Course Specification

Course Summary Information		
1	**Course Title**	MSc Cyber Security
2	**Course Code**	PT0959
3	**Awarding Institution**	Birmingham City University
4	**Teaching Institution(s)** (if different from point 3)	
5	**Professional Statutory or Regulatory Body (PSRB) accreditation** (if applicable)	The Institute of Engineering and Technology (IET) The British Computer Society (BCS)

6	**Course Description**
	The MSc Cyber Security course provides a broad foundation for Cyber Security concepts while delivering advanced knowledge and skills in key technical areas. Designed to meet the growing demand from global business and industry for robust cyber security systems, this course underpins the principles and practical professional skills you'll need to meet the future challenges faced by organisations, particularly when it comes to strategic security planning. This course provides future Cyber Security professionals with the knowledge and skills needed by the employers. Our strong links with industry enable us to teach the most demanding topics. You will develop state of the art technical knowledge, intellectual know-how, management capabilities and hands-on practical skills to succeed in meeting the Cyber Security challenges faced by modern organisations. Our academic staff members are actively engaged with cutting-edge cyber security research and its application in industrial settings to help solve their complex problems. These strong links provide you with plenty of professional opportunities that will help you to acquire valuable exposure to the real-life challenges of Cyber Security.

7	**Course Awards**		
7a	**Name of Final Award**	**Level**	**Credits Awarded**
	MSc Cyber Security	7	180
	MSc Cyber Security with Professional Placement	7	240
7b	**Exit Awards and Credits Awarded**		
	Postgraduate Certificate Cyber Security Postgraduate Diploma Cyber Security	7 7	60 120

8	**Variations from the University Academic Regulations**
	This course has approved variations to the University's Academic Regulations. These can be accessed via the student contract page: https://www.bcu.ac.uk/student-info/student-contract

9	Delivery Patterns		
Mode(s) of Study	**Location(s) of Study**	**Duration of Study**	**Code(s)**
Full Time Sept / June	City Centre	1 year	PT0959
Part Time	City Centre	2 years	PT0960
Full Time with Placement	City Centre	18 months	PT1354
Full Time January 'with Professional Placement'	City Centre (and placement provider)	18 months	PT1354
Full Time September 'with Professional Placement'	City Centre (and placement provider)	18 months	PT1354

10	Entry Requirements	
	Home:	The admission requirements for this course are stated on the course page of the BCU website at https://www.bcu.ac.uk/.
	EU:	
	International:	

11	Course Aims
	The MSc Cyber Security course is designed to equip future leaders with state-of-the-art technical knowledge, intellectual know-how, management capabilities and practical skills that will enable them to succeed in meeting the cyber security challenges facing modern organisations. Since the UK Government's first significant investment of £1.9B in 2016, the cybersecurity sector continues to grow with a recent study reporting the annual revenue within the sector to be £8.9B in 2021. Although this figure reported a 7% increase year-on-year however the shortage of skilled cybersecurity professionals continues with an UK Government study reporting approximately 680,000 businesses (50%) to have a basic skill gap and a further 449,000 (33%) businesses to have an advanced skills gap. Specifically, the basic skill gap means that the people in charge of cyber security in those businesses lack the confidence to carry out the kinds of basic tasks such as storing or transferring personal data, setting up configured firewalls, and detecting and removing malware. These figures have indeed prompted the UK Government to launch UK's Cyber Security Council on 31st March 2021 with the clear goal of establishing *the knowledge, skills and experience required for a range of cyber security jobs, bringing it in line with other professions such as law, medicine and engineering.* This situation reflects the high demand of Cyber Security graduates in the job market provided they are equipped with the right set of skills. This MSc Cyber Security course is designed to tap this potential. The required quality standards are met by positioning the course contents with the UK Quality Assurance Agency (QAA) Master's Degree Characteristics Statement and the National Cyber Security Centre (NCSC) Certification scheme for Master's Degrees in Cyber Security in the view of obtaining NCSC accreditation for this course. Furthermore, the course has received partial CEng from IET and BCS within the last 12 months. This course provides future Cyber Security professionals with the knowledge and skills needed by the employers. Our strong links with industry enable us to teach the most demanding topics. Students learn state of the art technical knowledge, intellectual know-how, management capabilities and hands-on practical skills to succeed in meeting the Cyber Security challenges faced by modern organisations.

