| PROGRAMME SPECIFICATION |  |
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| **1** | **Awarding Institution** | Newcastle University |
| **2** | **Teaching Institution** | Newcastle University |
| **3** | **Final Award** | MSc |
| **4** | **Programme Title** | Computer Security and Resilience |
| **5** | **UCAS/Programme Code** | 5144 |
| **6** | **Programme Accreditation** | British Computer Society |
| **7** | **QAA Subject Benchmark(s)** | Computing |
| **8** | **FHEQ Level** | M |
| **9** | **Date written/revised** | 9th March 2012 |

## 10 Programme Aims

1. To equip students with the skills and knowledge required to develop and assess secure and resilient computer-based systems
2. To provide a qualification enhancing employment prospects in dependable computing
3. To develop research skills
4. To develop and improve key skills in written and oral communication and in teamwork
5. To develop and improve skills in using the literature and information technology resources relevant to dependable computing
6. To encourage the development of creativity skills
7. To develop skills in critical assessment, analysis and storage of information
8. To provide a programme which meets the accreditation requirements of the appropriate professional bodies, thus providing a basis for further professional development and lifelong learning
9. To address the relevant professional, legal and ethical issues relevant to the development, assessment and maintenance of secure and resilient systems
10. To provide an international perspective on developments in computer security and resilience.
11. To provide a programme which meets the FHEQ at Masters level and takes appropriate account of the draft subject benchmark statements in Computing.

## 11 Learning Outcomes

The programme provides opportunities for students to develop and demonstrate knowledge and understanding, qualities, skills and other attributes in the following areas. The programme outcomes have references to the benchmark statements for Computing.

### Knowledge and Understanding

On completing the programme students should be able to demonstrate:
A1 Understanding of the theory underpinning dependability, security and resilience in computer-based systems
A2 Knowledge of advanced techniques for assessing information security
A3 Knowledge of the major methods for assessing system resilience
A4 Knowledge of the major fault tolerance techniques applicable in computing system design
A5 Understanding of the technologies for the design of trustworthy interactive systems, including human error assessment
A6 Understanding of the computer aided verification techniques relevant to security in distributed systems

A7 Understanding of the principles underlying high integrity software development using advanced static analysis and formal techniques
A8 Understanding of major professional, legal and ethical issues associated with work in secure and resilient computing systems
A9 Understanding of the international character of contemporary developments in security and resilience.

**Teaching and Learning Methods**

The primary method of imparting knowledge and understanding is lectures supported by practical work in classes and laboratories (A1-A9). Fundamental motivation (A1), is further reinforced through case study material describing real-world failures of security and resilience. Knowledge of leading technologies (A2-A6), is assisted through the practical laboratory work in addition to the lectures. Professional, legal and ethical issues (A8) are addressed explicitly in the dependability context and reinforced in the core technical modules and again in the group project. The international character of developments in the subject (A9) is emphasised in the research skills module and individual project. Through the many case studies underpinning studies in secure systems, Students will be encouraged to deepen understanding by independent reading in the relevant technical and scientific literature, supported by guidance in information literacy skills (in induction and prior to the group and individual projects) and subject-specific guidance given in lectures.

**Assessment Strategy**

Technical knowledge and understanding is primarily assessed through unseen written examinations (A1-9). In the case of major technical methods (A2-A6), assessment is also based on coursework based on practical exercises.

**Intellectual Skills**

On completing the programme students should:
B1 Be able to propose, conduct and write up an extended research project involving, where appropriate, a literature review, problem specification, design, verification, implementation and analysis
B2 Be able to design, implement and validate new software for secure or resilient applications
B3 Be able to organise and take part in systematic dependability analyses of existing systems
B4 Have expertise in the use and applicability of up-to-date software development tools
B5 Be able to assess the main human factors relevant to secure system operation
B6 Be able to apply the leading techniques for security in network and internet environments, including cryptography and public key infrastructures
B7 Be able to apply the major methods for assessing system resilience
B8 Be able to deploy fault tolerance appropriately in system design

**Teaching and Learning Methods**

Intellectual skills are imparted through lectures on research project planning (B1) and through one-to-one and small group supervisions during the individual project. Specific design, validation skills (B2,B4,B6,B8) are introduced in practical classes. Assessment skills (B3,B5,B7) are introduced through practical case studies in taught modules. Throughout the programme, the emphasis is on skills development through practical experience. Students are encouraged to acquire relevant skills through: the group and individual projects, which have a research element (B1); individual modules' laboratory classes in design (B2,B4,B6,B8), and dependability assessment methods (B3,B5,B7) . The group project aims to encourage students to learn how skills specific to sub-disciplines (B2-B7) interact in design and assessment.

