

PART TWO

PROGRAMME SPECIFICATION

MSc High Performance Computing

Awarding body/institution	Glyndŵr University
Teaching institution	Glyndŵr University
Details of accreditation by a professional, statutory or regulatory body	N/A
Final award/s available	MSc, PGDip , PGCert
Award title	High Performance Computing
UCAS code	N/A
Relevant QAA subject benchmark statement/s	Master's Degree characteristics (QAA, 2010) Master's Degrees in Computing (QAA 2011) The framework for higher education qualifications in England, Wales and Northern Ireland (FHEQ, 2008)
Other external and internal reference points used to inform the programme outcomes	N/A
Mode/s of study	Full, Part Time
Language of study	English
Date at which the programme specification was written or revised	September 2012

Distinctive features of the programmes

MSc High Performance Computing

This MSc course is designed to provide graduates with the skills to meet industrial, commercial and research needs to enable them to practise as effective professionals in the area of High Performance Computing. HPC is the use of modern, powerful, parallel, multi-core processors to provide solutions to problems encountered in a range of areas.

State-of-the-art HPC Wales project facilities are used on this course to provide access to some of the most advanced computing technology available. The HPC Wales project is set

to have a major impact on the Welsh economy and to create more than 400 jobs across key industry sectors both in the public and private sectors.

Students will be given the opportunity to understand HPC architectures and technologies and develop expertise in advanced tools and techniques for HPC software development. Additionally they will be exposed to typical applications and will develop programs to run on the specialised machines that form part of the HPC network. The programme has a strong practical focus and taught modules provide a broad coverage of the fundamentals of HPC and parallel computing. Students will have access 156-core HPC Wales Tier-2A cluster system with both interactive and batch submission available installed for Glyndwr University. Students will also develop skills in problem-solving, project management, independent and critical thinking, team work, professionalism and communication.

High Performance Computing Wales (HPC Wales) is a £40million five-year project to give businesses and universities involved in commercially focussed research across Wales access to the most advanced and evolving computing technology available. HPC Wales will invest in state-of-the-art computing technology, infrastructure and facilities on a pan-Wales basis, high level skills development and training and provide tailor made support services to business.

The availability of this technology is set to have a major impact on the Welsh economy, on business competitiveness, on innovation, high value R&D in higher education institutions and skills development. It is set to create more than 400 jobs across key industry sectors.

The MSc in High Performance Computing has been developed specifically to provide high level skills development and training to take forward the usage and development of High Performance Computing and super computing technology and solutions in the public and private sectors.

A very close relationship is being created between the member of the HPC-Wales project team and the Glyndwr academic staff. Since HPC Wales and Fujitsu provide fully-funded studentships in high performance computing at the PhD and Masters levels it is the intention of the MSc programme team to enable and encourage students to apply against these competitive calls each year. Additionally an application has been made to set up a HPC Centre of Excellence at Glyndwr University.

HPC is the use of powerful processors, networks and parallel supercomputers to tackle problems that are very compute or data-intensive. The same HPC techniques can be used to program the world's largest supercomputer containing hundreds of thousands of processors, or to exploit the full potential of a multi-core laptop. It is intended to be used for the solution to real world problems such as those relating to climate change, medicine or financial affairs requires computer scientists with advanced skills and knowledge. It requires IT professionals able to apply cutting-edge systems development techniques such as the application of modern cloud computing. The MSc in High Performance Computing is an ideal foundation for these kinds of careers.

HPC is widely used in a range of areas of science, engineering and industry. High performance computing technology has the capacity to handle and analyse massive amounts of data at high speed.

Tasks that can take months using normal computers can be done in days or even minutes. It is used to model and solve highly complex problems across a range of high value sectors.

Uses are diverse and examples include facial reconstruction modelling, animated graphics, fluid dynamic calculations, nuclear energy research, petroleum exploration, car crash simulations, airflows over aircraft wings, data mining and storage and visualisation.

HPC techniques are now essential for any software developer who wants to take full advantage of modern multi-core processors and computing clusters. Students will be introduced to these applications areas by a series of lectures given by visiting experts in the specialised fields.

Furthermore the MSc in High Performance Computing provides an excellent base from which to pursue a PhD.

Aims of the programme

The purpose of the MSc in High Performance Computing is to develop professional practitioners in High Performance Computing (HPC) who are able to apply current and emergent technology both in industry and in research.

The MSc in High Performance Computing aims to:

- Equip students with an understanding of HPC architectures and technologies.
- Equip students with expertise in advanced tools and techniques for HPC software development.
- Enable students to apply this knowledge in order to exploit modern parallel computing systems in key scientific and commercial application areas.
- Enable students to develop as HPC practitioners, able to apply current and emergent technologies in both industry and research.
- Enable students to develop skills in problem-solving, project management, independent and critical thinking, team work, professionalism and communication.

The programme draws upon the international research reputation and the excellent teaching quality and facilities of the Computing subject area. It includes two semesters of taught modules followed by an independent research project. The teaching and learning approaches have a strong practical focus. The modules provide a broad-based coverage of the fundamentals of HPC and parallel computing.

Students will have access to leading-edge HPC platforms and technologies during their studies.

