UNIVERSITY of BRADFORD

Faculty of Engineering and Informatics

Programme Specification

Programme title: BSc Computer Science for Cyber Security

Academic Year:	2018/19
Degree Awarding Body:	University of Bradford
Partner(s), delivery organisation or support provider (if appropriate):	
Final and interim award(s):	BSc (Honours) [Framework for Higher Education Qualifications (FHEQ) level 6] BSc (Ordinary) – exit award [Framework for Higher Education Qualifications (FHEQ) level 6] Diploma of Higher Education [Framework for Higher Education Qualifications (FHEQ) level 5] Certificate of Higher Education [Framework for Higher Education Qualifications (FHEQ) level 4]
Programme accredited by (if appropriate):	
Programme duration:	3 years full time; 4 years full-time including a year of study abroad and/or work placement
UCAS code:	I190 (3-year) I191(4-year)
QAA Subject benchmark statement(s):	Computing
Date of Senate Approval:	April 2003
Date last confirmed and/or minor modification approved by Faculty Board	November 2016

Introduction

This Computer Science programme has a specific focus on the theoretical foundations of computation and computer technology and how Computer Science is applied to Cyber Security. It incorporates ideas from many other disciplines,

including mathematics, engineering and management, and has a close affinity with digital communications as illustrated by the Internet, World Wide Web, and wireless communication technologies.

The BSc Computer Science is offered by the School of Electrical Engineering and Computer Science, part of the Faculty of Engineering and Informatics (EI) in the University of Bradford, which includes a renowned tradition of undergraduate and postgraduate programmes concerned with the understanding, design, and exploitation of computation and computer technology. The School places great emphasis on both teaching and research, and there are opportunities for students to join one of our research teams, and progress on to postgraduate taught programmes or research degrees on completion of their first degree. Note that the British Computer Society (BCS) for computing professionals accredits undergraduate and postgraduate programmes offered by the School. Its accreditation of our programmes, also means that successful honours graduates are exempted from further examinations for BCS membership. Employment prospects for graduates of the BSc Computer Science for Cyber Security should be excellent. Our current BCS-accredited programmes consistently enjoy graduate employment rates of over 90%.

Exposure to Industry is embedded within our programmes in a number of ways. Our Industry Advisory Board (IAB), with a membership comprised of industry representatives from both regional and national companies, meets twice a year to review our existing provision and to propose improvements throughout the academic year industry speakers and researchers deliver invited talks that inform and inspire our students about current and future developments within their discipline. For further information on industry talks and research seminars please refer to:

http://www.bradford.ac.uk/ei/electrical-engineering-and-computer-science/research/research-seminars/

Student societies with links to professional bodies afford further opportunities for our students to engage with industry, such as Pi Soc as the first ever BCS Student Chapter, and our ACM student chapter. These societies are encouraged and supported by the School to participate in industry and research led activities such as programming competitions, data dives and extra-curricular collaborations and visits. In addition, our placement scheme gives students the opportunity to work in real companies for up to one year as part of their programme, further enhancing their discipline specific and transferable skills.

Our teaching is informed by industry in several ways. Staff undertaking Knowledge Transfer Partnership projects, national and EU funded research projects and consultancy work embed new knowledge and concepts into their teaching materials and curriculum planning based on the research and development work they conduct.

The launch of the Computing Enterprise Centre offers our students the opportunity to develop industry-based projects and provides industry-sponsored competitive internships. We support industry placements and collaborate with local, national and international organisations offering students opportunities through our industry contacts and extended network of successful graduates.

Through our Computing Enterprise Centre we leverage industry contacts to embed cutting edge projects within modules such as Technical and Professional Skills in year 1, Enterprise-Pro in year 2 and Final Year Project in year 3, allowing students to work on topics highly relevant to their future careers throughout their course. Our Final Year Project showcase allows students to interact with both our Industry Advisory Board members and a wider audience of industry contacts to demonstrate their work and to receive feedback and ideas from professionals within the discipline.

