



**Swansea University  
Prifysgol Abertawe**

**FACULTY OF SCIENCE AND  
ENGINEERING**

**POSTGRADUATE STUDENT  
HANDBOOK**

**MSC (FHEQ LEVEL 7)**

**CYBER SECURITY  
DEGREE PROGRAMMES**

**SUBJECT SPECIFIC  
PART TWO OF TWO  
MODULE AND COURSE STRUCTURE  
2022-23**

## **Welcome to the Faculty of Science and Engineering!**

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to having an excellent experience with us.

We have further developed some exciting new approaches that I know you will enjoy, both on campus and online, and we cannot wait to share these with you.

At Swansea University and in the Faculty of Science & Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone. Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic staff, administrators, and your fellow students - I'm sure you will find many friendly helping hands ready to assist you.

We all know this period of change will continue and we will need to adapt and innovate to continue to be supportive and successful. At Swansea we are committed to making sure our students are fully involved in and informed about our response to challenges.

In the meantime, learn, create, collaborate, and most of all – enjoy yourself!

**Professor Johann (Hans) Sienz**  
**Interim Pro-Vice Chancellor/Interim Executive Dean**  
**Faculty of Science and Engineering**



<b>Faculty of Science and Engineering</b>	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
<b>School of Mathematics and Computer Science</b>	
<b>Head of School: Professor Elaine Crooks</b>	
School Education Lead	Dr Neal Harman
Head of Computer Science	Professor Xianghua Xie
Computer Science Programme Director	Undergraduate: Dr Liam O'Reilly MSc: Dr Bertie Müller
Year Coordinators	MSc Cyber Security Course Coordinator: Dr Pardeep Kumar  MSc Computer Science Course Coordinator: Dr Oliver Kullmann  MSc Advanced Software Technology Course Coordinator: Dr Anton Setzer  MSc Advanced Computer Science Course Coordinator: Dr Anton Setzer  MSc Data Science Course Coordinator: Dr Alma Rahat

## **DISCLAIMER**

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

## The 22-23 academic year begins on 26 September 2022

Full term dates can be found [here](#)

### **DATES OF 22-23 TERMS**

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

### **SEMESTER 1**

26 September 2022 – 27 January 2023

### **SEMESTER 2**

30 January 2023 – 09 June 2023

### **SUMMER**

12 June 2023 – 22 September 2023

## **IMPORTANT**

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism, Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance [here](#) and further information [here](#). You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity. You should also refer to the Faculty of Science and Engineering proof-reading policy and this can be found on the Community HUB on Canvas, under Course Documents.

## STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 9am-5pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

**Email:** [studentsupport-scienceengineering@swansea.ac.uk](mailto:studentsupport-scienceengineering@swansea.ac.uk) (Monday–Friday, 9am–5pm)

**Call:** +44 (0) 1792 295514 and 01792 6062522 (Monday-Friday, 10am–12pm, 2–4pm).

**Zoom:** By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

<https://myuni.swansea.ac.uk/fse/coe-student-info/>

## READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via <http://ifindreading.swan.ac.uk/>. We've removed reading lists from the 22-23 handbooks to ensure that you have access to the most up-to-date versions. Access to print material in the library may be limited due to CV-19; your reading lists will link to on-line material whenever possible. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

## THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

**Compulsory modules** must be **pursued** by a student.

**Core modules** must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under “Modular Terminology” on the following link -

<https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/>

# MSc (FHEQ Level 7) 2022/23

## Cyber Security

MSc Cyber Security

Coordinator: Dr P Kumar

### Compulsory Modules

Semester 1 Modules	Semester 2 Modules
<b>CSCM08</b> Information Security Management 15 Credits Dr B Muller	<b>CSCM10</b> Computer Science Project Research Methods 15 Credits Dr MJ Roach
<b>CSCM13</b> Critical Systems 15 Credits Dr AG Setzer	<b>CSCM28</b> Security Vulnerabilities and Penetration Testing 15 Credits Dr P James
<b>CSCM18</b> IT-Security: Cryptography and Network Security 15 Credits Dr P Kumar/Dr P James	<b>CSCM88</b> Network and Wireless Security 15 Credits Dr P Kumar
<b>Dissertation</b>	
<b>CS-M20</b> MSc Project 60 Credits Dr U Berger	
<b>Total 180 Credits</b>	

### Optional Modules

Choose exactly 15 credits

Graduates from our BSc programmes in Computer Science at Swansea University are usually not allowed to take modules of which they have already taken the level 3 version. The department aims to offer sufficient modules to allow a balanced choice of optional modules. In case of queries regarding the required modules for your scheme, please contact the course coordinator for the respective scheme.