In addition to the masters programme it has been recognised that there is a market for short (or shorter) postgraduate courses which can be offered by selecting specialised modules from the overall Masters programme. This will enable a number of Postgraduate Certificates and Postgraduate Diplomas to be offered.

Intended learning outcomes of the programme

On successful completion of the programme a graduate should demonstrate knowledge and skills as follows:

A: Knowledge and Understanding

PG Certificate Level HPC

- A1. Demonstrate comprehensive, detailed, state-of-the-art knowledge of the specialist area(s) (Networking, Multimedia, Web and Mobile development, Professional Issues and Professional Practice) covered by the programme within the context of the broader discipline of Computer Science.
- A2. Demonstrate knowledge of research methodology appropriate to this level of work.

PG Diploma Level HPC

Students will be expected in addition to the skills developed at the PG Certificate stage to:

- A3. Demonstrate clear and confident understanding of the theoretical and empirical limits and boundaries of the specialist area(s), and of the range of methods of study and types of judgments employed by advanced practitioners.

MSc HPC

The 'Masters' stage of the programme will build upon the knowledge and understanding developed at the PG Diploma stages by providing knowledge and understanding of those aspects of research methodology that are appropriate to the specialist area(s) covered by the programme. It will also require the student to develop detailed knowledge and understanding of the particular area in which the advanced independent-study project associated with the 'Masters' stage of the programme is carried out.

Students will again be expected, in addition to the understanding developed at the PG Diploma stage, to:

- A4. Utilise information resources and demonstrate how to access these to obtain state-of-the-art knowledge of current computer systems technology.
- A5. Demonstrate a sufficiently detailed knowledge of research methods appropriate specifically to their 'Masters' advanced independent-study dissertation/project, together with detailed knowledge of the particular area in which the project is carried out.
- A6. Demonstrate clear and confident understanding of appropriate research methodology and detailed understanding of the particular area in which the 'Masters' project is carried out.

B: Intellectual/Cognitive Skills

PG Certificate Level HPC

- B1. Application: Work autonomously or with minimal guidance where appropriate, carry out confident and accurate selection and application of principles and procedures appropriate to the resolution of a range of situations and professional problems associated with the specialist area(s) covered by the programme.
- B2. Analysis: Work autonomously or with minimal guidance where appropriate, identify and classify principles and ideas in contemporary information sources and situations to professional standards; analyse rigorously, effectively, critically and creatively; cope with complexity.
- B3. Synthesis: Work autonomously or with minimal guidance where appropriate, bring together facts/ideas/elements in support of an argument or case presented to professional standards; confidently evolve alternative solutions and concepts.

PG Diploma Level HPC

Students will be expected in addition to the skills developed at the PG Certificate stage to:

- B4. Evaluation: Work autonomously or with minimal guidance where appropriate, confidently integrate theory with professional/vocational practice; evaluate theories, processes, solutions and outcomes critically and effectively; use the evaluations of others critically, reflectively and constructively.
- B5. Problem-Solving: Work autonomously or with minimal guidance where appropriate, identify, define and resolve a range of problems associated with the specialist area(s) covered by the programme, work to professional standards.

MSc HPC

Students will again be expected, in addition to the skills developed at the PG Diploma stage, to:

- B6. Application: Demonstrate mastery of the principles, techniques and procedures associated with the advanced independent-study project carried out during the 'Masters' stage, including the ability to work effectively from information provided, with little or no guidance.
- B7. Analysis: Demonstrate mastery of the analytical skills associated with the 'Masters' stage project, again working autonomously or with minimal guidance where appropriate.
- B8. Synthesis: Demonstrate the full range of skills needed to plan and manage a 'Masters'-level project and produce a report/dissertation/thesis or other suitable research output on same working to a detailed specification and to professional standards.

- B9. Evaluation: Demonstrate the full range of evaluative skills associated with the 'Masters' stage project, including the effective exercise of judgement based on incomplete and/or contradictory information.
- B10. Problem-Solving: Demonstrate professional competence in participating in the identification of a suitable 'Masters' project task and seeking a satisfactory solution that meets the specific requirements of the problem.

C: Subject Specific Skills

PG Certificate Level HPC

- C1 : Make effective use of a range of theories, techniques, programming languages, operating systems, design support tools and development environments
- C2 : Specify, design, implement, test and document a computer-based system
- C3 : Work as a member of a development team, contributing to the planning and execution of a shared design and implementation task

PG Diploma Level HPC

Students will be expected in addition to the skills developed at the PG Certificate stage to:

- C4 : Propose, plan, undertake and report a self-directed individual programme of investigation, design and implementation

MSc HPC

Students will again be expected, in addition to the skills developed at the PG Diploma stage, to:

- C5 : Undertake a significant computing related thesis which involves an analytical, rigorous and critical approach to problem identification, solution and evaluation;
- C6 : Synthesise the knowledge, skills and theories covered by the programme in order to solve a complex problem that may require the integration of different computing techniques and / or technologies

D: Practical, professional and employability skills

PG Certificate Level HPC

- D1. Communication and Presentation Skills: Engage effectively in a range of independent roles; debate in a confident, professional manner; produce detailed critiques and coherent project reports to professional standards; give confident, high-quality oral and other presentations in a wide range of contexts appropriate to the specialist area(s) covered by the programme.