**Assessment Strategy**

Intellectual skills are primarily assessed by means of reports, designs and software developed by students in coursework activities and private study (B6-B8). The individual project deliverables (proposal, presentation and dissertation) are the main vehicles for assessment of B1. Reports from individual and group projects are used for assessment of B2, B4, B5. For B6-B8, assessment is based on project reports from coursework supplemented by focussed problems in unseen written examinations.

**Practical Skills**

On completing the programme students should be able to:
C1 Critically evaluate research and literature relating to security and resilience of computer-based systems
C2 Evaluate and use appropriate tools and techniques
C3 Undertake critical evaluation (theoretical and empirical) of alternative solutions
C4 Solve design problems

**Teaching and Learning Methods**

Practical skills are developed through practical study skills sessions in information research and literacy (C1) and practical design classes as part of the practical component of each module (C2,3,4). Students are encouraged to acquire these skills through preparing seminars and presentations on current topics in computer security and resilience (C1), through the preparation and presentation of design and tooling alternatives in practical classes and the group project (C2,3,4)

**Assessment Strategy**

Practical skills are primarily assessed through practical work. C1 is assessed through specific coursework exercises, a seminar and dissertation at the end of the individual project. C2-C4 are primarily assessed in individual and group-based coursework and the final project. C3 and C4 are also assessed, in part, via unseen written examinations.

**Transferable/Key Skills**

On completing the programme students should have:
D1 The ability to communicate orally in a professional context
D2 Written communication skills, including an appreciation of the role of peer review of papers, software, proposals and other research and development products
D3 Information literacy skills, including the ability to use computer-based resources for research in the professional literature and the capacity to undertake critical review
D4 The ability to work as part of a team, including group-based learning, research and development activity
D5 Creativity skills: recognising and responding to opportunities for innovation
D6 Planning and organisation skills

**Teaching and Learning Methods**

Communication skills (D1,D2) are imparted through seminars on oral presentation and technical writing within the module on research skills, the group and individual projects. Skills in computer-based information resources (D3) are promoted through specialist classes provided in conjunction with the Robinson Library's Information Literacy programme. Team working skills (D4) are developed in the group project module through introductory lectures on team working issues and guidance during the project. Creativity skills are introduced in practical classes, as well as the group and individual projects. Planning and organisation skills (D6) are stressed throughout the practical aspects of the programme, notably in the preparation for the group and individual projects. Students are encouraged to practise communication skills (D1) through group working, informal and formal presentations, and through written reports associated with practical exercises, the group and individual project

(D2). Skills in using computer-based information resources (D3) are encouraged by research-related exercises. Team working skills (D4) are practised through students collaborating in a major team-based project. Creativity skills (D5) are encouraged by tackling design problems which grow in the level of challenge, from specialised technical modules to group and individual projects.

**Assessment Strategy**

Key skills are primarily assessed through practical work (D1-D6). D1 is assessed by means of student presentations following practical work involving research and literature review, in the group and individual projects. D2 and D3 are assessed via reports submitted as parts of coursework and project work, including a specific research skill module, as well as the final dissertation. D4-D6 is assessed primarily via observation of teams during the group project. D5 and D6 are additionally assessed by observation during the individual project.

## 12 Programme Curriculum, Structure and Features

### Basic structure of the programme

The programme is studied over one year full time. There is a single stage to the programme, requiring the study of 180 credits. A 10 credit module consists of 100 hours of student effort, covering lectures, practical classes, small group teaching and private study, completion of coursework and revision. Most modules vary in size from 5 credits to 15 credits. There is one 90-credit module containing the individual project.
The programme is divided into three phases. Phase 1 lays foundations in the principles of computer security and resilience (A1, A3, A4) and follows this with material on specialist sub-disciplines which develop core technical knowledge (A1-A6) and also introduce professional (A7) and subject-specific skills through their practical and coursework components (B2-B8). This phase is composed of six 10-credit modules in Semester 1.
Phase 2 integrates the material covered in the sub-disciplines by giving a thorough grounding in the technology of high integrity software development and systems assessment. Some practice-related knowledge is introduced at this stage (A7,A8) but the emphasis is on developing professional and cognitive skills. Design and dependability evaluation skills are developed in a module focussed on high-integrity development processes and tools (B2-B4) while essential research and communication skills (C1, D1-D3) are explicitly developed in a seminar-based module on topics of current research interest with a strong international emphasis (A9). A group project module is a major way of developing professional skills in development and evaluation (B3-B5, B7, B8) and cognitive skills relating to design and tools selection (C2-C4). Team working skills (D4) are explicitly developed. Other key skills in communication are developed through oral and written reporting (D1, D2) on planning and design activities in the project (D5, D6). This phase is composed of 30 credits in three modules in Semester 2.
Phase 3 of the programme emphasises research skills, creativity and management of independent work through a substantive research-related project selected by the student in consultation with an academic supervisor. It consists of an initial phase in which students are given further training in cognitive and key skills (C1, D2, D3, D6) essential to the management of an individual research-related project, culminating the production of an assessed research proposal. The execution of the project concentrates on the development of specific subject skills in the chosen project area (B1, B4, B7, B8), higher cognitive and key skills (C2, C3, C4, D2, D5, D6). This phase commences in Semester 2 and carries on to the end of the programme.

