UNIVERSITY OF BRADFORD  
Faculty of Engineering and Informatics  
School of Electrical Engineering and Computer Science (EECS)  
Programme/course title: MSc Cyber Security

<table>
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<th>Awarding and teaching institution:</th>
<th>University of Bradford</th>
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<tbody>
<tr>
<td>Final award:</td>
<td>MSc [Framework for Higher Education Qualifications level 7]</td>
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<tr>
<td></td>
<td>Postgraduate Certificate (PG Cert)</td>
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<td>Postgraduate Diploma (PG Dip)</td>
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<table>
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<th>Programme title:</th>
<th>Cyber Security</th>
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<td>Programme accredited by:</td>
<td>British Computer Society</td>
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<tr>
<td>Duration:</td>
<td>1 year full time, 2 years part-time</td>
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<tr>
<td>UCAS code:</td>
<td>N/A</td>
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<tr>
<td>Date produced:</td>
<td>November 2003</td>
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<tr>
<td>Last updated:</td>
<td>June 2014</td>
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Introduction

The programme was originally introduced in 2004. The programme as a whole has been significantly revised to enhance its contents and ultimately the skills of all students graduating. This development process has taken a number of years and as such has included discussion and feedback from a number of academics, students, alumni, professionals and external examiners. This programme has been delivered each year since 2004.

The main goal of this MSc Cyber Security programme is to prepare professionally trained graduates for industry. In this respect, detailed discussions have taken place, initially with industry professionals, who along with all other stakeholders have had a major input into shaping the revised programme. The key motivation for the current programme curriculum is to ensure that all graduates have studied relevant security disciplines that reflected the aims of the GCHQ National Security Programme whilst adhering to the curriculum framework within the University of Bradford. In effect, it is considered imperative that you will have an in depth understanding of the issues faced by modern organisations. The programme is designed to offer graduates the opportunity to develop a deeper understanding of cyber security as a discipline. The focus within this programme on the principles, technologies and practices of cyber security helps you to gain the appropriate skills for future PhD studies and research careers as well as to become competent practitioners. The programme comprises particular developments in security with a firm base in academic research and also offers the opportunity for you to study selected topics in advanced computer science. The programme includes the opportunity to enhance industry relevant skills with
study in ISO27001 Lead Implementer and Ethical Hacking. These skill areas were highlighted by past alumni and industry practitioners for inclusion in the programme. Within this programme therefore, you have the opportunity to gain additional qualifications in: Certified ISO/IEC 27001 Lead Implementer; and CEH v8 Ethical Hacking.

This programme meets a continued growing demand for specialists in this area by offering a way for individuals in current employment with relevant industry experience as well as recent graduates to study and enhance and develop their skills. The MSc Cyber Security programme will therefore draw graduates wishing to enhance their undergraduate studies in computing with advanced study of security to equip them for senior positions with responsibility for the IT technical and management based security of an organisation. In addition, the programme admissions criterion encourages those with relevant industry skills to specialise in cyber security or refine and develop their existing expertise. The School of Electrical Engineering and Computer Science (SEECS) has for many years successfully taught a range of programmes at undergraduate and postgraduate level. This programme draws upon the successful research expertise of the SEECS from within the Faculty of Engineering and Informatics in the University in addition to that within the Interdisciplinary Research Centre (IRC) in Cyber Security. This IRC has members from within Peace Studies, Engineering, Electrical Engineering, Computer Science, Mathematics, Telecommunications, Management, Law, Social Science and Psychology. This broad base of expertise and research is a fantastic resource for the continued development of the programme in cyber security.

Programme Aims

The MSc programme in Cyber Security is intended to:

- Respond to current academic challenges provided by increasing reliance on computers and networks for core business activity and to meet commercial needs for employees who are able to understand and think strategically about future developments in this area.

- Provide a high academic quality of service to you, covering both theoretical and practical aspects of computing, networking and cyber security.

- Enable you to equip yourself with knowledge, skills and understanding, at an advanced level within the chosen field of study.