- D2. Numeracy: Practise and demonstrate professional competence in the full range of numerical/mathematical skills associated with the specialist area(s) covered by the programme.
- D3. IT Skills: Practise and demonstrate professional competence in the full range of IT skills associated with the specialist area(s) covered by the programme.

PG Diploma Level HPC

Students will be expected in addition to the skills developed at the PG Certificate stage to:

- D4. Learning Skills: Work autonomously or with minimal guidance where appropriate, directing and managing own learning using the full range of resources and study techniques appropriate to the specialist area(s) covered by the programme.
- D5. Interactive and Group Skills: Interact confidently and effectively within a range of learning and professional groups, as appropriate to the specialist area(s) covered by the programme; demonstrate appropriate negotiating, role, leadership and group-support skills to professional standards.

MSc HPC

Students will again be expected, in addition to the skills developed at the PG Diploma stage, to:

- D6. Communication and Presentation Skills: Produce a detailed, professional research report/dissertation/thesis or other suitable research output to the specification laid down for the advanced independent-study project; present and defend this against in-depth examination in an appropriate live context.
- D7. Numeracy: Demonstrate mastery of the specialist numerical/mathematical skills associated with the particular area in which the 'Masters' stage advanced independent-study project is carried out, including appropriate data analysis/statistical skills.
- D8. IT Skills: Demonstrate mastery of the specialist IT skills required to carry out the 'Masters' stage project, including search skills, data-analysis skills, data-presentation skills and document-production skills.
- D9. Learning Skills: Work autonomously or with minimal guidance where appropriate, direct and manage own development of mastery of the various research-methodology skills associated with the 'Masters' stage project.
- D10. Interactive and Group Skills: Demonstrate the various skills required to work effectively with a research supervisor and with any other support staff

Programme structures and requirements, levels, modules, credits and awards

The programme is offered in full-time and part-time modes. In full-time mode, the entire MSc syllabus may be completed in 12 months. Part-time study provides a flexible-delivery mode to suit student's individual needs. In flexible mode the duration of study may be extended to a maximum of five years to suit professional and personal circumstances. Attendance may be a mixture of mornings and afternoons per week to allow credits to be accumulated on an individual-module basis. The intermediate qualifications of PGCert (Postgraduate Certificate) and PGDip (Postgraduate Diploma) may be awarded after completing three (60 credits) or six (120 credits) modules respectively.

Award	Credits at level 7	Modules Required
MSc High Performance Computing	180 credits	6 modules + dissertation
Postgraduate Diploma High Performance Computing	120 credits	6 modules
Postgraduate Certificate High Performance Computing	60 credits	3 modules

Masters award requires 180 credits at level 7: 120 credits for the taught elements and 60 credits for the Dissertation / Project

Modules are valued at 20 credits. Typically, a full-time student studies modules equivalent to 60 credits per semester (normally 3 modules), with 15 weeks of teaching, revision and assessment activities for each module. These are normally studied in the first 2 semesters.

The full degree scheme, including submission of the dissertation in the prescribed form, shall be normally completed within 12 months from the date of the initial registration i.e. 3rd Semester. Glyndwr University publish an Academic Calendar each year that includes dates for Semesters 1, 2 & 3. This provides dates for teaching and assessment periods, assuming the students are able to start in the first week of this calendar then there will be no problem meeting the published dates.

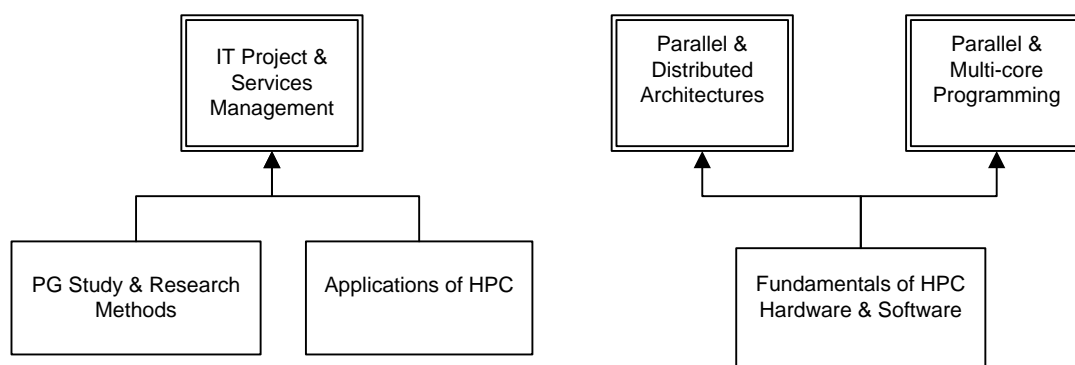
Programme Structure

The programme falls into 2 sections,

- a) a technical area where the Fundamentals of HPC Hardware & Software module in the first Semester prepares students for the more intense Parallel & Distributed Architectures & Parallel & Multi-core Programming in the second Semester
- b) a more research/organisational area where the Post Graduate Study & Research Methods module provides the student with the understanding of how to undertake Master level research and the Applications of HPC intended to give students an understanding of the areas associated with HPC. This would form the basis on which to study the Management of both IT projects and services in the HPC environment in second Semester.

