UWE

1.1.2. Teaching Institution: UWE

1.1.3. Faculty Responsible for the Programme: CEMS

1.1.4. Programme Accredited by: BCS

The award will be proposed for accreditation by the BCS (British Computer Society) in line with the current status of the original Computing for Real-time Systems degree which has won exemption from the BCS Part I and Part II examinations. The threshold criteria laid down by the BCS are now under active review, and the new documents will shortly become available for Universities to consider. CEMS will probably request the BCS to consider a group of awards simultaneously, when the new guidelines become available.

The alternative accreditation route offered by the IEE (Institute of Electrical Engineering), will also be considered as the IEE does offer a well recognised graduate development programme leading in a structured manner to the award of CEng status. This scheme has been adopted by some engineering organizations, but is less common amongst IT-based enterprises.

1.1.5. Target Award Title: BSc (Hons) Computer Systems Engineering

The award of the degree shall comply with the standard university regulations, requiring the student to achieve a minimum of 360 credits, of which 100 must be at level 3, to be eligible for an honours degree. To achieve a pass degree, the student must have 300 credits overall, of which 80 must be at level 3.

1.1.6. Other Final Award Titles: BSc Computer Systems Engineering

1.1.7. Interim Award Titles: DipHE Computer Systems Engineering,
CertHE Computer Systems Engineering

1.1.8. Modular Scheme Title: Not yet determined

1.1.9. UCAS Code: n/a

1.1.10. QAA Subject Benchmarking Groups: Computing & Engineering

1.1.11. Valid Until:

1.1.12. Valid From: September 2002

Section 2: Educational Aims

1.2.1. Award history

Initial interest in the proposed new award, Computer Systems Engineering, arose through the merger of the Computer Studies and Engineering faculties. The members of staff involved are mainly associated with the new school of Electrical and Computer Engineering and have all been involved with the existing undergraduate degrees of Computing for Real-time Systems and Digital Systems Engineering. These were originally established in Sept 1985 within the then SEMAC faculty, as a collaborative faculty modular programme titled: Microelectronics, Computing and Instrumentation. The two sister degrees were led by Engineering and Computer Studies, with some involvement by the Science faculty.

The formation of CEMS has stimulated a number of new programmes which explore the tight relationship between hardware and software found in many contemporary products and systems. The academic intention is to configure the four degrees, Computing for Real-time Systems, Computer Systems Engineering, Computing and Telecommunications and Digital Systems Engineering to exploit an interrelated group of modules for the benefit of staff and students. This will comprise a new Modular Scheme dedicated to the area of Digital Electronics and Computer Systems Technology. Each of the four associated degrees will have its own principal focus that becomes fully expressed by the final year option subjects. Further differentiation will occur through divergence of practical laboratory exercises and the topics chosen by students for their final year projects.

1.2.2. Academic and Commercial Focus

The new award offers students the chance to study technical aspects of the architecture and performance of modern computer systems. This involves an investigation of aspects of digital electronics (hardware) and operating systems (software) thus resulting in a programme of work which draws on two discrete, but closely related disciplines: Computing and Digital Electronics. The scope of the award is concerned with the understanding, design and exploitation of new computer technology. This necessarily blends a group of academic disciplines: computing, engineering, mathematics and systems analysis. The problem domain is of great concern and relevance to a large number of equipment suppliers, as well as the much larger number of end-user enterprises.

The immediate neighbourhood of north Bristol, surrounding UWE, reflects the hi-tech industrial developments that have occurred stretching from Reading down the M4 into the South West region. A large number of hi-tech enterprises, both large and small, have a continual need for well qualified graduates in the Computing and Electronics fields. This situation has rapidly grown to the point where further expansion is limited by the available skills. The twelve graduation years which have now completed since the start of the BSc Computing for Real-time Systems and BEng Digital Systems, provide good evidence of the academic quality of graduates and their popularity with employers. They have generally sought and obtained technically oriented jobs with established firms promising good career prospects. It is interesting to note that BSc CRTS graduates command salaries which are amongst the highest throughout UWE, underlining the continuing need for technically skilled individuals. The programme team remain enthusiastically committed to the original vision of a technically focused curriculum which encompasses aspects of both hardware and software.

1.2.3. General Educational Aims of the Award Programme

The primary objective of this award is to develop an understanding of those particular aspects of computer architecture and system configuration which affect overall system performance. Computer facilities have evolved from straightforward networks of identical PC workstations, to a more diverse provision where large, multi-processor servers offer much of the processing power for remote users. This arrangement is referred to as a client-server architecture. Such a change in hardware and operating systems software demands a modification to the standard Computer Science and Electrical Engineering courses, with a greater emphasis on data communications and distributed processing. The revised programme should include the study of both hardware and software and their close interaction within a multi-processor computer system. The skills and understanding needed will include digital electronics, CPU architecture, data transmission, systems programming and administration. Design methods suitable for both hardware and software environments will be explored.

Although the principal aim is to equip students to contribute to the design and production of new computer components and systems, the programme will also enable students to work effectively in many other roles which depend on a thorough understanding of the principal technologies entailed in modern computer systems. Such opportunities exist within the industrial and and commercial sectors of IT. Graduates will be well placed to cope easily with new technological advances which will undoubtedly occur throughout their future careers.

