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	MSc Grid Computing
Default award title	-
Interim award title	PgDip. Grid Computing PgCert. Grid Computing
Modular Scheme title (if different)	Faculty of Computing, Engineering & Mathematical Sciences Modular Scheme
UCAS code (or other coding system if relevant)	
Relevant QAA subject benchmarking group(s)	Computing
On-going	
Valid from (insert date if appropriate)	1st September 2006

Authorised by… **Date:…**

Version Code 1

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 general educational aims of the CEMS post graduate scheme are:

- to provide an intellectual experience of advanced study, underpinned by staff expertise, research, and experience;
- to enable the student to further and deepen his/her knowledge, understanding and analytical abilities in a stimulating and challenging academic environment;
- to prepare the student for further professional development in his/her chosen field;
- to develop the student's ability to conduct research in their chosen field;
- to offer postgraduate opportunities for part-time students in employment.

This programme aims:

- to conduct students through a programme of advanced study in applied Computer Science, using Grid Computing as its vehicle;
- to impart a broad and balanced range of relevant knowledge in aspects of applied Computer Science, with particular emphasis on those concepts, processes and technologies that make up Grid Computing;
- to provide graduates with a set of advanced skills in practices and technologies relevant to Grid Computing;
- to provide graduates with the necessary knowledge and skills to initiate, specify, carry out, manage and complete substantial projects in their field;
- to provide graduates with the necessary knowledge and skills to conduct research in their field, whether in a business or industrial context or in an academic environment;
- to instil in graduates a set of professional attitudes and skills, especially with reference to professional ethics;
- in view of the rapidly changing nature of the field, to instil in graduates the skills and habits of independent study and knowledge renewal.

Section 3: Learning Outcomes of the Programme

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

The learning outcomes below are specified in accord with educational aims of the Programme and with the module specifications attached at Appendix A.

A. Knowledge and Understanding

Knowledge and Understanding of:	***Teaching/Learning Methods and Strategies***	***Assessment***
1. The foundations of distributed computation, distributed information and collaboration in virtual organizations. 2. The components of computer and communication networks, and their protocols; parallel and distributed systems based on them and algorithms used in their implementation. 3. The fundamentals of grid computing, including data grids, computational grids, knowledge and collaboration grids. 4. Applications of grid computing in particular domains, in science, engineering and business. 5. One or two specialized topics which impact grid computing, including data storage across a grid, optimization, and security.	On all modules the learner is encouraged to undertake independent reading both to supplement and consolidate what is being learnt and to broaden their individual knowledge of the subject. The programme of study is designed to further the knowledge and understanding necessary to engage, from the beginning, in appreciating and solving problems. For all students of MSc Grid Computing, semester 1 of their studies introduces the context in which these issues reside by contrasting principles of distributed systems with centralized ones and introducing fundamental ideas about communicating over networks. At the same time, students will develop their research formulation skills in preparation for later independent work. Alongside the two core modules in the first semester, the four possible combinations of options steer students towards likely research topics for their projects: - Advanced Databases + Intelligent Adaptive Systems -> Distributed knowledge-based systems; - Advanced Databases + Security in Networks -> Data grids;	Testing of the knowledge base is through: Assessed coursework and Examination. Assessment of 5 is dependent upon option choice.

6. The nature of the research process and the range of research methods.	- Algorithms + Intelligent Adaptive Systems -> Optimization in distributed systems and grids; - Algorithms + Security in Networks -> Software aspects of security and secure systems.	

B. Subject-Specific Skills

Subject-Specific Skills	*Teaching/Learning Methods and Strategies*	*Assessment*
Students will be able to: 1. Understand and analyse the requirements of different kinds of distributed organization in business, science and engineering. 2. Recognize when a new virtual organization is made possible or arises as a result of technology, and take advantage of this development. 3. Design a communication protocol and implement it in a high-level language. 4. Apply principles from databases or the study of algorithms to grid computing; tackle grid database problems or algorithm parallelization problems. 5. Analyse the problem of performance optimization or security in a network. 6. Write a research proposal that includes aims, research questions, research method and expected outcomes. 7. Develop solutions to problems with the application domain(s) relevant to their option choices, using appropriate tools and techniques.	Throughout the program, the skills listed are developed through a combination of theoretical discussion, practical laboratory-based work, classroom based tutorial exercises and directed self-study. A number of the skills listed, including those from optional modules, are introduced in semester 1 and then drawn into sharper focus in semester 2, with greater specialization in the dissertation. The general teaching/learning method is therefore to impart these practical 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.	The possession of these skills is demonstrated both by the development of a practical piece of coursework (software or some other deliverable) and by examination. The practical nature of many of the skills to be acquired means that particular modules specifically address the skills.