	The course is being offered by the Department of Networks and Cybersecurity which also offers BSc (Hons) Cyber Security course providing a progressive route for students. Furthermore, the department also offers courses within Computer Networks, Computer Network Security, Digital Forensics, and Advance Computer Networks which provide a strong knowledgebase and resources underpinning the course. Furthermore, the course shares modules such as Advanced Ethical Hacking, Applied Machine Learning and Research Methods and Project Management. In line with the teaching and learning strategy of the School, the course adopts problem-solving and active learning, which is supported by assessments designed to promote student engagement, aligned to the development of skills applicable to professional practice. Further, learning activities are designed to facilitate success by building confidence through hands-on experience and formative feedback. Assessment is challenging, but also varied and rewarding. Besides full-time study, two-year part-time mode is offered to encourage those prospective students who are in employment. The part-time option will also encourage employers to support the higher-education of their employees. The course builds upon degree-level specialism and experience to prepare the student for a career in cyber security with specific skillset in Information Security Governance, Digital Forensics, and Cyber-Physical Systems Security. This course is supported by a vibrant research environment within the Security and Trustworthy Systems (STS) research cluster within the Department of Networks and Cybersecurity, and by traditionally strong industrial links with CISCO, Oracle, IBM, MS and BT.

12	**Course Learning Outcomes**
Knowledge and Understanding	
1	Demonstrate knowledge and understanding of key cyber security concepts, mechanisms, services and protocols that are used as basic building blocks for engineering security solutions across different computing paradigms
2	Analyse trends of cyber-attacks, evolving security threats, mechanisms for monitoring and detecting them, protection controls for mitigating their risks and approaches for holistic cyber defence within contemporary and emerging computing paradigms
3	Apply best practices for security management within an enterprise including legal obligations, regulatory requirements, international standards, ethical considerations, governance, incident response and business continuity plans.
4	Understand fundamental concepts within machine learning and be able to apply and evaluate machine learning schemes to quantify a range of performance metrics related to emerging data processing challenges
Cognitive and Intellectual Skills	
5	Systematically analyse security threats to information assets of an organization, propose suitable countermeasures and justify choices using relevant quantitative and qualitative methods for evaluating associated business risk.
6	Evaluate the conformance of security management processes of an organization against international security standards, such as ISO 27000, identify gaps and recommend mitigations.
7	Apply design principles including but not limited to least privileges, fail secure, and defence in depth to engineer security, privacy and resilience by design to a range of case studies.
8	Analyse and correlate digital forensic information from a variety of sources such as audit logs, hard disks, operating systems, file systems and web browsers in order to detect breaches of security policy, law or regulations.
Practical and Professional Skills	
9	Demonstrate the capacity to confidently use digital forensic tools for collecting, analysing, and processing electronic evidence through application of forensically-sound methodologies.
10	Demonstrate hands-on experience on security testing tools, such as penetration testing, to systematically identify certain types of vulnerabilities in communication network infrastructures.
11	Propose a contingency plan, consistent with the organization's view of associated risks, to ensure business continuity for an organization upon the detection of an adverse event.
Key Transferable Skills	
12	Apply skills in research, independent study, self-management, including time management and prioritization of tasks when tackling complex problems.
13	Demonstrate effective communication skills in writing, orally, and in presentations to specialist and non-specialist audiences. Be able to explain, justify and otherwise defend their work and ideas, both in its specific details and within a broader context
14	Demonstrate team-spirit by cooperating with others, plan and implement tasks at a professional level and contribute to team goals through making sound judgments.
15	Demonstrate systematic understanding of knowledge, critical awareness and evaluation of relevant complex issues and produce evidence of original application of knowledge towards an independent project.

13	Level Learning Outcomes

Postgraduate Certificate (PG Cert) Cyber Security

The first exit point of the course is the PG Cert Cyber Security which can be attained by completing 60 credits through three taught modules. This will enable you to partially meet at least 08 course learning outcomes.