Module Title	Level	Credits	Module Code
Post Graduate Study and Research Methods	7	20	COMM50
Fundamentals of HPC Hardware & Software	7	20	COM710
Parallel and Multi-core Programming	7	20	COM711
Parallel and Distributed Architectures	7	20	COM712
IT Project & Service Management	7	20	COM713
Applications of HPC	7	20	COM714
Dissertation	7	60	COMM56

Studying the Applications of HPC in the first Semester enables the students to understand many of the application areas in which HPC is used. The intention of this module is to get the students to select a specific area of the HPC that they could use as the focus for the second Semester modules and then on to the Dissertation. Specifically the approach adopted for the Applications module is to provide the students with an introduction to a wide range of the application areas. To this end visiting lecturers with expertise in these diverse areas will be used. Adopting this approach reduces the impact of the technical content of the modules in the first part of the programme and should give the student an answer to the question “why am I doing all this programming and why do I need to know about this hardware?”



Overall this is intended to ensure that the programme will address the diverse needs of the expected student intake. Additionally it also gives the opportunity to offer short course similar for business and a wide range of PhD students.

Post Graduate Certificate HPC

This is awarded to any student who gains 60 credits from combination of 60 credits

Post Graduate Diploma HPC

The PGDip HPC is intended for students who do not wish to take the dissertation or advised not to do it due to academic performance. They study all the taught modules offered in the MSc HPC and hence obtain 120 credits.

Curriculum Matrix - HPC								
Module Title		Post Graduate Study and Research Methods	Fundamentals of HPC Hardware & Software	Parallel and Multi-core Programming	Parallel and Distributed Architectures	Applications of HPC	IT Project & Service Management	Dissertation
Knowledge and understanding, intellectual skills, subject skills, and practical, professional and employability skills	A1	×	×				×	
	A2	×						
	A3			×	×	×		
	A4							×
	A5							×
	A6							×
	B1			×		×		
	B2	×					×	
	B3	×					×	
	B4			×	×	×		
	B5			×	×	×	×	
	B6							×
	B7							×
	B8							×
	B9							×
	B10							×
	C1			×	×	×		
	C2			×				
	C3		×				×	
	C4					×		
	C5							×
	C6							×
	D1		×					
	D2			×		×	×	
	D3	×	×			×	×	
	D4	×		×	×	×		
	D5		×				×	
	D6							×
	D7							×
	D8							×
	D9							×
	D10							×

Learning and teaching strategy

(used to enable outcomes to be achieved and demonstrated)

The Computing subject area has a Learning, Teaching and Assessment implementation plan as part of wider Institute and University developments. This seeks to assist the student to become an independent learner whilst still supporting the students in their transition to higher education. The curriculum is designed to encourage an appreciation for learning. Learning is enriched by appropriate underpinning, current research, industrial applications and the development of transferable skills

The broad aim of the Computing subject area in its postgraduate teaching is to focus on depth of study, and critical awareness and evaluation, in selected areas of current research and advanced scholarship within the academic discipline of Computer Science; while at the same time ensuring a more general all round ability. In addressing these aims, the postgraduate MSc programme in High Performance Computing includes material on the theory, design and implementation of HPC systems while at the same time focusing on particular specialist areas of research within the academic discipline of Computer Science.

The School also operates a number of specialist computer labs, with teaching based around the lab facilities. These specialist labs offers access to a range of software that is utilised within the modules defined in the programme.

The pace of delivery and range of syllabus content to be covered at PgCert / PgDip stage, requires a combination of teaching and learning strategies in most areas of study. Lectures are used to present core elements of the syllabus. Lectures are used as the main delivery mechanism, typically supplemented by supervised problem and lab classes, and group discussion. Structured laboratory sessions provide complementary coverage of practical aspects as well as illustrating lecture content. Directed reading is an essential adjunct in most areas of study. Some modules include group and small-scale project work, with student-led seminars and presentations. Moodle and a range of other online tools are also used to support teaching.

In the early stages of each module, problems will be well-defined and limited in scope and scale. At later stages, problems will become less structured (to encourage reflection on problem issues) and open-ended (to give scope to propose and evaluate alternative solution strategies). Case studies are used extensively to integrate study topics and to underline vocational relevance. Coursework assignments are important throughout.

As the programme progresses, students are expected to demonstrate increasing proficiency in use of IT tools and techniques to support production of technical documentation, to enhance oral and written presentations, to aid organisation of personal study material.

Part 2 of the programme is the Dissertation and is an area that has been given special consideration since it is such a significant piece of work undertaken by the student. Whilst students study the taught part of the course they are given a 1 hour a week special lecture to inform them of the requirements of the Dissertation. This module is run so that it coincides with the end of the taught part of the course which means that on completion of Part 1 students can then start immediately on producing the proposal for the dissertation. On submission of the proposal it is assessed and passed to an appropriate supervisor with expertise in the area that the student wishes to carry out the work. It is the supervisor's task to work with the student to improve the proposal to a level that is acceptable and achievable for a Masters level within the time constraints. Students work independently on the dissertation having regular meetings with the supervisor. It is important that the student identifies at the proposal stage the various requirements needed to complete the dissertation e.g. equipment, software, space.