Choose one module.

<b>CSCM23</b>	Designing-in Trust, Understanding and Negotiation	Dr B Muller/Prof M Roggenbach/Dr AZ Wyner/..	TB1	15
<b>CSCM48</b>	Web Application Development	Dr SP Walton	TB1	15
<b>CSCM85</b>	Modelling and Verification Techniques	Dr U Berger	TB1	15

### And

Choose exactly 15 credits

Choose one module.

<b>CSCM29</b>	Blockchain, Cryptocurrencies and Smart Contracts	Dr AG Setzer	TB2	15
<b>CSCM38</b>	Advanced Topics: Artificial Intelligence and Cyber Security	Prof SA Shaikh	TB2	15

<b>CS-M20 MSc Project</b>
<b>Credits: 60 Session: 2022/23 Academic Year</b>
<b>Pre-requisite Modules:</b>
<b>Co-requisite Modules:</b>
<b>Lecturer(s):</b> Dr U Berger
<b>Format:</b> Individual project supervision
<b>Delivery Method:</b> Individual project supervision
<b>Module Aims:</b> This module will provide students with the opportunity of exploring a particular topic in computer science in some considerable depth. It is only open to students studying MSc Computer Science, MSc Advanced Computer Science, MSc Advanced Software Technology, MSc in High Performance and Scientific Computing, and MSc Data Science.
<b>Module Content:</b> The student will carry out independent project under the guidance of their supervisor. The dissertation may include the following topics: <ul style="list-style-type: none"> <li>- Discussion of the subject area and its history;</li> <li>- A literature survey;</li> <li>- Formulation of scientific questions and the answers to them;</li> <li>- Theoretical background;</li> <li>- Description of the approach taken;</li> <li>- Discussion of issues arising in the undertaking of the project;</li> <li>- Evaluation of results;</li> <li>- Progress and achievements of the project;</li> <li>- Suggestions for further work.</li> </ul>
<b>Intended Learning Outcomes:</b> Students will be able to undertake independent research into appropriate areas of Computer Science; plan and undertake a significant independent piece of project work; critically evaluate their work in the context of current work in related areas.
<b>Assessment:</b> Project (100%)
<b>Assessment Description:</b> Project dissertation. The maximum word count for a Swansea University MSc is defined in the online Academic Guide: <a href="http://www.swan.ac.uk/registry/academicguide/">http://www.swan.ac.uk/registry/academicguide/</a>
<b>Moderation approach to main assessment:</b> Universal double-blind marking
<b>Assessment Feedback:</b> Students will receive guidance from their academic supervisor during individual supervision meetings. The minimum frequency of these is defined in University regulations; though it is expected that in practice they will be more frequent. Formal notification of the result of the MSc dissertation will be sent to the student via usual University processes. The student will receive individual feedback on their dissertation from their supervisor.
<b>Failure Redemption:</b> Resubmit dissertation in accordance with University regulations.
<b>Additional Notes:</b> Only available to students pursuing an MSc degree in Computer Science.

# CSCM08 Information Security Management

**Credits: 15 Session: 2022/23 September-January**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr B Muller

**Format:** 30 hours lectures and seminars

**Delivery Method:** On-campus/virtual lectures and lab sessions.

**Module Aims:** This module will address the theory and practice of information security. In particular, it will consider where data comes from, who collects it and what they can do with it. It will further look into theories of monitoring and surveillance, digital identity, legal and regulatory frameworks, data protection, cybercrime, business resilience, disaster recovery, and security audits.

**Module Content:** The theory and practice of information security: where does data come from, who collects it and what can they do with it? Data as a management tool, commodity, private asset, public good and public service.

Theories of monitoring and surveillance.

Theories of digital identity with applications to trust, anonymization and privacy. Technologies: biometrics, authentication, access control.

Legal and regulatory frameworks. Information Commissioners Office. Development of data protection. General Data Protection Regulation 2018. Company security policies and practices on digital media: use of email, the web and databases whilst at work, travelling and at home. Failures of information security: internal versus external. Case studies of data breaches.

The global landscape of cybercrime. Classification of cybercrime. Hackers and mules -- social engineering, leakage, penetration, betrayal, etc. Case studies of cybercrime, especially fraud. Convergence of real and virtual crimes.

Business resilience, continuity and disaster recovery. Risk analysis. Security audits. Role of chief information security officers.