The experience of running the well established BSc Computing for Real-time Systems programme has been exploited to develop and emphasise the importance of commercial context and professional issues through close discussions with industrial partners and feedback from students on placement. It is a principal aim to strengthen relationships with graduate employers and placement providers in order to maintain the relevance of technical skills and knowledge imparted to the students.

As is common with Engineering degrees, students are expected to develop a wide range of theoretical and practical skills. These include some computer-related cognitive abilities, practical problem solving strategies, originality in creative design, working effectively with colleagues, numerical estimation in addition to the use of simulation and modelling techniques for more exact prediction capability. They will also gain familiarity and competent fluency in the use of a typical set of tools which support the production of new software and hardware.

The programme includes as much practical work as possible to ensure that the students are confident selecting and using appropriate software tools within the context of contemporary methodology. This takes the form of laboratory exercises, developing the student's knowledge and practical skills, and also more open-ended exercises in which the students are able to demonstrate initiative and planning. Group work is popular with students and can be organised in a mildly competitive mode, leading to public presentations and peer assessment experience. Many benefits, wider than pure technical praxis, stem from these activities.

The general aims of the Modular Scheme are:

a) To be able to work in multi-disciplinary teams which may involve hardware designers, software engineers, and product managers.

b) To develop an understanding of the issues in digital systems design and be able to critically assess and exploit a wide range of design paradigms in the domain of computer systems and more generally in all areas of data transmission and processing.

c) To develop a professional approach to the engineering process and an awareness of ethical and commercial issues in product development and exploitation.

d) To develop skills in project management and the ability to tackle and solve problems in novel situations.

e) To accept and adopt a "life-long learning" approach to their career development.

f) To be able to design and implement new systems involving close interactions between software and hardware.

g) To adopt a flexible approach to skill acquisition and be open to new ideas and techniques as potential solutions to practical problems.

h) To adopt a self-critical and reflective approach to work with the aim of improving their performance by learning from experience.

1.2.4. Specific Award Aims

There is an increasing need for skilled engineers capable of working in mixed disciplinary teams involved in the development and support of complex, computer-based systems. As a consequence of the rapid growth in the use of computers within all aspects of our working lives, the pressure on suppliers to provide more powerful processors, at a lower price, has continually increased. In addition, the rise of the IP (Intellectual Property) market, in which chip specifications and designs are bought and sold for use by third party producers, has accelerated the demand for digital engineers capable of handling complex VLSI, gate array developments. As a result, it has become apparent that traditional skills in computer science and electronics have been out-paced and the acquisition of a more appropriate skill mix has been actively debated by academics and industrialists. The importance of expertise in this area is now well recognised and there remains a significant demand for engineers capable of dealing with problems which involve an understanding of both hardware and software.

The beginnings of a commercial trend is now apparent which will reverse the well established preference to migrate functionality away from specialist hardware devices into programmable control. This was originally driven by the high cost of bespoke hardware development and manufacture. With the emergence of CPLDs (Complex Programmable Logic Devices) it is now quite feasible to implement complex control applications entirely within hardware circuitry requiring no run-time executable code. Indeed, this technology also offers an easier route into custom CPU design as well as implementation.

This course attempts to fill the skills gap by providing students with sufficient expertise and technical understanding to work effectively in teams concerned with the development of new, innovative digital products. This aim requires a distinctly different emphasis to other courses offered within the faculty. In essence it is an applied computer technology degree which focuses on the more technical end of the spectrum, paying more regard to CPU design and performance issues than is normally possible.

The specific aims of the award are expressed in the ability of graduates -

a) To understand the system architecture of a several processors representing a range of technical solutions and to be able to offer an informed criticism of their architecture.
b) To be able to synthesise new computer systems from component parts.
c) To understand the techniques and measures used to compare the performance of different aspects of processor activity.
d) To be capable of designing and implementing a range of digital electronic circuits using industry standard components,.
e) To be able to take a functional specification and then design and implement a complex digital circuits using integrated devices.
f) To have knowledge of the range of programmable gate array devices available to electronic engineers.
g) To be capable of using efficiently all the necessary tools required for CPLD implementation.
h) To be capable of designing complex software using appropriate methodology.
i) To have good programming skills in low and high level languages.
j) To understand the structure and functionality of modern operating systems and appreciate the role of an operating system and in what way the underlying hardware supports its action.
k) To be capable of installing and maintaining an operating system.
l) To have practical skills and theoretical understanding to assist with problem identification and system debugging.
m) To participate in the decision making processes when establishing the hardware/software boundary within new products.
n) To appreciate the role and value of preliminary simulation studies in preparing for new developments. Be able to set up, carry out and analyse the results from such studies.
o) To be capable of choosing suitable tools to support the different phases of the development lifecycle: specification, design, implementation and test.
p) To understand the ways of increasing and maintaining product quality, from both the technical and personnel position.
q) To have the confidence to create new configurations in pursuit of better performance.
r) To plan and undertake verification and validation activities with regard to complex systems.