Students will also have the opportunity to work with their supervisors to publish papers in the area of their dissertation. These may be presented at conferences and published in the proceedings. Additionally students will be encouraged to produce posters and papers for locally organised ITA conference bi-annually in September.

Indicative Full Time Module delivery for MSc High Performance Computing

The normal mode of studying the course would be to start in September as Semester 1 and then continuing through Semester 2 and 3 to complete the year by submitting the dissertation in the following September. This will allow the MSc to be completed in 1 year.

Semester 3	Dissertation		
Semester 2	IT Project & Service Management	Parallel and Distributed Architectures	Parallel and Multi-core Programming
Semester 1	Post Graduate Study and Research Methods	Applications of HPC	Fundamentals of HPC Hardware & Software

However for a January start the structure and order of delivery will remain the same as for the September start except everything will be put back by 1 semester. The delivery schedule would then become:

Semester 1 (Following academic year)	Dissertation		
Semester 3	IT Project & Service Management	Parallel and Distributed Architectures	Parallel and Multi-core Programming
Semester 2	Post Graduate Study and Research Methods	Applications of HPC	Fundamentals of HPC Hardware & Software

Assessment strategy

(used to enable outcomes to be achieved and demonstrated)

The School has an agreed Assessment Strategy for all computing programmes which provides a framework for the assessment of students' competence, knowledge and understanding, and the grading of students for progression and the conferring of awards. It allows staff to give feedback to students and to evaluate the effectiveness of their own teaching. This strategy will be closely adhered to in the delivery of the programme and is guided by QAA Code of Practice- Section 6: Assessment of Students, National Qualifications Framework, and Glyndŵr University Assessment Guidelines.

A range of assessment techniques have been incorporated into the programme. Since it is a High Performance Computing programme then clearly the backbone of course is based around programming and working on the specialised machine/ machines which form part of the High Performance Computing Wales (HPC Wales) network. However to augment the programming modules a formal examination is incorporated into the Parallel and Distributed Architectures since this is the classic approach to this kind of module. A Group assignment has also been incorporated in IT Project management module since this is an important aspect that needs to be addressed at the master's level

Students will receive formative assessment opportunities, particularly during the practical and self-study elements of the programme, to ensure they can keep track of their progress and development. This will also be a key factor in ensuring student engagement and retention on the programme of study. In the case of practical assessment, this may be a final summative assessment, so more frequent formative assessment provides academic rigour and increases student awareness and confidence in the subject.

There will be emphasis placed upon students to undertake independent study and research activities, in particular when completing the Dissertation / Project element of the programme. This Dissertation / Project will be facilitated by a traditional summative assessment approach at the culmination of the work, however, there will be extensive use of formative feedback, milestones, and guidance from staff during this, and other, independent-study and research-based assessment undertaken by students. This is common practice for such modes of study and is in-line with the approach taken by postgraduate programmes in other HE institutions.

On submission of the dissertation the supervisor marks the work using a standard mark sheet allocating marks for specified areas. Where appropriate a student may be asked to demonstrate their work to the supervisor and second marker. All dissertations are second marked and if there is a dispute in the mark then it is moderated by a third person. On completion of this process and before the module board the External Examiner comments on all the marking.

Indicative submission dates MSc High Performance Computing

Module	Core/ optional	Level	Credit value	Assessment	Approx submission
Post Graduate Study and Research Methods	Core	M	20	Coursework	End of Semester 1
Applications of HPC	Core	M	20	Coursework	End of Semester 1
Fundamentals of HPC Hardware & Software	Core	M	20	Report Coursework	Week 7 End of Semester 1
Parallel and Multi-core Programming	Core	M	20	Coursework Coursework	Week 18 End of Semester 2
Parallel and Distributed Architectures	Core	M	20	Coursework Written Exam	Week 20 End of Semester 2
IT Project & Service Management	Core	M	20	Coursework	End of Semester 2
Dissertation	Core	M	60	Dissertation	End of Semester 3

For a January start these dates will be delayed by 14 weeks i.e. end of Semester 1 will become end of Semester 2 etc.

Feedback to students

Students will receive formative assessment, particularly during the practical and self-study elements of the programme to ensure they can keep track of their progress and development. This will also be a key factor in ensuring student engagement and retention on the programme of study. In the case of practical assessment, this may be a final summative assessment, so more frequent formative assessment provides academic rigour and increases student awareness and confidence in the subject.

Feedback is provided continuously to students through informal contact with subject lecturers and tutors in the seminar/tutorial and laboratory settings. In accordance with University Guidance, feedback is provided on assessed practical work normally within three weeks of submission of the work.

Timely feedback is given to individual students on each module. This indicates the grade obtained which areas were excellent, good or not so good. Areas of improvement are identified and in the case of a referral what work needs to be carried to gain a pass. There is a section of the pro-forma used entitled "For the future" which is intended to direct the student.