Programme Learning Outcomes

When you have completed the programme you will be able to:

At PG Certificate PG Diploma level
LO1. Demonstrate an advanced understanding and application of some of the theories, principles and techniques applicable in the field of Cyber Security;

LO2. Demonstrate a systematic understanding and critical awareness of secure; systems within an organisation and the technical, legal and business issues involved;

LO3. Demonstrate a systematic understanding and critical awareness of the nature of a computer related crime and the people and organisations involved therein;

LO4. Demonstrate an advanced understanding of, and ability to apply concepts and principles underlying cryptographic primitives and protocols;

LO5. Demonstrate a comprehensive and critical understanding of techniques specific to the field of computer security;

At PGDip level all the above including

LO6. Critically analyse, model, construct and evaluate specific types of networks and be able to effectively implement a reliable and effective security protocol;

LO7. Select, adapt and apply the underlying technologies of secure systems;

LO8. Mastery of the practical and theoretical concepts of computer science, current and emerging trends in technology;

At MSc level all the above including

LO9. Select, design, plan and manage a self directed and managed research-informed project;

LO10. Demonstrate a critical awareness of current and possible future opportunities and problems in; Internet, Computer and System Security evaluating current developments and trends.

On successful completion of the MSc Cyber Security you will be able to achieve mastery of the principles and applications of network, computer and systems security through:

Systematic Knowledge and Understanding and a critical awareness at advanced level, of core computing, networking and security subjects including security technologies, detailed understanding of the implications and issues relating to secure applications; recognition of the influence of the cyber world on secure system design and evaluation, and application development for firewalls, authentication, encryption, certificates and security protocols.

Discipline Specific Skills, showing: originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry in security and cyber technologies are used to create and interpret knowledge in the discipline; the ability to design, implement, and evaluate secure systems; development of critical understanding of regulatory and practical issues relating to cyber security:
Personal and Transferable Skills necessary for employment requiring: the exercise of initiative and personal responsibility; decision-making in complex and unpredictable situations; and the independent learning ability required for continuing professional development.

Curriculum

The MSc Cyber Security covers a range of specialist topics, leading to the qualification of a Master's degree with the option to study for additional industry qualifications. Typically, a taught full-time Master's programme lasts for twelve months of full-time study (twenty four months part time). The programme has two stages: the taught programmes stage which takes place during the first two semesters (or four semesters for the part-time route), and the project/dissertation stage. The taught programmes stage is organised on a modular basis.

The programme is structured in terms of Core and Optional modules. Optional modules include ISO27001 Lead Implementer and Ethical Hacking which can lead to industry relevant qualifications in addition to the qualification of an MSc Cyber Security. The relevance of the programme's content to the stated teaching aims and objectives is based on existing core computer science and informatics topics as well as modules on relevant cyber security in relationship to secure implementation of systems, and their application in practice. You will have opportunity to enhance Personal Transferable skills principally through participation in and taking responsibility for a major individual project.

The programme has core modules in semester one and two providing grounding and advanced study of the field. There are optional modules in semester two providing the opportunity for you to fine tune the programme to your particular interest. The final semester allows you the opportunity to develop, through sustained major project work, advanced knowledge and understanding of cyber security.

Students must achieve 60 credits out of the 80 core credits from within the taught element of the programme to gain a Postgraduate Certificate; with a further 40 credits from the optional modules for a Postgraduate Diploma. Upon completion of the Dissertation, amounting a further 60 credits, you will obtain the award of Master.

Postgraduate Certificate (Level 7)

<table>
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<tr>
<th>Module Code</th>
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<th>Credits</th>
<th>Level</th>
<th>Semester</th>
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<tr>
<td>CM1052D</td>
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Postgraduate Diploma (Level 7)

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<th>Module Code</th>
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<th>Semester</th>
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<tr>
<td>CM1064D</td>
<td>Internet Security and Protocols</td>
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<td>20</td>
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<tr>
<td>CM1054D</td>
<td>Advanced Simulation Modelling</td>
<td>O</td>
<td>20</td>
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<tr>
<td>CM1044D</td>
<td>AI with Applications</td>
<td>O</td>
<td>20</td>
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<tr>
<td>CM1075D</td>
<td>ISO27000 Framework (ISMS)</td>
<td>O</td>
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<tr>
<td>CM1074D</td>
<td>Ethical Hacking</td>
<td>O</td>
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Masters

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The curriculum may change, subject to the University's programme approval, monitoring and review procedures.

Teaching and Assessment Strategies

The programme offers a curriculum with core elements and options. Dissertation work further enriches the opportunities you have to take control of your own learning. A range of teaching and learning methods is employed including lectures, tutorials, laboratory work and directed private study. Each 20-credit module on the programme requires you to commit 200 hours of study. Some of these hours will be formally timetabled - lectures, laboratories, seminars, tutorials and workshops whilst others will involve you carrying out private study.