The essential need for a broad-based undergraduate course, covering a wide range of skills and academic subjects is still recognised, but the competing requirements for depth and quality, as implied within a degree programme with honours, must also be fairly acknowledged. The reconciliation of depth with breadth must be a prime responsibility of the course team, requiring some difficult compromises. Many changes to module syllabuses, or even the primary choice of module subjects, have been made as a result of active discussions with past students, placement supervisors and graduate employers.

1.2.5 Student Recruitment and Employment Opportunities

This award is intended for students who have good academic potential, but who also wish to retain a practical approach in their learning experience. Their medium term aspirations are directed towards a career in a technical capacity, moving on, in the long term to a managerial or entrepreneurial role. The normal academic structure and aims found within an honours degree are supplemented by the skills and experience offered by the placement period. In this regard, the commercial, pragmatic viewpoint often necessary within an industrial enterprise, will have to be reconciled by the students with the ideas and techniques learnt within the University classroom. Such a juxtaposition can greatly benefit both the individual and the organisation which employs them.

Students who successfully complete this four year degree programme are expected to extend their professional knowledge and skills in order to enable them to achieve one or more of the following aims:

a) to consolidate and extend the base of their knowledge and expertise in the core areas of Computing Technology, Systems Applications, Product Development, and Systems Administration.
b) to strengthen and expand their practical expertise in the design and implementation of programmable systems so as to become more effective and proficient as practitioners.
c) to gain a theoretical knowledge of a variety of systems application areas so as to adapt and move more readily between them during their future careers.
d) to obtain the knowledge and understanding to provide a sound basis for a successful career within the field of technology and associated service provision.
e) to widen their skill-base, and so enable them to interact more effectively with colleagues, and clients.
f) to more fully understand the relevance of their own academic studies to the world of commerce and industry.

Employers are still keen to recruit graduates with proven technical skills and the enthusiasm to undertake new project development. The reputation of the BSc Computing for Real-time Systems as a challenging award, supplying graduates with a good theoretical grasp as well as practical abilities, offers a useful launch pad for new awards which retain an association with the older course. It is noticeable how graduate interviews are now frequently arranged to include a searching technical assessment and a non-trivial practical test, indicating the growing suspicion that academic standards may be slipping. It is the strong intention of the award team that graduates from the new modular scheme will not be found deficient in any of the key areas covered within the award programme.

Section 3: Learning Outcomes

1.3.1. Specific Learning Outcomes

Undergraduate students require a course well founded in the basic academic principles which will serve them throughout their working lifetimes. Now more than at any other time, students face a future brimming with change and uncertainty. Their experience at University must in full measure prepare them for this challenge.

In addition to the above, students need to gain strong practical skills so that their initial transition into the job market will be easy and painless. The award attempts to cater for students from a variety of backgrounds and with differing needs imposed by rapidly evolving contemporary technology. The common factor linking all students is their technical enthusiasm and curiosity about the functioning of computer systems. They will enter with diverse practical experience and with the appropriate academic qualifications, requiring some degree of individual adjustment to higher education. On the other hand, it should be emphasised that all students are expected to have previous experience with the use of computers and some exposure to elementary electronics Indeed, in many cases it is this very experience which initially fired the curiosity to pursue such a course at university. The specific learning aims were presented in the previous section. On completion of the degree the student is expected to be able to give evidence of the following intellectual and practical skills:

A. Knowledge and Understanding

The student will develop and demonstrate a range of technical knowledge and understanding and will be able to:

a) rapidly assimilate complex technical ideas and skills,
b) work independently and in a self-disciplined manner to understand new material,
c) critically analyse information, especially with regard to particular applications,
d) apply a variety of systems analysis and design methods within different contexts,
e) use a range of abstract and practical techniques to analyse complex problems involving hardware and software,
f) understand the central importance of good communication within the work environment,
g) select and synthesise appropriate solutions from a variety of sources.

B. Intellectual Skills

On completion of the degree the student is expected to be able to give evidence of the following intellectual skills:

a) the ability to take a real-world problem, identify the principal technical issues involved, and undertake the analysis and system design work,
b) to seek out and employ effectively, relevant information and suitable techniques,
c) identify the appropriate roles for hardware and software within a system,
d) be able to choose and use appropriate implementation languages,

e) be able to choose an appropriate design method and then undertake systems design with that method,
f) be able to implement system designs and debug the prototype systems,
g) select and evaluate software tools,
h) undertake simulation trials of proposed designs through rapid prototyping,
i) where necessary and helpful, employ numerical estimation techniques.

C. Subject/Professional/ Practical Skills

On completion of the degree the student is expected to have developed the following subject-specific practical skills:

a) the application of appropriate tools, techniques and frameworks in all areas of systems development and use,
b) the installation and configuration of software packages,
c) the ability to actively participate in the development and introduction of efficient and effective information systems.
d) interpretation of design specifications, and implementation of code in a suitable language,
e) specification and purchasing of software tools,
f) production of technical literature at a variety of levels,
g) planning and creation of technical presentations for colleagues and clients.