Duration: 1 year
Stages: 1
Credits: 180
Module credits:
All modules are compulsory
Semester 1: 6 modules, each 10 credits
Semester 2: 3 modules: 10 + 5 + 15 credits, followed by
Project: 90 credits, beginning half way through semester 2.

### Key features of the programme (including what makes the programme distinctive)

Subject to agreement with industry, the project work can be undertaken with a sponsoring company.
Modules in the first semester are taught in intensive mode.

### Programme regulations (link to on-line version)

http://www.ncl.ac.uk/regulations/programme/

## 13 Criteria for admission

*Entry qualifications*
Good Honours degree (2.2 or above) or equivalent in Computing Science, Software Engineering or a discipline with a significant computing component (e.g. Engineering including Systems Engineering, Mathematics).

*Admissions policy/selection tools*
Applicants with non-standard qualifications may be interviewed.

*Non-standard Entry Requirements*
Science and Engineering graduates with several years' industrial experience will also be considered. Holders of professional qualifications in computing (e.g. MBCS) will also be considered.

*Additional Requirements*
None

*Level of English Language capability*
For applicants whose first language is not English we ask for IELTS 6.5 or TOEFL 233 (computer-based).

## 14 Support for Student Learning

The Student Services portal provides links to key services and other information and is available at: www.ncl.ac.uk/students/

*Induction*
During the first week of the first semester students attend an induction programme. New students will be given a general introduction to University life and the University's principle support services and general information about the School and their programme, as described in the Degree Programme Handbook. New and continuing students will be given detailed programme information and the timetable of lectures/practicals/labs/ tutorials/etc.

*Study skills support*
Students will learn a range of Personal Transferable Skills, including Study Skills, as outlined in this Programme Specification. Some of this material, e.g. time management is covered in the appropriate Induction Programme. Students are explicitly tutored on their approach to both group and individual projects.

*Academic support*
The initial point of contact for a student is with a lecturer or module leader, or their tutor (see below) for more generic issues. Thereafter the Degree Programme Director or Head of School may be consulted. Issues relating to the programme may be raised at the Staff-Student Committee, and/or at the Board of Studies.

*Pastoral support*
All students are assigned a personal tutor whose responsibility is to monitor the academic performance and overall well-being of their tutees.
In addition the University offers a range of support services, including the Student Advice Centre, the Counselling and Wellbeing team, the Mature Student Support Officer, and a Childcare Support Officer.

*Support for students with disabilities*
The University's Disability Support Service provides help and advice for disabled students at the University - and those thinking of coming to Newcastle. It provides individuals with: advice about the University's facilities, services and the accessibility of campus; details about the technical support available; guidance in study skills and advice on financial support arrangements; a resources room with equipment and software to assist students in their studies.

*Learning resources*
The University's main learning resources are provided by the Robinson and Walton Libraries (for books, journals, online resources), and Information Systems and Services, which supports campus-wide computing facilities.

The School of Computing Science has well equipped computer laboratories consisting of networked PCs with dedicated labs for each stage of the programme. In particular the School hosts a videoconferencing suite, funded through the HEFCE Centre of Excellence in Teaching and Learning programme. Key software used in the support and delivery of the programme is available to students free of charge. The University's Robinson Library has available multiple copies of all recommended undergraduate texts.

All new students whose first language is not English are required to take an English Language test in the Language Centre. Where appropriate, in-sessional language training can be provided. The Language Centre houses a range of resources for learning other languages which may be particularly appropriate for those interested in an Erasmus exchange.

## 15 Methods for evaluating and improving the quality and standards of teaching and learning

*Module reviews*
All modules are subject to review by questionnaires which are considered by the Staff Student Committee and Board of Studies. Changes to, or the introduction of new, modules are considered at the School Teaching and Learning Committee and at the Board of Studies. Student opinion is sought at the Staff-Student Committee and/or the Board of Studies. New modules and major changes to existing modules are subject to approval by the Faculty Teaching and Learning Committee.