Programme Aims

The aim of the programme is to provide students with a sound grounding in the fundamentals of computer science, Cyber Security, software development (programming) and the tools and applications that modern computer scientist's use. This aim will be achieved by:

1. Providing students with a core of fundamental modules, in stages 1 and 2, that are essential to all computer scientists, plus a range of options they will then specialise in Cyber Security.
2. Providing the support in the form of lectures, labs and tutorials that will enable students to develop their personal portfolio of skills and knowledge, in line with the School of Electrical Engineering and Computer Science's commitment to providing a very high standard of academic delivery and environment, supported by up-to-date computing facilities, hardware devices and software tools.
3. Developing discipline and personal transferable skills so that during studies and on graduation they may move directly into responsible positions in industry or commerce (such as placement, graduate schemes respectively) and as business innovators, or may pursue further programmes of study.
4. Enabling development of problem analysis and computational solutions by application of fundamental principles and concepts of computer science, such as abstraction, data representation, logic, algorithms and digital technologies.
5. Promoting educational opportunities and interest in academic development for ethnic minorities, women, mature and alternatively qualified students, as well as for school-leavers and traditionally qualified students.

Programme Learning Outcomes

To be eligible for the award of Certificate of Higher Education at FHEQ level 4, students will be able to:

LO1 Describe the history of computer science
LO2 Outline the professional, ethical, security, industrial and research dimensions of the discipline of computer science
LO3 Demonstrate knowledge of fundamental concepts and theories of computer science, and the environment in which they operate; basics of software construction and the tools required to support it, develop skill in constructing software.
LO4 State and explain relevant models, principles and practices applicable to the study of computers, computer architecture and systems.
LO5 Explain how logic is used as a tool for describing computer

systems.

LO6 Collect, manage and present information, ideas and concepts, and interpret data using suitable techniques.

LO7 Work effectively as individuals and in groups.

LO8 Communicate accurately and reliably with a range of audiences using basic theories and concepts of the subjects of study.

Additionally, to be eligible for the award of Diploma of Higher Education at FHEQ level 5, students will be able to:

LO9 Apply knowledge and skills in computing to the analysis of complex software engineering.

LO10 Apply knowledge of investigative and research principles to demonstrate an understanding of how to evaluate computing designs, processes and products.

LO11 Apply knowledge of relevant software tools to problem solving and system design, development and security management.

LO12 Apply knowledge of computer systems to the assessment and management of specific security problems and challenges.

LO13 Use practical computer science skills in the design and manufacture, and testing of computer systems.

LO14 Use personal and technical skills to communicate effectively within computing environments in partnership with other professionals.

LO15 Apply knowledge of the fundamentals of security management and the system tools required to manage vulnerabilities

Additionally, to be eligible for the exit award of Ordinary Degree of Bachelor at FHEQ level 6, students will be able to:

LO16 Demonstrate a systematic understanding of key aspects of their field of study, including acquisition of coherent and detailed knowledge informed by aspects of Computer Science.

LO17 Deploy accurately established techniques of analysis and enquiry within Computer Science.

LO18 Show conceptual understanding that enables students to devise and sustain arguments, and/or to solve problems, using ideas and techniques, and to describe and comment upon particular aspects of current research, or equivalent scholarship, or practice in Computer Science.

LO19 Demonstrate an appreciation of the uncertainty, ambiguity and limits of knowledge.

LO20 Develop the ability to manage their own learning, and to make use of primary sources.

Additionally, to be eligible for the award of Honours Degree of Bachelor at FHEQ level 6, students will be able to:

LO21 Develop a systematic understanding of the fundamental concepts and theories of computer science including detailed knowledge of hardware, computer architecture, information and communication technologies

LO22 Demonstrate ability to comment on aspects of current research in the discipline

LO23 Understand how to analyse problems and develop solutions using leading edge ideas and techniques
LO24 Grow an ability to read and make use of research articles in journals and research literature: Particularly in Cyber Security
LO25 Exercise initiative in information management, interpretation and presentation of Computer Science tools, products and solutions.
LO26 Understand and appreciate the nature of cybercrime and how to protect against it at a management level
LO27 Demonstrate an understanding of the use of appropriate cryptographic primitives and protocols for securing network applications.
LO28 Apply and analyse issues of security from a number of different disciplinary perspectives
LO29 Apply the concepts and principles in key computing subjects, including data and information security and forensics, information systems, communication networks.
LO30 Demonstrate professional interest and expertise for a variety of careers such as software security architect, software developer, system administrator, IT project manager, IT consultant or computing researcher that match both learners and employers expectations.