C. Intellectual (Cognitive) Skills

Intellectual Skills	***Teaching/Learning Methods and Strategies***	***Assessment***
In general terms, intellectual or cognitive skills include abilities in: 1. Critical Thinking 2. Analysis 3. Synthesis of different types of information 4. Evaluation 5. Problem Solving 6. Appreciating problem contexts 7. Balancing conflicting objectives	Skills 3 (synthesis of different types of information) and 6 (appreciating problem contexts) are particularly well supported, reflecting the focus of the course on the integration of information and resources from a variety of sources. Skills 2 (analysis), 4 (evaluation) and 7 (balancing conflicting objectives) are also well covered, showing the same general kinds of emphasis Skills 1 (critical thinking) and 5 (problem solving) are pervasive in the programme, and they come to the fore in all the modules. By the end of the programme, as a result of repeated exposure to problems and cases, and under the culminating influence of work on their dissertations, students should have well developed critical thinking and a well informed and incisive approach towards problems and their effective solution or alleviation.	The skills discussed here are in the main rather abstract, general or high-level, and in consequence not easily assessed specifically. What we will be generally looking for in assessed work – as will be indicated in the coursework and presentation specifications or briefings – is cogency, depth of analysis, and critical reflection. The student has more scope to achieve these in an essay or report than in a presentation; in assessing the latter we will pay particular attention to succinctness and balance of content and effectiveness in delivery.

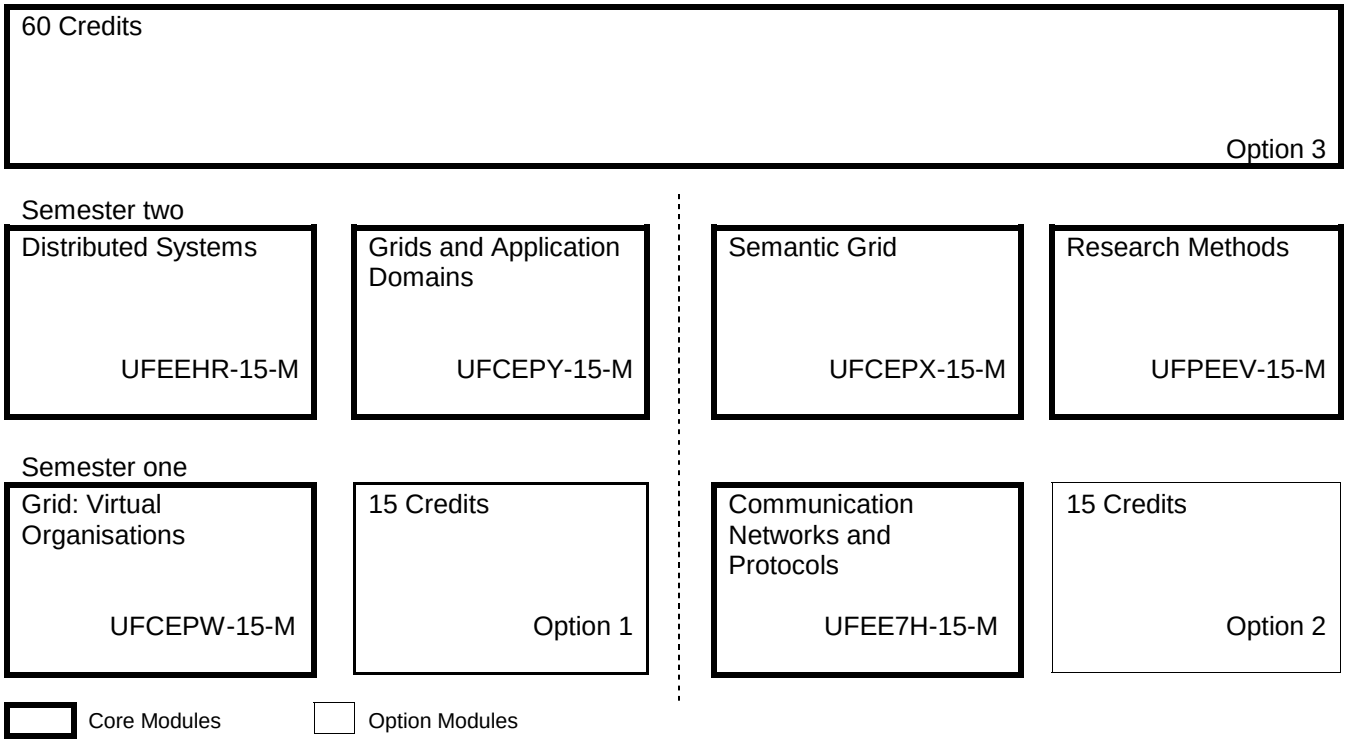
D. Transferable Skills and Other Attributes