Example scenario:

MODULES	Course Learning Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CMP7158 Research Methods and Project Management												√	√	√	
CMP7166 Digital Forensics	√		√					√	√			√	√	√	
CMP7XXX Cyber-Physical System Security	√	√			√		√					√	√	√	
CMP7XXX Information Security Governance	√	√	√		√	√	√				√	√	√	√	
CMP7171 Advanced Ethical Hacking	√	√			√					√		√	√		
CMP7200 Individual Dissertation Project												√	√		√
CMP7XXX Applied Machine Learning		√		√	√							√	√	√	

Postgraduate Diploma (PG Dip) Cyber Security

A PG Diploma Cyber Security can be achieved by successfully completing 120 credits of the course through the six taught modules. This will enable you to partially meet the LO1-14 of the course learning outcomes

MSc Cyber Security

In order to achieve an MSc Cyber Security, you must successfully complete the Individual Masters Project module in addition to the requirements for the PG Dip Cyber Security. This will enable you to meet all 15 learning outcomes of the course. The Master's project is a research dissertation which must be focused at investigating a significant cyber security challenge and adopt a structured research-informed approach to conduct the study.

The Master's dissertation enables you to gain experience of managing a significant task within cyber security and apply technical, research, and project management skills. It will also help you prepare for managing similar tasks in industrial settings as well as enabling you to gain research experience which will be beneficial for further studies such as the PhD.

14	Course Learning, Teaching and Assessment Strategy

a. Delivery of the Course: Learning and Teaching

The timeframe for course delivery period consists of two semesters plus the summer, 180 credits in 12 months and 24 months for part-time students. Students will have 2 attempts at assessment under BCU academic regulations.

Knowledge and understanding are acquired though formal lectures, tutor-led seminars and practical activities, and a range of independent learning activities. Emphasis is placed on guided, self-directed and student-centred learning with a progressively increasing independence of approach, thought and process. This independent learning includes an element of peer review in order to evaluate the effectiveness of the learning.

Lectures are used to introduce themes, theories and concepts, which are further explored in seminars. Technology enhanced learning is used, where appropriate, through the provision of online resources, discussion forums and other activities. Advanced textbooks are used, together with professional material and journal articles, in order to ensure that students develop a critical understanding of work at the forefront of their discipline. The module guides direct students to a full range of resources, including books and journals, as well as specialised course-based material. Practical, including lab-based, sessions are used throughout the course to develop practical skills and to place theory in a work-related context.

A flipped curriculum enables analytical and problem-solving skills to be further developed using a range of appropriate 'real' and 'theoretical' case studies and problem-based learning scenarios. Alongside developing and applying skills through coursework, research is emphasised throughout the course. Learners extend research skills ability in the first semester module, Research Methods and Project Management, which develops the key skills of research, academic writing and time management required for study at master's level. These skills are further developed and placed into context by undertaking a major individual project.

Transferable/key skills are core to the learning strategy of the course. They are pervasive and are incorporated into modules and assessments as appropriate, e.g. team-working skills are fostered via group task-based tutorial activities. Students are encouraged to plan their own work schedules and are required to meet deadlines. Reflection and self-awareness are fostered throughout.

A range of assessment methods are employed, assessment criteria being published in each assignment brief. Knowledge and skills are assessed formatively and summatively by a number of methods: coursework, examinations (seen and unseen, open and closed-book), presentations, practical assignments, vivas, online forums, podcasts, and project work.

Our teaching philosophy revolves both around students ‘learning by doing’ and also transferring acquired knowledge to others in a flipped classroom environment. Activities will occur both individually and in teams. Tutors will provide leadership and mentoring aimed at supporting the students’ transition into independent learners. In this partnership students will be encouraged to become proactive so that they can develop their confidence to undertake a range of progressively complex and challenging tasks.

Students are expected to attend all teaching sessions as well as to read and prepare before these sessions. Good preparation will enable students to get the most from their contact time and will help them become an autonomous learner. Teaching sessions will include lectures and small group interactive seminars.

b. Assessment:

The students will demonstrate acquisition of work-related skills by using an assessment strategy that is reflective of industry needs. Assessments will be varied and include knowledge and skills tests. However, the focus will predominantly be on the use of coursework. Here students will learn to present their ideas and showcase their work to a variety of audiences. Students will also learn to present their ideas through written pieces of work for example by formulating proposals and reports. The assessment diet also includes in-person presentations which are aimed at enabling students to learn valuable communication and leadership skills. For instance, CMP7170 Information Security governance module includes presentation based on a group research work and our plan is to engage industry audience for this event to enable students to have exposure to employability requirements.