Curriculum

Stage 1

FHEQ Level	Module Title	Type (Core/ Option/ Elective)	Credits	Semester (s)	Module Code
4	Mathematics for Computing	C	20	1	COS4014-B
4	Technical and Professional Skills	C	20	1	COS4015-B
4	Fundamentals of Programming	C	20	1	COS4016-B
4	Computer Architecture and Systems Software	C	20	2	COS4001-B
4	Software Design & Development	C	20	2	COS4017-B
4	Internet Technologies	C	20	2	COS4018-B

At the end of stage 1, students will be eligible to exit with the award of Certificate of Higher Education if they have successfully completed at least 120 credits and achieved the award learning outcomes.

THIS AWARD DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS

Stage 2

FHEQ Level	Module Title	Core/ Option/ Elective	Credits	Semester (s)	Module Code

5	Database Systems	C	20	1	COS5020-B
5	Data Structures and Algorithms	C	20	1	COS5021-B
5	System Security Management	C	20	1	COS5017-B
5	Enterprise-Pro	C	20	2	COS5019-B
5	Computer Communications and Networks	C	20	2	COS5025-B
5	Computational Modelling and Artificial Intelligence	O	20	2	COS5022-B
5	Statistics and Data Analysis	O	20	2	COS5026-B

At the end of stage 2, students will be eligible to exit with the award of Diploma of Higher Education if they have successfully completed at least 240 credits and achieved the award learning outcomes.

THIS AWARD DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS

Stage 3

FHEQ Level	Module Title	Core/ Option / Elective	Credits	Semester (s)	Module Code
6	Final Year Project	C	20+20	1,2	COS6006-D
6	Cyber Security	C	20	1	COS6008-B
6	Mobile Application Developments	O	20	1	COS7025-B
6	Neural Networks & Fuzzy Systems	O	20	1	COS6004-B
6	Elective*	O	20	1	
6	Foundations of Cryptography	C	20	2	COS6007-B
6	Principles of Security Technologies	C	20	2	COS6025-B

* Choice for Elective is a 20-credit module at level 6 or 7 with no timetable clashes once in programme.

The exit award of Ordinary Degree DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS

Students will be eligible for the award of Honours Degree of Bachelor if they have successfully completed at least 360 credits.

THIS AWARD CONFERS ELIGIBILITY TO REGISTER WITH BCS.

Placement and/or Study Abroad

This programme provides the option for students to undertake a work placement or period of study abroad between Stages 2 and 3. Students wishing to take this option will be registered for the 4 year programme.

Students can alternatively go abroad for one or two semesters during their second year. Students will undertake modules to replace those they would have studied at the University of Bradford.

On successful completion of the ENG5002-Z, placement, students will be eligible for the award of University Diploma Industrial Studies.

On successful completion of the ENG5004-Z, study abroad experience, students will be eligible for the award of University Diploma Industrial Studies (International).

For further information about study abroad opportunities please refer to *http://www.bradford.ac.uk/international/erasmus-and-international-exchanges/*

Learning and Teaching Strategy

Students will experience a wide range of teaching and learning environments and a consistent balance between direct academic delivery, and individual and group study. Concepts, principles and theories are generally explored in formal lectures, practiced in associated tutorials and seminars, and demonstrated and experimented in laboratory classes. Practical skills are developed in laboratory sessions. The programme includes a number of innovative and active learning methods. For example, Team Based Learning (TBL) strategies are integrated within a number of modules. In addition, we endeavour to use team teaching methods where lecturing staff are able to contribute their highly specialised research and knowledge into the curriculum.