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".	Skill 1 is developed through a variety of methods and strategies including the following: • Participation in group discussions • Presentations of research findings both in person and on-line • Discussions in individual tutorials • Generation of written reports, project documentation, and a dissertation	The set of transferable skills is in general assessed as part of more specifically tailored assignments – which is appropriate, given the broad definition of the skills.
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.	Skill 2 is developed through a variety of methods and strategies including the following: • Conducting self-managed and tutorial-based practical work • Assignment and project work (as an individual)	
3. IT Skills in Context (to use software in the context of problem-solving investigations, and to interpret findings)	. Skill 3 is developed widely throughout the programme as IT is central to most teaching and learning activities.	
4. Problem formulation: To express problems in an effective manner or with appropriate notations.	Skill 4 is developed through a variety of methods and strategies including the use of the following: • Standard computing/mathematical constructs • The use of pseudo code to describe algorithms	
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.	. Skill 5 is developed through a variety of methods and strategies, with minimal or no supervision, including the following: • Independent research of relevant topics • Independent use of all available sources of information (human, printed, electronic) to achieve understanding	

6. Awareness of professional literature: to read and to use literature sources appropriate to the discipline to support learning activities.	Skill 6 is developed through a variety of methods and strategies including the following: • Directed literature study • Research activities, including critical evaluation of different sources of information • Study of non-academic literature relating to commercial products • Use of documentation such as software manuals	
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.	Skill 7 is developed throughout the programme activities such as: • Planning as a group • Working together toward a common goal • Working in a multi-disciplinary environment • Dealing with problems within the group	

Section 4: Programme Structure.

Programme Structure for **MSc Grid Computing** **For December 2005**



Part-time students in year one take modules to the left of the dotted line and in year two to the right of the dotted line

Option 1 taken from	
UFCE3U-15-M	Algorithms
UFCEPQ-15-M	Advanced Databases (E-Learning)

Option 2 taken from	
UFEE7K-15-M	Intelligent Adaptive Systems
UFEEN8-15-M	Security in Networks

Option 3 taken from	
UFCE3Y-60-M	Computer Science Dissertation
UFCE3C-60-M	Dissertation Software Engineering

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 general requirements for entry to a postgraduate programme are described in the University Academic Regulations. These are available from the UWE's web site, or on request, and apply to this programme. In addition, an Honours degree in Computer Science or a similar subject will normally be required. Applicants with first degrees in other disciplines may be considered if they have relevant professional experience of sufficient depth. Students must have adequate understanding of:

Programming in a high-level language such as C, C++ or Java

Section 6: Assessment Regulations

The Modular Assessment Regulations apply to this programme

Section 7: Student Learning: Distinctive Features and Support

Class Activities The mode of delivery of a module is determined by its Module Leader, and typically involves a combination of one or more activities such as lectures, tutorials and seminars, laboratory work, group work and individual project work. The most usual combination is a one-hour lecture with a one-hour lab or tutorial per week. This programme places a strong emphasis on learning and understanding the nature of distributed activity through group work, especially carried out on-line using an appropriate framework.