Assessment for this programme is designed to develop skills in the area of cyber security in addition to more generic professional transferable skills such as team working, communication, leadership and decision making. The combination of group work, individual submissions, examinations, theoretical work and lab based exercises helps develop skills that are essential in industry. Alongside gaining an MSc Cyber Security, you have the opportunity to gain additional qualifications in ISO/IEC 27001 Lead Implementer and CEHv8 Ethical Hacking if you undergo additional assessment.

Four workshop sessions act as a springboard for consideration and integration of Legal Social Ethical and Professional (LSEPI) issues into the project work from its commencement. All students progressing onto the dissertation are required to attend these workshops. As part of the workshop series, seminar sessions will take place to introduce the concepts and wider context of LSEPI practices within the Computing discipline (e.g. analysis skills, the research process, dissertation outlines and managing projects, data protection, computer misuse, ethics etc.). The seminars define relevant terms and the implications for professional practice within Computing.
These are followed by a tutorial session with a case study scenario for groups of students, and the members of staff supervising dissertations, to discuss and debate the various aspects of LSEPI practice that would impact upon the scenario and the possible decisions and hypothetical outcomes. The tutorial concludes with a plenary to discuss the wide variety of issues and viewpoints from the groups and the implications for their dissertation work.

To ensure these topics are developed within a students’ dissertation period, these initial workshops will be strengthened through the requirement for you to discuss these issues with your supervisor on a one to one basis. In addition, you will be required to complete an Ethical Approval Form with the aim of highlighting any potential ethical and legal implications of the work you propose.

Assessment Regulations

This Programme conforms to the standard University Assessment Regulations for Postgraduate Programmes which are available at the following link:
http://www.bradford.ac.uk/agpo/ordinances-and-regulations/

Admission Requirements

The University welcomes applications from all potential students regardless of their previous academic experience; offers are made following detailed consideration of each individual application. The University standard minimum entry requirement is a first degree 2:2. 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. Entrance requirements for each programme will vary but consideration of your application will be based on a combination of your formal academic qualifications and other relevant experience.

If you have prior certificated learning or professional experience which may be equivalent to parts of this programme, the University has procedures to evaluate this learning in order to provide you with exemptions from specified modules contained within the curriculum. Please talk to us if you do not fit the standard pattern of entry qualifications.

We are continually reviewing and developing our practices and policies to make the University more inclusive, but if you are disabled we may need to make some adjustments to make sure that you are not disadvantaged. We would advise you to contact the course or programme leader before you apply to discuss these.

Entry requirements: Typically 2:2 or above

Learning Resources

The JB Priestley Library on the city campus and our specialist library in the School of Management provide a wide range of printed and electronic resources to support your studies. We offer quiet study space if you want to work on your own, and group study areas for the times when you need to discuss work with fellow students. Subject librarians for each School provide training sessions and individual guidance
in finding the information you need for your assignment, and will help you organise your references properly.

Student PC clusters can be found in both our libraries and elsewhere on the campus. Many of these are open 24/7. You can also use the University's wireless network to access the internet from your own laptop. Most of our journals are available online (both on and off campus), and you can also access your University email account, personal information and course-related materials this way.

Staff are on hand during the daytime to help you if you get stuck, and there is a 24/7 IT helpline available.

Students admitted to the programme will have the School of Electrical Engineering and Computer Science (SEECS) as their “home” school. As such, on admission, you will go through a process of induction within a Computing discipline and SEECS. At induction, you will have access to the University Plagiarism Training Package that must be completed. This is available in Blackboard and directly under the “My Organizations” link.

The School of EECS has recently developed and built a state-of-the-art attack laboratory to facilitate various testing methodologies for developing effective techniques to detect and/or prevent various sophisticated current and potential future cyber attacks. The test lab includes powerful switches to analyse high volumes of traffic. It enables you to test various exploit tools, e.g. MetaSploit, Nessus, fragroute, etc., and analyse the techniques used to conduct exploits that use evasion and detection-avoidance strategies. You can also assess the current capabilities of open-source and commercial tools to detect such threats and specifically identify gaps in their threat-detection and leakage-identification capabilities.

EECS has a commitment to providing excellent up to date lab facilities and has over 200 PCs and 28 Macs. In addition, we have a networking lab with over 40 PCs that is isolated from the more general network. All these facilities are available to you 24 hours a day 7 days a week.

An ethical hacking lab allows you to access equipment to simulate real time information infrastructure and facilities for penetration testing. EECS is committed to the renewal of its computer labs and assesses requirements on an annual basis.

