Course Specification

Course Summary Information		
1	**Course Title**	MSc Advanced Computer Networks
2	**Course Code**	PT1576
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) *Pending approval by the IET of the change in course title from 'MSc Data Networks and Security'.*

6	**Course Description**

The MSc Advanced Computer Networks is the ideal course for those who intend to pursue/progress in the computer networks / network security industry. Whether you are looking to start a career in networking or to progress in your current career, we have designed this course with the most relevant and state of the art developments to give you practical technical experience in the domain of enterprise network design, penetration testing, network automation and more. We have also taken an applied approach to incorporating research as part of the course, so for those interested in research careers and PhD studentships, this would be a strong stepping-stone.

Throughout the course, you will have access to our advanced labs with racks of networking devices as well as our online NetLab system which gives you the ability to access real networking hardware from anywhere via internet. This gives you flexibility to work and practice around your own schedule.

We take pride in having close links with our industry partners and this course was designed to address the gap between academia and industry when it comes to required technical skills. While on the course, you will have access to a wealth of knowledge, and will have the opportunity to benefit from certification courses such as Cisco CCNA, CCNP, DevNet, JUNOS, PaloAlto PCNSA.

This course intends to develop your competence in using tools and techniques for designing, configuring, and managing Enterprise networks leveraging the latest protocols, technologies and features, and securing these networked systems against networking attacks and exploits.

To prepare you for future careers, the course is designed to cover advanced key topics in computer networks, namely, Advanced Enterprise Networks, Wireless Communications, Network Security and Advanced Ethical Hacking, Network Automation and Orchestration, Applied Artificial Intelligence solutions to networking and network security problems. In addition, you will receive a solid grounding in research methods and project management before undertaking an individual project that provides an opportunity to demonstrate technical and general employability skills in preparation for career progression. More specifically, the individual project simulates typical graduate workplace tasks that require in-depth knowledge and skills in a specific area of computer science and network engineering. This will include consideration of wider issues and the ability to manage activities and resources, as well as generate, implement, and report on solutions to meet task objectives. Throughout your studies, you'll be supported by our expert teaching staff, all of whom have a wide range of research and industrial experience in areas such as intelligent

systems, mobile computing, Semantic Web, machine learning and software engineering, which they use to enhance the curriculum.

7	Course Awards		
7a	**Name of Final Award**	**Level**	**Credits Awarded**
	Master of Science Advanced Computer Networks	7	180
	Master of Science Advanced Computer Networks with Professional Placement	7	240
7b	**Exit Awards and Credits Awarded**		
	Postgraduate Certificate Computer Network Studies	7	60
	Postgraduate Diploma Advanced Computer Networks	7	120

8	**Derogation from the University Regulations**
	1. A maximum volume of 20 credits per course in a Master's degree (other than an integrated Master's degree) can be compensated.
	2. No condonement of modules at Levels 4-7 is permitted.

9	Delivery Patterns		
Mode(s) of Study	**Location(s) of Study**	**Duration of Study**	**Code(s)**
Full Time	City Centre	12 months	PT1576
Part Time	City Centre	24 months	PT1577
Full Time with Professional Placement	City Centre	18 months	PT1578

10	**Entry Requirements**	
	Home:	We would normally expect you to hold at least a Second-Class (2:2) Honours degree or equivalent in Computing, Engineering or Information Management. Applicants without standard entry qualifications but with extensive industrial experience could be considered if they provide evidence of the necessary knowledge and skills to successfully complete the course.
	EU:	International applicants are required to have IELTS overall band of 6.0 or equivalent.
	International:	International applicants are required to have IELTS overall band of 6.0 or equivalent.
	Access:	N/A

11	**Course Aims**
	The MSc Advanced Computer Networks is designed to develop key technical and practical skills required by the current computer networks and network security industry. The design and development of the modules is inspired by our conversations with our industrial partners and prepares our students with key technical and soft skills required for fast career progression. While our general approach is focused on practice-based teaching and learning, the curriculum is also research-informed to provide an opportunity for further research and a smooth transition to PhD studentship.

With introduction and adaption of relevant novel technologies such as Software Defined Networking, DevOps, Machine Learning, IoT and 5G, we foresee a significant demand for skills in these areas and the course aims to bridge this gap by delivering the latest and most relevant content through an innovative learning and teaching approach.