*Programme reviews*
The Board of Studies conducts an Annual Monitoring and Review of the degree programme and reports to Faculty Teaching and Learning Committee.

*External Examiner reports*
External Examiner reports are considered by the Board of Studies. The Board responds to these reports through Faculty Teaching and Learning Committee. External Examiner reports are shared with institutional student representatives, through the Staff-Student Committee.

*Student evaluations*
All modules, and the degree programme, are subject to review by student questionnaires. Informal student evaluation is also obtained at the Staff-Student Committee, and the Board of Studies.

*Mechanisms for gaining student feedback*
Feedback is channelled via the Staff-Student Committee and the Board of Studies.

*Faculty and University Review Mechanisms*
The programme is subject to the University's Internal Subject Review process, see http://www.ncl.ac.uk/quilt/assets/documents/qsh-isr-policy.pdf

*Accreditation reports*
This new programme was considered for accreditation at the visit of the British Computer Society in 2008. Full, final confirmation of Accreditation is awaited.

*Additional mechanisms*
None

## 16 Regulation of assessment

*Pass mark*
The pass mark is 50

*Course requirements*
Progression is subject to the University's Masters Degree Progress Regulations, Taught and Research and Examination Conventions for Taught Masters Degrees. Limited compensation in up to 40 credits of the taught element and down to a mark of 40 is possible and there are reassessment opportunities, with certain restrictions.

*Common Marking Scheme*
The University employs a common marking scheme, which is specified in the Taught Postgraduate Examination Conventions, namely:

| **Summary description applicable to postgraduate Masters programmes** | | **Summary description applicable to postgraduate Certificate and Diploma programmes** | |
|---|---|---|---|
| <50 | Fail | <50 | Fail |
| 50-59 | Pass | 50 or above | Pass |
| 60-69 | Pass with Merit | | |
| 70 or above | Pass with Distinction | | |

*Role of the External Examiner*
An External Examiner, a distinguished member of the subject community, is appointed by Faculty Teaching and Learning Committee, after recommendation from the Board of Studies. The External Examiner is expected to:

- See and approve examination papers
- Moderate examination and coursework marking
- Attend the Board of Examiners
- Report to the University on the standards of the programme

In addition, information relating to the programme is provided in:

The University Prospectus (see http://www.ncl.ac.uk/postgraduate/)

The School Brochure http://www.ncl.ac.uk/computing/

The University Regulations (see http://www.ncl.ac.uk/regulations/docs/)

Please note. This specification provides a concise summary of the main features of the programme and of the learning outcomes that a typical student might reasonably be expected to achieve if she/he takes full advantage of the learning opportunities provided. The accuracy of the information contained is reviewed by the University and may be checked by the Quality Assurance Agency for Higher Education.

**Annex**

## Mapping of Intended Learning Outcomes onto Curriculum/Modules

| Intended Learning Outcome | Module codes (Compulsory in Bold) |
|---|---|
| A1 | **CSC8102, CSC8201** |
| A2 | **CSC8102, CSC8202** |
| A3 | **CSC8105, CSC8201** |
| A4 | **CSC8201** |
| A5 | **CSC8203** |
| A6 | **CSC8105** |
| A7 | **CSC8204, CSC8404, CSC8406** |
| A8 | **CSC8201, CSC8202, CSC8205, CSC8206** |
| A9 | **CSC8205** |
| B1 | **CSC8205, CSC8299** |
| B2 | **CSC8204, CSC8404, CSC8406** |
| B3 | **CSC8204, CSC8206** |
| B4 | **CSC8204, CSC8206, CSC8299, CSC8404, CSC8406** |
| B5 | **CSC8203, CSC8206** |
| B6 | **CSC8102, CSC8202** |
| B7 | **CSC8105, CSC8206, CSC8299** |
| B8 | **CSC8206, CSC8299** |
| C1 | **CSC8205, CSC8299** |
| C2 | **CSC8206, CSC8299, CSC8404, CSC8406** |
| C3 | **CSC8204, CSC8206, CSC8299** |
| C4 | **CSC8204, CSC8206, CSC8299** |
| D1 | **CSC8206, CSC8299** |
| D2 | **CSC8102, CSC8105, CSC8201, CSC8202, CSC8203, CSC8205, CSC8206, CSC8299** |
| D3 | **CSC8205, CSC8299** |
| D4 | **CSC8206** |
| D5 | **CSC8204, CSC8206, CSC8299, CSC8404, CSC8406** |
| D6 | **CSC8206, CSC8299** |