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. Many of the staff on this programme are active researchers in international projects; regular contact on-line will be maintained through email, instant messaging and more specialised systems (e.g. Access Grid or VRVS)

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 diversity of content in the programme and the importance of engagement in the learning community.

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. Module leaders will also issue a reading strategy to help in this regard.

Computing Facilities in CEMS 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. Students in this programme will generally work in the Windows/PC environment, using a combination of Office tools and Internet browsers and web tools.

One of the most popular areas is the Open Access laboratory. This area is not 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 first 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.

Library Services The large multidisciplinary library based at the Frenchay Campus (the Bolland Library) is open 24 hours per day during term time and can accommodate a range of different study needs, e.g. silent, group, PC-based. There are also separate rooms for viewing audio visual materials and the use of assistive technologies. Library staff are available for subject enquiries until 8pm most evenings (7pm on Fridays) and on Saturdays. Some of the more standard library functions may be undertaken through self-service machines outside staffed hours, e.g. issue of books. There is a Faculty Librarian who specifically supports the faculty of Computing, Engineering and Mathematical Sciences and will provide training and support in the use of the library and the retrieval of relevant materials. In the Library, PCs and laptop access points are widely available, and provide entry to the main catalogue as well as to other online resources and collections and search tools.

Section 8 Reference Points/Benchmarks

The QAA Subject Benchmark Statement Computing applies most closely to this programme Although the published benchmark statement refers to Bachelor's Honours degrees rather than to an MSc programme, there is a proposed benchmark standard for taught masters in computing. The proposed standard is built on the Bachelor's Honours statement and has been used to inform the development of this programme. In particular, the proposed statement suggests that, irrespective of the discipline from which a student enters the programme, a masters programme must *"add value* to undergraduate degrees" and "be characterised by an ethos of advanced work and scholarship". This programme adheres to these underlying principles.

Immediately upon entry to this programme, students will be required to make use of knowledge and skills appropriate to an honours graduate in computing. They will be required to use skills of software development and design to analyse problems presented in the first semester; they will use critical evaluation to discuss journal papers at an advanced level; they will use their understanding of key aspects of computing to extend their knowledge in new directions. Ultimately, they will also be required to demonstrate original thinking in the development of their level M dissertation.

In addition the defining principles of the study of Computing according to the draft benchmark are:

- Knowledge and understanding of aspects of computer systems and their use;
- A combination of theory and practice, with practice being guided by theoretical considerations
- A strong emphasis on applications with usability being important
- The use of specification, design, implementation and maintenance being important features which characterise the lifecycle and contribute fundamentally to the concept of process
- An understanding of and attention to the many and varied aspects of quality and
- An understanding of professional, social and ethical issues related to Computing.

The design of this award has followed these principles to the greatest extent the subject allows. In its present form, the specification emphasises understanding and recognition of principles and opportunities. It is envisaged that in the next few years, with the increasing adoption of grid computing in industry, the emphasis on specification, design and implementation of grid systems will increase.

Contextual Documentation

1. Responsibility for Programme Leadership
Overall academic responsibility for the programme in Grids Computing will lie with the Director of Taught Postgraduate Programmes and Programme leadership will be located in the School of Computer Science in CEMS. For the development of the programme prior to validation, Tony Solomonides is designated Programme Champion.

2. CVs for Module Leaders
CVs are attached in Appendix B.

3. Background and Demand
Grid Computing (sometimes 'utility computing' in the enterprise environment) is a paradigm of distributed computing which promises to supplant internet computing and internet-based 'application service' provision. Grids extend the connectivity of the internet through resource sharing in terms of processing, storage and communications.

Grid computing is already a major computational medium for large scale science (bioinformatics and genomics, particle physics, astronomy). The faculty has been active in grid computing for health ('Healthgrid') including now three EU funded projects and also in supporting a major experiment at CERN.

In terms of industrial interest, IBM has had a long-term involvement in grid computing, but more importantly, in the summer of 2005, Microsoft has recruited the head of the UK e-Science programme, Professor Tony Hey of Southampton, and the head of EGEE, the largest European grid project, Professor Fabrizio Gagliardi of CERN. This is indicative of the readiness of commercial markets to adopt the new paradigm.