In particular the External examiner commented on the quality of the feedback given to the students and sited it as an example of good practice.

This feedback pro-forma is created for each individual student and is normally printed and handed to the student however it is available electronically if the student requests it.

Programme Team

Prof Vic Grout

John Davies – Programme Leader

Dr. Stuart Cunningham

Dr. Rich Picking

Denise Oram

Stephen Caulder

It is recognised that it will be necessary to not only enhance the knowledge of this team by undertaking professional development but also to supplement the range of knowledge of the applications of HPC by utilising visiting Professors and other experts in the field. These experts would include members of the HPC Wales project team so that the experience they have gained during the set up phase can be passed on to the students. The following support team indicates the depth of the experts that are available to this programme.

Supporting team

Prof. P. Excell

Visiting Prof. W.T. Hewitt

Visiting Prof. L. Tarricone

Visiting Prof. Christian Schröder

Visiting Prof. David Staton

Dr. A. Osanlou

John Worden

Bindu Jose

Nigel Houlden

J. Matthews

R. Hebblewhite

N. Roberts

Assessment regulations that apply to the programmes

Assessment is carried out in accordance with Glyndŵr University's Regulations for Taught Masters.

The programme has been designed in accordance with the Regulations for Glyndŵr University Modular Masters Degrees.

The Masters award requires 180 credits at level M: normally 120 credits for the taught elements and 60 credits for the Dissertation / Project

The modules are equivalent to 20 credits. Typically, a full-time student studies modules equivalent to 60 credits per semester (normally 3 modules), with 15 weeks of teaching, revision and

assessment activities for each module.

The full degree scheme, including submission of the dissertation in the prescribed form, shall be normally completed within the following periods from the date of the initial registration:

Full-time candidates not more than 2 years

Part-time candidates not more than 5 years

All taught modules and the dissertation or project module, are marked on a percentage scale, with a pass/fail threshold of 40%.

While most students will aim to achieve the full Masters qualification, all Masters programmes offer the subsidiary awards of Postgraduate Certificate or Postgraduate Diploma for students unable to complete their full programme of study. The full list of awards and their requirements is as follows:

Award	Credits at level 7	Modules Required
MSc High Performance Computing	180 credits	6 modules + dissertation
Postgraduate Diploma High Performance Computing	120 credits	6 modules
Postgraduate Certificate High Performance Computing	60 credits	3 modules

Progression

1. Detailed information relating to progression and awards are outlined in Regulations for Glyndŵr University Modular Masters Degrees.
2. Each student follows a course of study which will enable the successful candidate to attain either an exit award of Postgraduate Certificate or the exit award Postgraduate Diploma or progress to the MSc stage.

Progression to the MSc stage is determined by the Assessment Board and will require the student to have successfully acquired 120 credit points in the previous PgD stage

The Welsh Language

The Computing subject area will offer Welsh medium assessment, (including written assignments, examinations, projects and theses) to students and will provide assessment in accordance with the student's linguistic preference.

The subject area will offer and establish the need for Welsh medium assessment as part of its registration processes. Where a qualified tutor is available, students will then be allocated to a tutor who is able to assess the work in Welsh. At present, the subject area does not have enough bilingual tutors or full-time academic staff who are able to assess through the medium of Welsh. Where a need for Welsh medium assessment has been identified and no appropriate Welsh speaking tutor/assessor is available, the written assessment will be translated into English. This translation will be conducted by University qualified translators.

The subject area will collect data on the linguistic preferences of students during the registration process. This data will be used, where possible, to offer students academic and other support in the Welsh language and enable the University to assess the demand to develop bilingual educational provision further.

A range of advisory and study support services provided for students and prospective students are available in both English and Welsh in the University.

Criteria for admission to the programme

The MSc Computer Networking is intended for graduates who already have a first degree in Computer Science or a closely related subject, and who wish to extend the knowledge gained in their undergraduate study with more advanced specialised material reflecting current research at the "cutting edge" of the discipline.

General Academic Requirements

The standard entry requirement for the MSc programme is an honours degree of at least 2:2 classification in a Computer Science related subject area, or equivalent in a science-based degree with a strong computing and/or engineering element. In some cases applicants with substantial commercial or industrial experience can be accepted, subject to interview and references.

In addition to these requirement applicants for the MSc HPC would be expected to have a strong programming background. No prior HPC knowledge is assumed, but applicants must be competent programmers in C, C++, Fortran or Java.

In some cases a non-graduate candidate may be accepted provided that the applicant has substantial commercial or industrial experience or held a responsible position which is relevant to the programme to be pursued for a minimum of two years, within the previous five years. This is subject to interview and references.

Applicants whose first language is not English, or whose Bachelors degree is not from a university in an English speaking country, are required to provide evidence of proficiency in English by having attained one of the following or its equivalent:

English test & Minimum score:

TOEFL - Paper based test	580 with 4.0 on essay writing
TOEFL - Computer based test	240 with 4.0 on essay writing
TOEFL - Internet based test	94 with at least 20 in listening, 23 in reading and 24 in writing.
IELTS	6.5 with not less than 6.0 in listening, reading, speaking and writing.
English GCSE	Grade C

Students should have achieved IELTS scores within the last 2 years.