D. Transferable Skills

On graduation the student is expected to have developed most of the following Transferable and Key attributes:

a) use of computers and standard software packages,
b) ability to communicate ideas, orally and in the written form,
c) effective group activities including: planning, problem solving and report generation,
d) project planning: estimating and recording,
e) effective use of the Web as a source of information,
f) administration of desktop PCs,
g) demonstrate a reflective, critical and creative approach to their work,

The award learning outcomes are developed within the modules as indicated in the following table:

CSE Table

MODULES / SKILLS	UFS001C1	UFS002C1	UFE001C1	UFE002C1	UFS001C2	UFS002C2	UFS003C2	UFE001 C2	UQP001XP	UQC120D3	UFS001S3	UFS002S3	UQC152H3	UQC154S3
1.3.1Aa	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1.3.1Ab	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1.3.1Ac						*	*	*	*	*	*		*	*
1.3.1Ad		*	*			*	*		*	*	*	*	*	*
1.3.1Ae	*	*	*	*		*		*	*	*	*	*	*	*
1.3.1Af					*				*			*		
1.3.1Ag	*	*	*	*	*	*	*	*	*	*	*		*	*
1.3.1Ba					*	*	*	*	*	*		*	*	*
1.3.1Bb					*				*	*	*	*		*
1.3.1Bc	*		*			*				*			*	*
1.3.1Bd					*	*	*			*			*	*
1.3.1Be							*		*	*				*
1.3.1Bf	*	*			*	*	*			*	*			*
1.3.1Bg		*			*	*	*		*	*	*		*	
1.3.1Bh		*				*	*			*	*	*		
1.3.1Bi	*	*	*	*	*			*	*	*	*	*		
1.3.1Ca	*	*			*	*	*		*	*	*			*
1.3.1Cb					*				*	*			*	*
1.3.1Cc							*		*	*		*		
1.3.1Cd	*	*			*	*	*		*	*			*	*
1.3.1Ce									*	*		*		*
1.3.1Cf	*	*					*		*	*		*		*
1.3.1Cg					*		*		*	*		*		*
1.3.1Da	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1.3.1Db	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1.3.1Dc	*				*	*	*		*			*		
1.3.1Dd					*				*	*		*		
1.3.1De	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1.3.1Df	*				*				*	*			*	*
1.3.1Dg	*	*	*	*	*	*	*	*	*	*	*	*	*	*

1.3.2. Assessment of Learning Outcomes

The students' understanding and practical skills, as listed in the previous section, will be demonstrated and assessed in a range of ways of which some examples are described below. In general the principal learning outcomes and the more specific technically-oriented items are checked and assessed in several modules and at many times through the year.

A. Knowledge and Understanding

a) The assimilation of complex technical ideas and structures will be assessed by coursework and terminal exams. In addition, the final year project provides an opportunity for close monitoring of the student's progress by their personal supervisor over an extended period.

b) University study requires students to work independently and in a self-disciplined manner to meet assignment deadlines and participate effectively in the group case-study exercises.
c) The ability to critically analyse technical information is routinely tested through the use of worksheets to guide weekly laboratory activity. Often these are far from complete, requiring considerable judgement on the part of the student. Assignment work will also include some written reports concerning technical aspects of the work. A comparative appraisal concerning alternative solutions is a familiar format for examination questions.
h) Often the students will be dealing with an extended problem in the guise of a systems case-study requiring analysis before the design activity can take place.
i) The ability to handle abstract reasoning as well as implementing practical solutions involving hardware and software, is demonstrated especially through the final year project.
j) Group working is now a common activity for students throughout the course. The central importance of good communications within a team will not pass unremarked. The role of the Placement Year is also important when considering preparation for the work environment.
k) The selection and use of existing tools, components and libraries is central to many of the modules offered on this award.

B. Intellectual Skills

a) Real-world problems are often too complex for students initially to deal with. Only after some experience with carefully structured, “academic” problems can they deal with the chaotic richness of a real-world situation. The students’ performance during their final year project is the clearest indicator of their success in meeting this ambitious target. However, the use of structured case-studies provides an interim stage for gaining experience and carrying out assessments.
b) The need to use libraries and WWW information sources are included as part of several coursework assignments. Again, the final year project specifically requires the display of such skills,
c) The opportunity to experiment with basic design decisions and migrate functionality between hardware and software can be an exhilarating experience. For example the use of FSM during the systems design phase does not constrain the implementation to either modality. This is clearly demonstrated during the second year introduction to VHDL,
d) Students will be capable of effectively using several programming languages by the end of the course. C, C++ and Java may all be chosen by the student to carry out a programming assignment in the final year. For systems administration the equivalent range would be offered by writing csh, sh, and perl scripts. Examination is not the most appropriate method of assessing programming skills, so a dossier of graded coursework is used .
e) Structured and object oriented design method s are presented and assessed in the first and second level programming modules. The application of a design methodology to a real problem has to be carried out if a computing software project is undertaken.
f) Programming assignments normally require a design, source code listing and the live demonstration of a prototype systems. This will require the successful application of debugging skills.
g) During the first year the student may be advised which tools to use, but as the course progresses more experience allows the free choice of tools. Often after the placement, students will adopt different tools from those principally supplied by the university.

h) Simulation trials followed by rapid prototyping is an increasingly popular method of developing new systems, both hardware and software. This is required as part of the first I/O assignment and the second level VHDL design.
i) The first level CSA module places some emphasis on the use of numerical estimation. The phase tests have many questions requiring quick calculations. The need for mathematical support throughout the award has been analysed, and each module has an explicit declaration and commitment in this regard.