This course is offered Full-time, Part-time and also Full-time with the Professional Placement option to give our students the opportunity to gain work experience as part of their degree.

This course is supported by our research cluster within the Security and Trustworthy Systems (STS) research cluster in the Department of Networks and Cybersecurity, and by our strong industrial links with Cisco, Juniper, Oracle, IBM, MS, BT and PaloAlto. |

12	**Course Learning Outcomes**
1	Demonstrate knowledge and understanding of network design, network management, optimisation of network systems and network security.
2	Demonstrate knowledge of principles and underlying technologies of computer and data communications, device operating systems, and their underpinning protocols and structures for securing and optimising network solutions.
3	Demonstrate knowledge and understanding of appropriate tools, techniques and standards used in designing, managing, optimising and securing networked systems.
4	Describe the standards for network design, network management, optimisation of network systems and network security.
5	Use proficiently information and materials from a variety of sources for independent research, enquiry and learning.
6	Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs secure and optimised networked systems.
7	Draw independent conclusions based on a rigorous, analytical and critical assessment of argument, opinion.
8	Critically analyse and evaluate the requirements for network design, network management, optimisation of network systems and network security for a set of business requirements.
9	Plan, design and implement techniques and technologies used by network security engineers and managers.
10	Demonstrate practical skills acquired through laboratories sessions and workshops, either individually and/or group project work in accordance with ethical standards, professional codes of conduct and set guidelines.
11	Implement applications and network solutions using appropriate methodologies, tools and novel techniques.
12	Work independently or within a group, with limited need for supervision, in a professional and industrial context.

13	**Monitor, record, analyse and interpret data to effectively communicate to diverse audiences.**
14	Manage time, prioritise activities and work to time-scales.
15	Demonstrate effective information retrieval skills from a range of sources and be able to cite and reference such sources.
16	Reflect on progress and plan for personal and career development.
17	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) Computer Networks Studies:

To obtain a PG Cert Computer Networks Studies, you will need to complete 60 credits (a combination of any 3 modules), through which you will need to partially meet at least 11 of the course learning outcomes.

Example Scenario:

MODULES	Course Learning Outcomes																
Level 7 Core Modules	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Advanced Enterprise Networks	X	X	X	X		X		X	X	X	X						
Wireless Communications	X	X	X					X		X	X				X		
CMP7171 Advanced Ethical Hacking	X	X							X						X		
CMP7221 Network Automation and Orchestration	X	X	X	X		X		X			X				X		
Applied Machine Learning					X	X			X				X				
CMP7158 Research Methods and Project Management					X		X					X	X	X	X	X	
CMP7200 Individual Masters Project							X		X		X	X	X	X	X	X	X

Postgraduate Diploma (PG Dip) Advanced Computer Networks:

To obtain a PG Dip Advanced Computer Networks, you will need to complete 120 credits (all 6 taught modules), through which you will need to fully meet course learning outcomes 1-6, 8-9, 11 and partially meet 7, 10, 12-16 of the course learning outcomes.

MSc Advanced Computer Networks:

In order to achieve MSc Advanced Computer Networks, you must successfully complete the Individual Masters Project module in addition to the requirements for the PG Dip Advanced Computer Networks and meet all 17 learning outcomes of the course. The Individual Masters Project is a research dissertation which must be focused at investigating a relevant significant

Computer Networks/Network Security challenge and adopt a structured research-informed approach to conduct the study.

The Masters dissertation enables you to gain experience of managing a significant task within computer networks / network 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 two 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 re-enforced through practical lab sessions and 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 second semester module, Research Methods and Project Management, which develops the key skills of research, academic writing and time management required for study at Masters level. These skills are further developed and placed into context by undertaking a major individual project in semester 3 (summer semester for September intake full-time cohort).

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, restricted-book and closed-book), presentations, practical assignments, in-person vivas and technical interviews, 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 scheduled learning time and will help them become an autonomous learner. Teaching sessions will include theoretical lectures, practical demonstrations and small group interactive seminars.

b. Assessment Strategies

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 application of what students have absorbed throughout the semester through 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/interviews which are aimed at enabling students to learn valuable communication and leadership skills required for career progression. For instance, as part of Advanced Enterprise Networks' assessment, the students are required to complete a portfolio coursework which involves planning and configuring key protocols and features in an enterprise network setting, and this is followed by a presentation/technical interview which validates their understanding of the curriculum and provides them with an insight of what to expect in job interviews. Our plan is to engage with our industry partners so they can be a part of this process and provide our students with valuable feedback on their performance.