Pre-sessional English language courses are available at the University Second Language Learning Centre for students who wish to improve their language skills prior to commencing their studies.

Programme Management

The programme will be managed under the auspices of the Institute for Arts, Science and Technology School of Computing and the programme will develop and operate within the terms of the overall management of curriculum within the Institute.

However, there will be a designated MSc Programme Leader for the MSc Computer Networking who will be responsible for the day-to-day running of the programme, including the following:

- The management and development of curriculum and the course portfolio
- Student tracking and student records
- Collation of assessment data, presentation of data at examination boards, and preparation of student transcripts
- Management/co-ordination of overall assessment activities across the programme
- Liaison with external bodies and agencies,
- Quality assurance and annual monitoring, including compilation of the Annual Monitoring Report
- Co-ordination of admissions activities and other recruitment activities, including relevant publicity activities

At module level there is devolved responsibility for the following:

- The maintenance and development of teaching and learning materials for all students enrolled on the module,
- The publishing and updating of module timetables, which shall include a weekly schedule of module sessions and required reading, to be distributed to students at the start of all modules
- The setting, marking and collation of marks for all module assessments and examination papers, including resit assessments, and submission of student results to the Programme Leader
- Tutorial support for students taking the module which they are responsible
- Quality monitoring, including processing of annual student feedback questionnaires and, where appropriate, student feedback for individual modules
- Liaison with part-time members of staff involved in module teaching

Programme Team

Prof Vic Grout

John Davies – Programme Leader

Dr. Stuart Cunningham

Dr. Rich Picking

Denise Oram

Supporting team

Prof. P. Excell
Visiting Prof. W.T. Hewitt
Visiting Prof. L. Tarricone
Visiting Prof. Christian Schröder
Visiting Prof. David Staton
Dr. A. Osanlou
John Worden
Bindu Jose
Nigel Houlden
J. Matthews
R. Hebblewhite
N. Roberts

Quality Management Arrangements

Quality assurance mechanisms are well established at University level and at programme level these are invoked via programme team meetings, assessment boards, and the annual monitoring report. At subject level, the Programme Leader reports to the Subject Group at its monthly meetings. All of these are overseen at School level by the Academic Subject Board, which is responsible for the management of academic quality and standards within academic areas.

These internal quality assurance mechanisms are used to evaluate and enhance the quality and standards of the provision. For example, the annual monitoring report serves as an aid to the subject area in enhancing the quality of the provision by

- i. enabling reflection on issues arising in the previous academic year,
- ii. enabling feedback from students, staff and External Examiners to be discussed and considered and
- iii. emphasising action taken (or to be taken) on issues arising;
- iv. providing a crucial source of evidence that the University's internal quality management and enhancement processes are robust, efficient and effective

Monitoring and Feedback

The University has procedures in place for the regular review of its educational provision, including the annual review of both modules and programmes which draw on feedback from such sources as external examiners' reports, student evaluation, student achievement and progression data. In addition, programmes are subject to a programme periodic review (PPR) and re-validation in year 5 that includes external input.

Feedback from students plays a critical part in informing the School's strategic thinking. It also allows the School to evaluate how its service provision is viewed by its most important group of stakeholders, its students.

Students can provide feedback in a number of ways:

Staff-Student Consultative Committee.— SSCCs, chaired by a member of academic staff from outside the programme, will be held at least once per semester. The Chair will minute student

feedback for action/response by the Programme Leader. Minutes of the SSCCs and the response from the Programme Leader will be posted on the programme pages of Moodle.

SPOMs— Module Leaders will distribute SPOMs at the end of each module. A summary of the analysis of the SPOMs, along with any other feedback (e.g. from the student suggestion box), will be passed to the Programme Leader for action/response.

Research and Scholarship underpinning the curriculum

The Subject area believes that students learn best in a research oriented environment taught by people working at the forefront of their disciplines. The skills and expertise in the School are augmented by the presence of the Centre for Applied Internet Computing (CAIR) which has now been encompassed into the Creative and Applied Research for the Digital Society (CARDS) research Centre, where staff are researching in the areas of Computer Programming and Software Engineering, Networking and Internet Technologies, Mobile Communications, Web systems, Security and Computer Forensics, Computer Graphics, Media Technologies, E-Commerce and business impact. Current research projects include:

- Computer Music and Audio
- Metrics for determining network stability
- Social and Behavioural Algorithms
- Computational mathematics
- Combinatorial optimisation and network algorithms
- Information Systems Failure
- Intelligent user interface design and adaptive tutoring systems
- Games Technology
- Routing algorithms and protocols
- Database optimisation
- Search engines
- Holistic visualisation of distributed knowledge
- Security and security visualization
- Complex decision analysis
- Wireless network optimisation
- Standardisation of reusable interface components
- Computing and Internet Ethics
- e-Learning/Business/Commerce
- Teaching and learning in IT
- Domotics and Remote-Controlled Home Automation Systems
- Document compression and transmission.

The Research Centre - Creative and Applied Research for the Digital Society (CARDS) has taken over the Centre for Applied Internet Research (CAIR) which has built up its activities very impressively over the past four years. The commitment and enthusiasm of the staff is very evident and significant outputs have been achieved over a whole range of activities, covering publications, grant winning, conference organisation, industrial engagement etc.