C. Subject/Professional/ Practical Skills

a) The application of appropriate tools, and techniques is necessary to carry out many of the assignments. For example: editors, compilers, debuggers, simulators, word processors.
b) Systems Administration involves the installation and configuration of operating systems as well as software packages. This work is carried out in the second and third level modules as a group activity.
c) Students may develop and trial software during their Placement Year. However it is also common for them to choose to experience this as part of their project.
d) Programming assignments are often presented as functional specifications, requiring the student to design and produce code. Although the academic assignments have to be small in comparison to commercial examples, by working in groups, the size constraint can somewhat be overcome.
e) Very little opportunity arises for students to have practical experience of the specification and purchasing of software tools on behalf of the university. However, on placement, or as private purchasers, they do carry out such activity.
h) The production of a project report gives students a chance to test their skills in writing a lengthy item of technical literature . Otherwise, much shorter reports are required as part of coursework assessments. These are important, partly as a means of maintaining writing skills so necessary for examinations.
i) Students are required to prepare and present seminars to their colleagues. An example would be on returning from placement, they will give a presentation to the second year students about their successes and failures during the preceding year.

D. Transferable Skills

a) All the students will use computers and standard software packages throughout the course. There will be no specific training or assessment imposed, mainly because the students have already succeeded at A-level or BTEC with computing or IT involvement.
b) The ability to communicate ideas, orally and in the written form, will be required throughout the course, but notably in the final year Integrated Case Studies module.
c) There will be many opportunities for practising effective group working skills. The Systems Administration activity takes place within small groups, and is assessed by group report and oral presentation,
d) The final year project requires the inclusion of a project plan, with all the stages recorded and commented on.
e) Although students rapidly become fluent Web surfers, they do not always approach research activity in an orderly fashion. To improve their skills, guidance notes are provides in the first

year and several modules require students to write technical reports on different topics, using the Web and library as sources of information.

l) The Systems Administration modules are centred on this topic. Assessment is by report writing, group presentation and capability demonstration.

m) Students should adopt a reflective, critical and creative approach to their work which is most apparent to staff during the final year project. Their performance in dealing with a searching examination question will also be indicative in this regard..

Section 4: Programme Structure

Note: This structure is indicative and subject to change

1.4.1. Award Structure

The first year is subdivided into four, 30 credit, modules which deal with fundamental principles and the introduction to disciplines and techniques important for the systems programmer or computer engineer. The new Modular Scheme will provide a common first year to all the contained award routes. This enables students to reconsider their initial UCAS choice and adopt the route most suited to their changing career aspirations. It is intended that the Computer Systems Engineering award will be joined within the new Modular Scheme by the awards: Computing and Telecommunications, Computing for Real-time Systems and Digital Systems Engineering.

The teaching in the first, common year presents a solid introduction to the principles and practice of Digital Electronics and Computer Programming. The initial programming language will be C which leads subsequently into modules in C++ and Java. Students are introduced to basic ideas in electronic engineering, mathematics, computing and the architecture of digital computers .

The second year will again provide four modules of which two are designated as shared, core items within the new Modular Scheme. These cover the area of C++, Object Oriented Programming and Data Transmission techniques. Each contained award route can now diverge by offering two further, specialist modules of their own. The BSc CSE will develop in the areas of CPU Design and Operating Systems.

As with all of the other awards offered by the Faculty, this programme includes an industrial placement period during the third year. This is considered an important part of the overall academic experience, allowing students to place their formal knowledge and laboratory skills into context and application. The benefits are often not fully recognised until the graduates compare their abilities and performance with a contemporary colleague who graduated from a non-sandwich award.

The final year has a traditional six module structure and is centred around a large personal project. Having smaller modules allows students a wider choice of topics and greater flexibility for staff to revise and update the curriculum. Often final year option modules follow the research interests of teaching staff and can evolve and adapt in the light of commercial interests. The full award structure is shown diagrammatically below, while the full list of modules is as follows:

Year 1		Credits	
Programming in C	UFS002C1	30	Core
Digital Electronics & Interfacing	UFE001C1	30	Core
Computer Systems Architecture	UFS001C1	30	Core
Digital Systems Development	UFE002C1	30	Core
Year 2			
Software Design with C++	UFS003C2	30	Core
Data Transmission	UFE001C2	30	Core
Architecture of CPUs & VHDL	UFS002C2	30	Award Specific
Operating Systems & Sys Admin	UFS001C2	30	Award Specific
Year 3			
Placement	UQP001XP	120P	Core
Year 4			
Project	UQC120D3	40	Core
Advanced Systems Admin	UQC154S3	20	Award Specific
Advanced CPU Architecture	UFS001S3	20	Award Specific
Option Module 1	UFS H3	10	Option
Option Module 2	UFS H3	10	Option
Option Module 3	UFS H3	10	Option
Integrated Case Studies	UFS002H3	10	Core
		360	

1.4.2. Award Options

This award only offers option choices to the student in the final year. The two second year specialist modules which distinguish the award routes, are not optional. At the time of validation it is impossible to state which, if any, of the current final year option modules will be selected in four years' time. Most likely, in such a fast changing field, many completely new modules will then be on offer. The selection will be carried out by the Award Leader in consultation with all the academic staff and student representatives. This will be done in order to best reflect the interests of the students and the philosophy of the award. As an indicator, the current list of option modules offered to the BSc CRTS and BEng Digital Systems awards is listed below.