Throughout the programme, we make use of case studies so that students can apply their theoretical understanding to real-world issues. In this way, abstract concepts are brought to life through practical activities.

In addition to the standard technology enhanced learning approaches, we embed technologies to deliver key concepts in an interactive environment that strongly links theory with practical skills. For example: in programming lectures, a remote desktop application allows lecturers to demonstrate coding in an environment identical to that in our cutting edge labs; our stage 2 Enterprise-Pro module requires and supports students to develop their projects using an industry standard tool for collaborative team based software development. This allows them to develop industry standard skills based on real working practice.

Professional and personal skills are developed through the Technical & Professional Skills module which involves communications skills, library skills, group work and

presentations. The Enterprise-Pro group project module develops an appreciation of how to manage group dynamics whilst working on a substantial computing and software engineering exercise. Honours students undertake a major individual project in their final year, drawing together the knowledge and experience gained throughout the programme. The project provides the opportunity for students to demonstrate the ability to solve problems using current ideas and current, cutting-edge techniques that are at the forefront of computing and applied multidisciplinary disciplines.

Each 20-credit module on the programme requires students to commit 200 hours of study. Many of these hours will be formally timetabled - lectures, laboratories, seminars and tutorials – and others will involve students carrying out private study or group work. The balance between these forms of study changes as they pass through the three years of the programme. There are many *contact hours* (time spent with academic tutors) in all stages of the programme; in the final year students will also be expected to manage their plan for the individual project, under the general guidance of their academic tutors.

All of our staff have achieved, or are working towards, Fellowship of the Higher Education Academy. As part of our commitment to Excellence in Learning and Teaching, we conduct research into innovative and effective teaching methods. For example, assessment for our Final Year Project module was enhanced by incorporating regular formative and summative feedback opportunities to enhance the final outcomes, based on a research project conducted by staff within the School that culminated in a journal publication.

Assessment Strategy

Research active staff are involved in curriculum development based on their research activities, exposing students to the very latest and future developments within their field of expertise. We integrate knowledge and experience from Industrial partners through both our Industry Advisory Board and research projects through case studies, lab based activities and invited talks, ensuring that research findings are at the heart of our curriculum.

Methods of assessment are similarly varied and progress will be assessed using a mix of formal examinations, presentations and seminar papers, reports, laboratory tests, essays, coursework assignments, and projects. The appropriate method is chosen so that students may demonstrate the particular learning outcomes of each module.

Assessment Regulations

This Programme conforms to the standard University Regulations which are available at the following link:

http://www.bradford.ac.uk/aqpo/ordinances-and-regulations/

Admission Requirements

The University welcomes applications from all potential students and most important in the decision to offer a place is our assessment of a candidate's potential to benefit from their studies and of their ability to succeed on this

particular programme. Consideration of applications will be based on a combination of formal academic qualifications and other relevant experience.

The **minimum** entry requirements for the programme are as follows:

- A total of 128 UCAS tariff points, to include 80 points from 2 GCE A levels or equivalent. At least one from Computing, ICT, Maths or a science is preferred. Or DDM in a relevant BTEC Diploma. International Baccalaureate (see UCAS tariff point requirements).
- GCSE English and Maths minimum grade C or grade 4 or equivalent.

Applications are welcome from students with non-standard qualifications or mature students (those over 21 years of age on entry) with significant relevant experience, and will be considered on individual basis by academic tutors.

Recognition of Prior Learning

If applicants have prior certificated learning or professional experience which may be equivalent to parts of this programme, the University has procedures to evaluate and recognise this learning in order to provide applicants with exemptions from specified modules or parts of the programme.

Minor Modification Schedule

Version Number	Brief description of Modification	Date of Approval (Faculty Board)
1	Updates for Periodic Review Nov 2015	
2	Updates for Academic Portfolio Review 2016	17/05/16
3	Minor Modification November 2016	