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%.

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 course aim - the inclusion of sustainability within that is a logical connection. The faculty 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 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.

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- 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.
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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.
- Cisco NetAcad learning portal.
- Social media platforms for example the effective use of Facebook and Twitter.
- Access to specialist equipment in the school (Net Lab Offering).
- Access to 24 bookable laptops.
- Optional and core technical skills sessions throughout the course.

15	**Course Requirements**

15a	**Level 7:**

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

Module Code	Module Name	Credit Value
CMP7158	Research Methods and Project Management	20
CMP7221	Network Automation and Orchestration	20
CMP7171	Advanced Ethical Hacking	20
CMP7237	Wireless Communication	20
CMP7239	Applied Machine Learning	20
CMP7238	Advanced Enterprise Networks	20
CMP7200	Individual Master's Project	60

Level 6:

In order to qualify for the award of MSc Advanced Computer Networks with Professional Placement, a student must successfully complete all of the Level 7 modules listed above as well as the following Level 6 module:

Module Code	Module Name	Credit Value
PLA6004	Professional Placement	60

| 15b | Structure Diagram |

Full-Time (September Start):

Year 1 1st Semester (Sep - Dec)	Advanced Enterprise Networks (20 credits)	Advanced Ethical Hacking (20 credits)	Wireless Communications (20 credits)
Year 1 2nd Semester (Jan – May)	Network Automation and Orchestration (20 credits)	Applied ML (20 credits)	Research Methods and Project Management (20 credits)
Year 1 3rd Semester (May – Sep)	Individual Master's Project (60 credits)		

Full-Time (January Start):

Year 1 1st Semester (Jan - May)	Advanced Enterprise Networks (20 credits)	Advanced Ethical Hacking (20 credits)	Wireless Communications (20 credits)
Year 1 2nd Semester (June – Sep)	Network Automation and Orchestration (20 credits)	Applied ML (20 credits)	Research Methods and Project Management (20 credits)
Year 1 3rd Semester (Sep – Jan)	Individual Master's Project (60 credits)		

Full-time with Professional Placement (September Start):

Year 1 1st Semester (Sep - Dec)	Advanced Enterprise Networks (20 credits)	Advanced Ethical Hacking (20 credits)	Wireless Communications (20 credits)
Year 1 2nd Semester (Jan – May)	Network Automation and Orchestration (20 credits)	Applied ML (20 credits)	Research Methods and Project Management (20 credits)
Year 1 3rd Semester (May – Sep)	Individual Master's Project (60 credits)		
Year 2 1st Semester (Sep – Jan)	Professional Placement (60 credits)		

Full-time with Professional Placement (January Start):

Year 1 1st Semester (Jan - May)	Advanced Enterprise Networks (20 credits)	Advanced Ethical Hacking (20 credits)	Wireless Communications (20 credits)
Year 1 2nd Semester (June – Sep)	Network Automation and Orchestration (20 credits)	Applied ML (20 credits)	Research Methods and Project Management (20 credits)
Year 1 3rd Semester (Sep – Jan)	Individual Master's Project (60 credits)		
Year 2 1st Semester (Jan – May)	Professional Placement (60 credits)		

Part-Time (September start only):

Year 1 **1st Semester** **(Sep – Dec)**	Advanced Enterprise Networks (20 credits)	Wireless Communications (20 credits)
Year 1 **2nd Semester** **(Jan – May)**	Network Automation and Orchestration (20 credits)	Applied ML (20 credits)
Year 2 **1st Semester** **(Sep – Dec)**	Advanced Ethical Hacking (20 credits)	
Year 2 **2nd Semester** **(Jan – May)**	Research Methods and Project Management (20 credits)	
(May – Sep)	Individual Master's Project (60 credits) January - September	

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.

Level 7

<u>**Workload**</u>

17% time spent in timetabled teaching and learning activity

Activity	Number of Hours
Scheduled Learning	300
Directed Learning	514
Private Study	986
Total Hours	1800

<u>**Balance of Assessment**</u>

Assessment Mode	Percentage
Coursework	68%
Exam	6%
In-Person	8%