**Student Support and Guidance**

Ongoing support for you is provided in the form of one-stop facilities located at the SEECS Student Support Office (SSO), open throughout the day during term, and in the mornings and afternoons outside term. Support for registered students is also provided 24/7 via the intranets of the School of Electrical Engineering and Computer Science, and the School’s Technical Support. The School also uses the University’s Virtual Learning Environment (VLE) to support you with individual modules.

**Course Team**

Support for you personally and in your course of study, will be provided both by the University and the Course Team. You will be allocated a personal academic tutor who is someone with whom you will be able to talk about any academic or personal
concerns. The School will ensure that there is someone available with whom you feel comfortable to help and support you. You will be provided with a comprehensive series of handbooks that you can consult on a range of learning issues and your course tutors will be available to consult on subject specific queries.

**Students’ Union**

We value the feedback provided by students and collaborate with the Students’ Union, through a system of course representatives and formal staff student liaison committees, so that any issues you wish to raise are addressed rapidly.

The Students Union provide professional academic representation and advice. The Students’ Union and the University of Bradford work in partnership to provide confidential counselling and welfare services where you can get help with any aspect of your personal or academic life. Student Financial and Information Services (part of the Hub) will provide you with information about a diverse range of issues such as council tax, personal safety and tourist information. International Students can access a range of additional advice and support services through the Student’s Union.

**Employability and Career Development**

The University is committed to helping students develop and enhance their employability profile, commitment towards a career pathway(s) and to implementing a career plan.

Professional career guidance and development support is available throughout your time as a student and as a graduate from Career Development Services. The support available from Career Development Services includes a wide range of information resources, one to one appointments, a weekly workshop programme, a mentoring programme, graduate recruitment and careers fairs, plus information and help to you find part time work, summer work placements, internship programmes and graduate/postgraduate entry vacancies. In addition, some students will receive seminars and workshops delivered by Career Development Services as part of their programme of study. All students are encouraged to access Career Development Services at an early stage during their studies and to use the extensive resources available on their web site [www.careers.brad.ac.uk](http://www.careers.brad.ac.uk).

Career Development Services annually undertakes a survey of all postgraduates to find out their destination six months after graduation. The survey gathers data on the employment and further study routes graduates have entered and a range of other information including job roles, name and location of employers, salary details etc. The survey findings for each programme of study are presented on the programme information pages on the University website and via Career Development Services’ website [www.careers.brad.ac.uk](http://www.careers.brad.ac.uk).

The specific provision on this programme is established to offer you the opportunity to develop key industry relevant skills. Particularly we work closely with industry to understand the latest requirements to incorporate these within our programme. For example, you have the opportunity to graduate with an MSc Cyber Security and additional qualifications in: Certified ISO/IEC 27001 Lead Implementer; and CEH v8
Ethical Hacking. These are seen as key skills by industry practitioners. We also offer you the opportunity to interact with practitioners through guest lectures and industry sponsored dissertation topics. We continue to work closely with our Careers Development Services with access to a dedicated careers specialist for our School.

**Academic Skills Advice**

For postgraduate students on taught courses who are looking to improve their marks during their time at university, study skills and maths advice is available to all regardless of degree discipline. Students can access a programme of interactive workshops and clinics which is delivered throughout the year. This is in addition to our extremely popular face-to-face guidance from Academic Skills Advisers, who also offer a wide range of online and paper based materials for self-study.

**Disability**

Disabled students will find a supportive environment at Bradford where we are committed to ensuring that all aspects of student life are accessible to everyone. The Disability Service can help by providing support, advice and equipment to help you get the most out of your time at Bradford. It is a place where you can discuss any concerns you may have about adjustments that you may need, whether these relate to study, personal care or other issues. For more information contact the Disability Service by phoning: 01274 233739 or via email: disabilities@bradford.ac.uk

**University policies and initiatives**

**Ecoversity**

Ecoversity is a strategic project of the University which aims to embed the principles of sustainable development into our decision-making, learning and teaching, research activities campus operations and lives of our staff and students. We do not claim to be a beacon for sustainable development but we aspire to become a leading University in this area. The facilities we create for teaching and learning, including teaching spaces, laboratories, IT labs and social spaces, will increasingly reflect our commitments to sustainable development. Staff and student participation in this initiative is crucial to its success and its inclusion in the programme specification is a clear signal that it is at the forefront of our thinking in programme development, delivery, monitoring and review. For more details see www.bradford.ac.uk/ecoversity/
Further Information:
For further information, please check the University prospectus or contact Admissions.

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+44 (0)1274 234567
http://www.brad.ac.uk/ei/electrical-engineering-and-computer-science/contact-us/

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