1.4.3. Award Structure Diagrams

Note: This structure is indicative and subject to change

Award Structure for BSc (Hons) Computer Systems Engineering

Individual Project UQC120D3 – 40	Advanced Systems Administration UQC154S3 –20	Advanced CPU Architecture UFS001S3 - 20	ICS UFS002 H3 - 10	Option 1 -10	Option 2 -10	Option 3 -10	4
Industrial Placement							3
Data Transmission UFE001C2 -30	CPU Architecture & VHDL UFS002C2 -30	Operating Systems and Systems Administration UFS001C2-30	Software Design & C++ UFS003C2 -30				2
Digital Electronics & Interfacing UFE001C1- 30	Computer Systems Architecture UFS001C1 - 30	Digital Systems Development UFE002C1 -30	Programming in C UFS002C1 – 30				1

The current options offered by BSc CRTS & Beng DSE to students in their final year are:

UQC152H3	Advanced Operating Systems Programming
UQC130H3	Concurrent and Parallel Systems
UQC132H3	Compiler Design
UQC133H3	Object-oriented Databases
UQC134H3	Distributed & Parallel Databases
UQC137H3	Intelligent Systems
UQC138H3	Programs from Formal Specifications
USC313S3	The Art of Digital & Image Processing
UEE018S3	Systems on Silicon
UEE019H3	Introduction to Control
UQC143H3	VHDL for Real-time Systems

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

The award-specific modules provide a central focus which characterises the degree. Starting at Level 1 Digital Systems and Programming in C which cover the fundamentals of hardware architecture and interface programming, building at Level 2 to Microprocessor Architecture and Data Transmission, and culminating in the study of. Advanced CPU Architecture and Systems Administration at Level 3. Another subject which further bridges this disciplinary divide is the use of the hardware specification language VHDL to configure PLDs (Programmable Logic Devices). In this way, programmers may engage in hardware design and implementation without engaging with a soldering iron. The full impact of the adoption of high level specification languages for education within Computer Science and Electronic Engineering courses has yet to be fully resolved.

It is widely accepted that students benefit from a sandwich placement year. It assists them in developing a maturity and judgement in the selection and use of technical tools and skills. It supports their understanding of principles and theory, and enables them to choose a suitable career after graduation with greater confidence. More mundanely, the financial pressure that most students now suffer is in some measure alleviated by the salary paid during their industrial placement. This aspect of modern student life is becoming more critical as frequently recorded by academic staff when called on to offer advice to troubled individuals. It is now common place for full-time students to have part-time jobs in order to fund their studies. Students can also benefit from a successful sandwich placement year because it is often possible to continue a close involvement with committed managers for the rest of their course. This delivers extra financial advantages in the short term, as well as providing students with an excellent commercial experience and training early in their career.

As already described, the first two years of this new modular scheme are based on the study of four, 30 credit modules. The change from the previous scheme of six 20 credit modules has been undertaken in response to several issues and mounting pressures.

Firstly, and perhaps most significantly, the philosophy of a diverse, broad-based programme of study was originally specified during the preceding Polytechnic era. It was then broadly accepted that the Polytechnic students, and their potential employers, were best served by a less profoundly theoretical, and more wide-ranging approach to the curriculum. Thus, familiarity with an eclectic spread of disciplines , requiring many modules each week, was the order of the day. Little thought was given to the didactic efficiency of requiring students to switch rapidly from subject to subject in quick succession. The new modular scheme is intended to allow students to successfully pursue their studies in greater depth by concentrating on a narrower range of subjects during the first two years, a scheme more in keeping with the approach adopted by traditional universities.

Secondly, it was recognised by staff that students are more often than not required to have part-time employment in order to sustain their time at university. Without this income they would have to abandon their studies. But to organise their timetables, ensuring that attendance is possible during the week at twelve separate occasions is a considerable worry, both for the student and the administrators tasked with fitting together rooms, students and staff. With a four module scheme, only eight weekly attendances would be required, somewhat relaxing the time-tabling constraints.

The previous regime has been routinely criticised for encouraging a superficial approach to academic studies. So, just as a student successfully grapples with one idea, then a completely different, even unrelated topic is thrust forward for their attention. The change from six to four taught modules will thus enable staff and students to pursue those subjects in greater depth, if with some reduction in generality.

Section 5: Entry Requirements

1.5.1 General University Requirements

The normal entry requirements for this course are currently set at 3 Cs at A-level, or 240 new tariff points, with the usual University requirements for a minimum pass in GCSE English and Maths. If A-level qualifications are involved, they should include a scientific or technical subject, such as Computer Science, Physics or Technology which has provided the opportunity for a practical laboratory activity and the completion of a personal project wherever possible. BTEC Computing or Electronic Engineering qualifications are accepted if at least 3 of the final year modules are passed with merit, with the personal project also awarded at least a merit. Other qualifications are considered individually, and commercial work experience may also be credited during the application assessment.