In recent years, the Centre has benefited substantially by the appointment of two experienced professors from outside and they have imported significant publishing and project management momentum which it has been possible to incorporate into the Centre's submission to the Research Assessment Exercise (RAE 2008). This has been augmented by the adoption of an additional associate member of the Centre from the electrical engineering subject area, having a substantial research publishing record. The Centre has achieved an excellent evaluation in the RAE, with 90% of its research being classified as 'internationally recognised' and some 'world leading'. The Computing and

Informatics 'Grade Point Average' (GPA) of 2.35 was the highest in the university – an excellent result for a young (but rapidly emerging) centre.

Significant achievements during the recent past include the very professional organisation of a conference to the highest international standards; the development of a large-scale EU-funded research project, the steady production of conference publications, in addition to a sound proportion of academic journal publications; the setting up of a usability laboratory - a relatively unique facility in Wales; the importing of a substantial new base of specialism in wireless technologies and a success in a radio frequency identification tagging (RFID) project, which is intended to be rapidly grown into an additional research theme. This particular success formed part of an undergraduate student project, emphasising the integration of teaching and research.

Particular support for learning

Students on the programme will receive the following forms of student support and guidance:

- **Admissions.** All students on the programme will have the opportunity to discuss their application with staff, and receive appropriate advice and guidance prior to admission. This will include review of expectations of the programme and clarification of workload and requirements.
- **Induction.** New students on the programme will undergo an induction programme which will provide them with a full introduction to the programme, and will include elements of work on study skills and professional development.
- **Student Handbook.** All students on the programme will receive a Student Handbook which will contain details and guidance on all aspects of the programme and forms of student support and guidance, programme-based, School-based and institutional
- **Progress Review and Attendance Monitoring.** Student attendance will be subject to regular monitoring through registers, and this will be a means of addressing issues of student support. There will also be regular reviews for each student with personal tutors.

Student Support

Every student is allocated a personal tutor in the first weeks of the programme. The personal tutor is someone students can contact to discuss any problems of a non-academic nature. These may relate to special needs or personal problems that may affect the student's academic performance.

Academic problems should first be addressed to the lecturer concerned. If the problem is not resolved or it does not relate to a specific module, then the Programme Leader should be contacted. A more detailed complaints procedure is given in the School's Student Handbook

Another forum for discussion is the Staff Student Consultative Committee. Student representatives, who are elected by the students, meet lecturing staff on the programme once a semester to exchange ideas about the programme. This allows students to communicate their shared concerns in an informal manner, and for the staff to react and respond speedily to address their concerns.

Additional support for International students

There is network of support that is available at many different levels within the University and these combine to provide a supportive framework for the international students. Specifically, this includes three main activities:

- Language provision designed to ensure that the international students have achieved a minimum level of language skills before they embark on their chosen degree programme. This is a six-week pre-sessional intensive English Language for Academic Study course that aims to bring students to an IELTS (International English Language Testing System) level of 6.5 – the standard demanded for entry into master's degree programmes.
- Glyndŵr University offers English language classes alongside studies that improve not only spoken and written English but also academic English. Classes take place weekly and are delivered by the University's English language tutors also t help students to integrate into the life of the local community as well as helping them develop transferable skills such as practical, research and report-writing skills.
- An induction / orientation course that precedes the start of formal teaching and that allows the international students to become familiar with the University and studying at the University whilst at the same time outlining some of the cultural differences that exist between their country of origin and the UK.

Facilities

There are 4 specialist IT labs used for Computing students and in addition, students have access to the University open-access computing labs and other University wide services, including the wireless network.

Every student studying the network modules are given their own id and password to allow them to access the Cisco Network Academy. This material is of a very high quality professional standard and has become the industry standard for computer networking.

There is comprehensive Virtual Learning Environment (Moodle) containing a range of advice and guidance. Module lecture notes and programme content are available online through Moodle and it is used for all the modules within the programme. This enables students to gain access to tutorial work and assignments set for the various modules. Many study materials are available via Moodle such as online databases; e-journals and library catalogue information are also available online.

A well-equipped networking laboratory is available to assist the students in their practical work. Glyndwr Universities B121 laboratory is the main teaching resource however there is an additional laboratory (E1) available to enable students to have access to equipment over extended periods so that they can undertake their dissertation. The main teaching laboratory enables up to 26 students to work at any one time. Additionally simulator tools e.g. ns2, Opnet, are also available that are primarily used for the dissertation phase of the programme

Equality and Diversity

The University has adopted a policy of providing equal opportunities for all its students, staff, applicants and others involved in its work. One aspect of this policy is its intention to prevent, as far as possible, the harassment of one person by another, whether on the basis of gender, sexual orientation, sexuality, race or ethnic origin, religion, disability, or any other personal attributes or views held by the person harassed.

As part of the University's Disability Policy, students with a physical disability or learning difference are encouraged to contact the University Disability Adviser to ensure their needs are acknowledged formally. The outcome of such an assessment could result, for example, in additional time being allowed for examinations, or the provision of further learning support.