Guidance in academic studies will be provided in the form of a range of support mechanisms. This will include formative feedback from tutors as well as having access to a wide range of excellent support services that exist within the university.

In accordance with the University Regulations students will be permitted three attempts at assessments. After first sit, if a student is unsuccessful in any of the assessments, there will be two resit opportunities for which their mark, provided that they pass the assessment, will be capped at 50%.

An indicative module assessment has been annexed to this document which highlights the efforts to spread the assessment across different weeks in the semester, which enables students to manage their workload.

c. Sustainability and Global Citizenship:

BCU is committed to integrating sustainability into the curriculum. The notion that we should all seek to find ways to support reduce waste, increase recycling, and lower levels of environmental impact will be familiar, but this is a narrow view of sustainability. Our curriculum also considers sustainability in terms of its connection with Global Citizenship. The United Nations define Global Citizenship in education as; 'enabling students to develop the attributes, behaviours and skills needed to work and live in a way that safeguards ecological, social and economic wellbeing, both in the present and for future generations'. We encourage our students to live and work more sustainably whilst recognising the impact that their decisions, and actions, have on the local, national and global communities to which they belong. We have made a commitment as an institution to create graduates with a global outlook (Graduate Attributes) and each of our courses will now include an internationalised programme aim - the inclusion of sustainability within that is a logical connection. The department and course demonstrate internationalisation by:

- Using cultural and international experiences or knowledge as a learning resource.
- Encouraging intercultural experiences, partnerships and collaborations.
- Contributing to international scholarly activity and knowledge exchange.
- Providing and promoting a range of accessible opportunities for the international and intercultural learning.
- Facilitating ongoing intercultural and international dialogue and partnerships.
- Proactively developing inclusive learning outcome, practices, skills, and/or attitudes appropriate for diverse societies, culture and individuals.

- Adapting the content, language, pace and modes of delivery and assessment to the learning context and the diversity of learners
- Using flexible and inclusive approaches that appreciate and respect individual differences in knowledge, education and culture.

d. Inclusivity:

BCU is committed to integrating sustainability into the curriculum. One of the main tenets of Industry 4.0 is improving the efficiency of the manufacturing processes all across its value chain. This has a very positive impact on the notion of a Sustainable Industry aiming to reduce waste, increase recycling, and lower levels of environmental impact.

Moreover, it is now difficult to separate the notion of sustainability with that of the impact it has on a global scale. The United Nations define Global Citizenship in education as; 'enabling students to develop the attributes, behaviours and skills needed to work and live in a way that safeguards ecological, social and economic wellbeing, both in the present and for future generations'. As such, our course will present students with a recognition of the impact that the future development on different industries and sectors brings to regional, national and global communities.

The department and Programme demonstrate internationalisation by:

- Using cultural and international experiences or knowledge as a learning resource.
- Encouraging intercultural experiences, partnerships and collaborations.
- Contributing to international scholarly activity and knowledge exchange.
- Providing and promoting a range of accessible opportunities for the international and intercultural learning.
- Facilitating ongoing intercultural and international dialogue and partnerships.
- Proactively developing inclusive learning outcome, practices, skills, and/or attitudes appropriate for diverse societies, culture and individuals.
- Adapting the content, language, pace and modes of delivery and assessment to the learning context and the diversity of learners
- Using flexible and inclusive approaches that appreciate and respect individual differences in knowledge, education and culture.

e. Digital / Online content:

It is an essential 'life skill' to be able to access, process and assimilate information in the broadest sense. Therefore, students are expected to have high levels of digital and information literacy both at University and outside. The ability to articulate that information and to construct new understanding is also critical to graduate success. Through this course, students are encouraged to recognise different types of information and resources, to develop their ability to question the validity of that information or resource, and to recognise the importance of both print and online resources to facilitate development of their knowledge.

Being able to feel confident, informed and discerning in the use of digital information and technologies is important, whether it is the effective sourcing of research material, technical skills development for creative practice such as presentations, or simply managing information and systems appropriate to a student's study needs. Students undertaking a technology-based degree are also expected to actively explore and evaluate new and emerging technologies as part of their studies and professional development.