1.5.2 Entrants to Year One of the Programme

The alternative minimum entry requirements set out by the University for degree awards are presented as follows::

a) grade E or above in two appropriate subjects at GCE A-level and grade C or above in three GCSE subjects, or grade E or above in three subjects at A-level and grade C or above in one GCSE subject;

b) the Scottish Certificate of Education with at least Grade C in two subjects at Higher and three at Standard Grade;

c) a BTEC National Certificate or Diploma;

d) the Advanced General National Vocational Qualification (AGNVQ);

e) an appropriate Access course validated by an authorised validating agency recognised by the Access Courses Recognition Group;

f) the European Baccalaureate;

g) the International Baccalaureate;

h) a Foundation Year for the named Award;

i) the Irish Leaving Certificate with at least grade C in two subjects at Higher level and three at Ordinary level;

j) another qualification recognised by the Academic Board as an equivalent qualification.

Note 1: Two Advanced Supplementary Level subjects equates to one Advanced Level subject.

Note 2: All candidates must demonstrate proven ability in the use of English language and mathematics, normally evidenced by a pass at grade C or better in the appropriate GCSE.

The current normal entry requirements are set at 200 tariff points, with some evidence, either academic or practical, of prior experience of using computers or working with electronic devices. An A-level in Mathematics or Physics is not required for entry to this award.

1.5.3 Non-Traditional Entrants - Year One

Mature applicants will be assessed by the admissions team for knowledge, skills and experiential learning which indicate the potential to perform effectively within higher education and to benefit from entry to the named award. Candidates may be admitted directly to an award or may be encouraged to undertake a Foundation Year.

The Faculty is strongly committed to facilitating access to its awards by non-traditional entrants, that is those leaving secondary education without the minimum entry requirements in terms of A-level and BTEC qualifications or those successfully completing a linked Access course.

Candidates who have successfully completed Year 1 of an HND may be considered for entry to Year 1 of the degree where academic prerequisites are satisfied.

1.5.4 Year 1 Award Specific Entry Requirements

Some awards, but not all, have award specific entry requirements. These normally involve specified A level subjects for entrants applying through that route. The table provided in the current prospectus shows minimum points normally sought but candidates may be accepted on their individual merit and their ability to benefit from the course of study. Where A level Mathematics is mentioned this can be Mathematics, Pure Mathematics, Applied Mathematics, Pure Mathematics with Statistics etc. All awards are subject to the standard entry requirements .

1.5.5 Entry to the Second and Final Years of the Programme

Candidates can be admitted to the second or final year of the Programme on the basis of appropriate academic qualifications or professionally accredited experience.

Candidates may be admitted under CATS and/or APEL regulations (See the University's Academic Regulations Sections D3 and D5). Credit under APEL will normally only be received up to a maximum of 50% of the credit points for the award which is sought.

Students holding an appropriate-DUT or equivalent from one of the European institutions having links with awards in this programme are also covered by these regulations.

Where a candidate has completed of Year 1 of an HND with excellent results, they may be considered exceptionally for entry to Year 2 of a degree award. In making the decision on eligibility the Variations Board will take into account the student's overall performance in Year 1. As a guide to its decision, a student on an HND who has successfully completed Year 1 and who has achieved Passes with Merit or with Distinction in at least 4 modules or equivalent and normally an average of at least 60% over 6 modules, will be considered for transfer. Normally a student who has been referred in any module will not be eligible for admission directly into the second year of a degree..

An HND student may be permitted by the Variations Board to proceed to the sandwich year (Year 2P) or Year 3 of a non-accredited degree provided they have achieved an academic level during Year 2 of their award deemed satisfactory for transfer. This restriction, of transfer to a non-accredited degree, is essentially concerned with accreditation by the British Computer Society, one of the conditions for accreditation being that the student undertakes the last two academic years of the accredited degree; academic years here refer to the historical perspective of the structure of degrees and is interpreted as the final two taught years, excluding the sandwich year. As a guide to its decision, a student on an HND who has successfully completed Year 2 and who has achieved Passes with Merit or with Distinction in at least three Level 2 modules or equivalent will be considered for transfer.

Candidates who have completed an Ordinary degree may, at the discretion of the Admissions Committee, be allowed to enter Year 3 of an Honours degree award.

1.5.6 Transfers between Awards

The CEMS Variations Board has been set up in the Faculty to consider applications for variations to a student's programme of study, including transfer between awards, one of its guiding principles being that the transfer to another award is subject to any necessary pre-requisites having been completed directly or through modules of broadly equivalent content.

Section 6: Assessment Regulations

The current version of the University MAR assessment regulations govern the decisions taken by Field and Award Boards.

Section 7: Student Learning

1.7.1. Teaching

Teaching methods are tailored to meet the needs of the student as far as possible. Whereas large traditional weekly lectures provide an efficient means of steering a course and delivering information to the whole cohort, they are generally criticised as an ineffective vehicle for teaching. In practise, some students will benefit from time spent in lectures, while others will prefer to investigate the subject through text books and the World Wide Web. This latter facility, as might be expected, is particularly useful in the computing domain, with many excellent tutorial sites in addition to the massive amount of technical information offered by the large suppliers, such as IBM and Intel.