Further evidence is available in the form of industry reports. For example, the Quorcica group in the UK and the 451 Group in the US have issued a number of reports and updates on the uptake of grid computing. The evidence, both by industry and by region, is encouraging. For example, among industries, financial services, digital media, telcos and pharmaceutical industries, are early adopters; at least three of these industries are well represented in the Bristol area, All reports assess the US to be somewhat ahead of Europe which is in turn only marginally ahead of the Asia Pacific region. Considering the potential for student recruitment in the latter, the case for a Master's in Grid Computing is compelling.

In the scientific and health care/medical fields, the university has already received substantial funding from such bodies as CERN, Geneva, and the European Commission's Information Society Technology programme. For example, the EC has made a major commitment to making a 'healthgrid' the infrastructure of choice for a large number of health care and medical research projects. Within the UK itself, the e-Science programme has now encompassed all research councils and is funding, among other projects, the Centre for e-Research in Bristol (based at the University of Bristol) which includes members of the course team as principal investigators.

4. Standards and Quality
UWE enjoys an excellent reputation for the quality of its taught programmes, confirmed through Subject Reviews, Teaching Quality Assessments and Institutional Audits carried out by the QAA. The Faculty's honours degrees are accredited by appropriate professional bodies, including the British Computer Society and the Institution of Electrical Engineers.

The Faculty's research in various branches of Computing, especially Artificial Intelligence, Software Engineering and Grid Computing, is highly regarded in national and international circles. Its many research centres and groups, including the Centre for Complex Cooperative Systems, the Intelligent Autonomous Systems Laboratory and the AI Group, carry out collaborative research and consultancy

with many national and international partners, including Motorola (UK), CERN (Geneva), Siemens (Germany), CNRS (France), Beijing Institute of Technology (China) and university hospitals in Cambridge, Paris, and Udine and Genoa (Italy),

5. Staff development

Within the Faculty of Computing, Engineering & Mathematical Sciences, individual staff are responsible for their development. Staff act under the guidance of their Head of School and Field Leader who will ensure that plans are consistent with the organisational strategies and priorities. These contexts include:

- UWE's expectation that all academic staff will contribute to teaching and research and/or professional practice, as articulated through the concept of the "UWE Academic";
- the Development Plan for each School, proposed during 2001-02 and now being implemented;
- the Faculty's Teaching & Learning Strategy;
- the Personal Scholarship Plan developed by each member of academic staff;
- the outcomes of the annual cycle of reflection and analysis on the delivery of programmes, as expressed through annual reporting arrangements at Programme, Award, Field and Module level.
- Annual appraisal/review.

School Development Plans were endorsed by the Faculty Board during 2001-02 for each of the faculty's five schools. For each school, they set a context in respect of the strategy for research and for academic planning within which individual development may take place. At the time of writing, this is being followed through by the creation of a Personal Scholarship Plan by each member of staff, outlining his/her development plans over the coming years.

The Faculty's Teaching & Learning Strategy provides an additional important context for individual and collective development. Broadly, the strategic aims are

- to enable independent learning;
- to support a diversity of student backgrounds;
- to contain staff workloads;
- to minimise non-progression rates.

The faculty's Teaching & Learning Group has an ongoing responsibility to develop the means by which these aims will be met. Their deliberations have significant implications for future staff development priorities, for instance in the increasing use of methods of module delivery which place greater reliance on students' ability to manage their own activities, including electronic delivery, and in new approaches to the assessment and to the management of tutorials and practicals.

Under an EC-funded ‘Asia-Link’ project, members of the course team have been collaborating with the National University of Science and Technology Institute of IT in Rawalpindi, Pakistan, the University of South Brittany, France, and Beijing Institute of Technology, China, in a programme to supervise young members of staff in the two Asian universities to PhD level and to create special Master’s and CPD courses for delivery at all four partner institutions. Members of the team have also been active in various Grid education activities, including the organization of CCGrid conference workshops in Grid Computing education and in courses delivered through the Access Grid at the Centre for e-Research in Bristol

6. Management and Quality Assurance

The programme will operate under the quality assurance procedures of the Faculty of Computing, Engineering & Mathematical Sciences as approved by the university's Academic Quality & Audit Committee from time to time and most recently in 2001.

7. Institutional Policies, Mission & Strategy, Regulations, Procedures and Notes for Guidance

The programme is consistent with these.