	The course will develop and support students in a number of ways: • Library induction to access online books, journals and articles and general research material. • CICT induction to managing your Birmingham City University iCity account, including print, library and equipment loans, emails and access to Student Services. • Moodle as a digital location of module specific information, lecture presentations, 'how-to' videos, information and news updates and submission upload. • Social media platforms for example the effective use of Facebook and Twitter. • Access to specialist equipment in the school. • Access to 24 bookable laptops. • Optional and core technical skills sessions throughout the course.

15	**Course Requirements**
15a	***In order to complete this course a student must successfully complete all the following modules (totalling 180 credits):***

Module Code	Module Name	Credit Value
CMP7166	Digital Forensics	20
CMP7171	Advanced Ethical Hacking	20
CMP7158	Research Methods and Project Management	20
CMP7240	Cyber-Physical Systems Security	20
CMP7241	Information Security Governance	20
CMP7239	Applied Machine Learning	20
CMP7200	Individual Dissertation Project	60

In order to qualify for the award of MSc Cyber Security with Professional Placement, a student must successfully complete all of the Level 7 modules listed above as well as the following module:

Module Code	Module Name	Credit Value
PLA6004	Professional Placement	60

15b	Structure Diagram

Full-time (offered in September and January)

Semester 1	CMP7166 Digital Forensics (20 Credits)	CMP7241 Information Security Governance (20 Credits)	CMP7171 Advanced Ethical Hacking (20 Credits)
Semester 2	CMP7158 Research Methods & Project Management (20 Credits)	CMP7240 Cyber-Physical System Security (20 Credits)	CMP7239 Applied Machine Learning (20 Credits)
Semester 3	CMP7200 Individual Master's Project (60 Credits)		

Full-time (June)

Semester 1	CMP7166 Digital Forensics (20 Credits)	CMP7241 Information Security Governance (20 Credits)	CMP7171 Advanced Ethical Hacking (20 Credits)
Semester 2	CMP7158 Research Methods & Project Management (20 Credits)	CMP7240 Cyber-Physical System Security (20 Credits)	CMP7239 Applied Machine Learning (20 Credits)
Semester 3	CMP7200 Individual Master's Project (60 Credits)		

Part-time (offered in September)

Year 1

Semester 1	CMP7166 Digital Forensics (20 Credits)	CMP7241 Information Security Governance (20 Credits)
Semester 2	CMP7158 Research Methods & Project Management (20 Credits)	CMP7239 Applied Machine Learning (20 Credits)

Year 2

Semester 1	CMP7171 Advanced Ethical Hacking (20 Credits)	
Semester 2	CMP7240 Cyber-Physical System Security (20 Credits)	CMP7200 Individual Master's Project (20 Credits)
Semester 3	CMP7200 Individual Master's Project (40 Credits) *(continued from semester 2)*	

With Placement (offered in January and September)

Year 1

Semester 1	CMP7166 Digital Forensics (20 Credits)	CMP7241 Information Security Governance (20 Credits)	CMP7171 Advanced Ethical Hacking (20 Credits)
Semester 2	CMP7158 Research Methods & Project Management (20 Credits)	CMP7240 Cyber-Physical System Security (20 Credits)	CMP7239 Applied Machine Learning (20 Credits)
Semester 3	CMP7200 Individual Master's Project (60 Credits)		

Year 2

Semester 1	PLA6004 – CEBE Professional Placement (60 Credits)

16	Overall Student Workload and Balance of Assessment

Overall student *workload* consists of class contact hours, independent learning and assessment activity, with each credit taken equating to a total study time of around 10 hours. While actual contact hours may depend on the optional modules selected, the following information gives an indication of how much time students will need to allocate to different activities at each level of the course.

- *Scheduled Learning* includes lectures, practical classes and workshops, contact time specified in timetable
- *Directed Learning* includes placements, work-based learning, external visits, on-line activity, Graduate+, peer learning
- *Private Study* includes preparation for exams

The *balance of assessment* by mode of assessment (e.g. coursework, exam and in-person) depends to some extent on the optional modules chosen by students. The approximate percentage of the course assessed by coursework, exam and in-person is shown below.

Workload

16% time spent in timetabled teaching and learning activity

Activity	Number of Hours
Scheduled Learning	288
Directed Learning	442
Private Study	1070
Total Hours	1800

Balance of Assessment

Assessment Mode	Percentage
Coursework	81%
Exam	0%
In-Person	19 %