On the whole, the weekly practical laboratory sessions for small groups of students are preferred both by tutors and students. They provide a social, relaxed atmosphere in which problems can be aired and advice offered. Tutorial worksheets are used to guide the student through a series of exploratory exercises. Support material is normally published on the Web so that students may access it from home as well as on site. Perhaps the most interesting aspect of the award is the opportunity for establishing closer co-operation with committed commercial organisations. This will take the form of invited lectures on technical topics, a new source of ideas for group case-studies and personal projects and the provision of a professional ethos to the award.

The award team also intends that the following overall teaching aims are stated in line with the standards expected of an honours degree

a) Actively maintain academic standards and course content through the application and incorporation of ideas originating from research and commercial consultancy.
b) Meet the needs of commercial placement providers and graduate employers in this case by helping to improve the effectiveness and relevance of the taught course material.
c) Encourage by example the development of students' intellectual and personal qualities by extending their confidence in the use of computer-based systems.
d) Support and encourage staff development. through close liaison with commerce and industry.

1.7.2. Learning

Universities have traditionally been seen as offering tutor-directed learning. This was achieved through many activities included: lectures, tutorials, seminars, laboratory-based practicals, problem classes, and discussion groups. With the widening of access to HE, the broadening of admissions criteria and the unification of the Polytechnic and University sectors, alternative approaches to the teaching and learning have been positively promoted. This has seen a change from a focus on "teaching" to a focus on "learning", where the students are given more responsibility in the selection and organisation of the subjects comprising their awards. To assist with this move towards "self-directed study" the Bolland Libary offers a range of resources and facilities which students can access:

1. Private study areas.

2. Group work rooms, for discussion and debate.
3. Networked PC workstations for Web browsing
4. Computing and Engineering Journals
5. Self-study video courses.(C, Unix and other related subjects)
6. Large Computing and Engineering text book collection
7. Photocopying facilities.
8. Short, medium and long term loan facilities.
9. Subject librarians keen to offer advice on database search strategies.

Another recent change, accelerated by the switch in student funding from immediate grants to long-term loans, has been the requirement for the majority of students to earn money throughout their course of studies. Attendance at class can clash with work hours, and the essential part-time job often takes higher priority. In an attempt to alleviate the effects of such a situation, as previously stated, tutors normally offer course material through the WWW, allowing students to view material directly from their home. Such remote access is very popular and provides useful learning support.

Section 8: Reference Benchmarks

1.8.1 General QAA Guidelines

The relevant QAA benchmark guidelines concern Computing and Engineering courses:

http://www.qaa.ac.uk/cmtwork/benchmark/computing.pdf
http://www.qaa.ac.uk/cmtwork/benchmark/engineering.pdf

Reference to these documents has been made while creating this Award Proposal in the selection and relative weighting of the broad spectrum of subject areas and technical outcomes that are listed. From the Computing Benchmarks the principal areas considered were: computer architecture, processor functionality, programming languages, development tools, computer applications, communications networks, digital systems, operating systems, problem identification, analysis, design methods, commercial exploitation, professionalism. The general recommendations are summarised below.

Students on graduation are expected to be able to demonstrate a sound understanding of the academic discipline, as covered by their programme of study, as well as a practical facility in the application of the relevant theory. This will include an ability to exercise critical judgement across a range of issues and an awareness of the commercial influences and restraints within which they will operate. They should deal with the concepts critically, and be able to analyse and apply the associated principles and practice in an appropriate way. It is important that they can transfer their understanding from the more limited academic environment to the looser real world scenario where information can be poorly structured, redundant, conflicting and even misleading.

They need to show effective judgement in the selection and use of appropriate tools and techniques when approaching a problem. The design and development of components or processes should be approached in an orderly, systematic manner. While dealing with any complex problem, activity should be structured within a clear lifecycle plan. This could involve problem identification, analysis, design, implementation, testing, all of which is accompanied by effective documentation. By retrospectively reviewing and evaluating the work, the opportunity for self-improvement will become available.

The central role of mathematics in the basic development and commercial exploitation of engineering is indisputable. Many products rely on the modelling power of mathematics in order to work in a stable, reliable fashion. Graduates should be able to recognise situations where the application of the appropriate arithmetic methods or modelling techniques will reduce development time or lead to a more robust, cost-effective solution. Systems simulation is of growing importance for software engineers and is a significant tool for use in the early investigatory stages of many projects. Graduates must also have the ability and willingness to carry out rough numerical estimations to assist the design process.

All graduates will demonstrate a range of general, transferable skills which will support their future careers, whatever direction they may take. The ability to contribute to a team and organise their own work with minimum guidance, is an essential requirement for all programmers and engineers. They also need to apply appropriate professional practices within an ethical framework and so identify mechanisms for continuing personal and professional development through life long learning.

The field of computing requires a flexible, broad-based set of skills, and in order to prepare for this challenge, graduates must be familiar with a range of applications. This will offer some preparation for the likely diversity in their professional careers.

Students must be encouraged and supported to express their creative and innovative flair so that they will more easily be able to contribute significantly to the analysis, design and development of successful, new systems. The very novelty of the discipline of Computing demonstrates the continuing demand for creative, original solutions to complex, intractable problems.