**Intended Learning Outcomes:** Students will be able to

- critically evaluate the personal, organisational, and legal/regulatory context in which information systems could be used, the risks of such use and the constraints that may affect how cyber security is implemented and managed,
- explain security requirements, and specify appropriate security measures,
- critically analyse the nature, role and problems of data in all aspects of modern life as well as the scope and limits of technologies and human factors in security,
- carry out risk analysis and evaluate compliance issues for data in an organisation or company,
- undertake security audits of policies, practices and technologies.

**Assessment:** Group Work - Presentation (30%)  
Report (70%)

**Resit Assessment:** Coursework reassessment instrument (100%)

**Assessment Description:** Presentation and report on an individual topic.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Formative feedback during term time. Written individual feedback on presentation and report outlining strengths and weaknesses.

**Failure Redemption:** Use of resit instrument as appropriate.

**Additional Notes:**

Available to visiting and exchange students.

# CSCM10 Computer Science Project Research Methods

**Credits: 15 Session: 2022/23 January-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr MJ Roach

**Format:** 12 lectures and seminars plus 6 one-to-one project supervision meetings; 3 hours presentations

**Delivery Method:** On-campus/virtual lectures and lab sessions.

**Module Aims:** This module will introduce students to some fundamental research methodologies and good practice in research. They will undertake background research including a literature review and specify the aims of their MSc project.

**Module Content:** Seminars about selected scientific texts and research projects

Lectures on

- fundamental research methodologies
- good practice in research
- formulation of research questions and hypotheses
- logical reasoning
- literature research
- proper acknowledgement of sources
- principles of carrying out experimental research including ethical issues
- presentation of results

Individual guidance from project supervisors on

- identifying a research topic
- finding and reading related work
- report writing, citations and references
- using (digital) library services and search tools

**Intended Learning Outcomes:** Students will:-

- have gained a thorough understanding of fundamental research methodologies and good practice in research including:

- the formulation of research questions and hypotheses;
- techniques of valid and convincing argumentation;
- literature research methods;
- the proper acknowledgement of sources;
- the extraction of information from literature;
- project planning.

- be conversant with the principles of carrying out experimental research.

- have an understanding of how scientific research is conducted, reported, reasoned about and evaluated.

- be able to show their understanding of the requirements of a masters level project by writing a formal project proposal and specification which contains an outline solution to the problem and which clearly defines the scope of the MSc project, its goals, the methodology to be undertaken and the criteria of its evaluation

- have gained an in-depth knowledge in specific areas related to their project, and have critically assessed different methods to be used in their project and will have developed a detailed plan for carrying out their project.

have an understanding and appreciation of the importance of relevant legal, social, ethical and professional issues as they relate to their project.

**Assessment:** Presentation (30%)  
Report (60%)  
Class Test 1 - Coursework (10%)

**Resit Assessment:** Coursework reassessment instrument (100%)

**Assessment Description:** Report on background research in project area 15% (end February, Semester 2)

Careers Development exercise 10% (February/March, Semester 2)

Oral presentation on project aim/background research 25% (end March/April, Semester 2)

Detailed specification of proposed summer project 50% (May, Semester 2)

**Moderation approach to main assessment:** Universal double-blind marking

**Assessment Feedback:** Individual feedback will be given by markers (CSCM10 lecturers, supervisors and second markers) using marking pro-forma. The comments and marks of the detailed specification document will be discussed by the project supervisor at individual meetings.

**Failure Redemption:** Failure to be redeemed by submitting document addressing unsatisfactory aspects of initial submission(s).

**Additional Notes:**

Only available to students on MSc Computer Science, MSc Advanced Computer Science, MSc Advanced Software Technology.

<b>CSCM13 Critical Systems</b>
<b>Credits: 15 Session: 2022/23 September-January</b>
<b>Pre-requisite Modules:</b>
<b>Co-requisite Modules:</b>
<b>Lecturer(s):</b> Dr AG Setzer
<b>Format:</b> 20 hours lectures, 10 hours lab.
<b>Delivery Method:</b> On campus lectures.
<b>Module Aims:</b> This module introduces techniques for developing critical systems, especially safety critical systems. Students will gain experience in applying modern tools in the development of critical software.
<b>Module Content:</b> Introduction and Motivation: What are high integrity and critical systems? Legal and ethical issues. Examples of major failures of high integrity systems. Successes and how/why they worked. Standards for safety-critical software and their shortcomings.  Analysis: The hazard analysis process. Safety analysis and the safety case. Safety issues related to, but outside software. Human factors - the role of poor interfaces in software failures.  Specification and Verification: Languages and tools for formal specification and verification of software. Detailed demonstration of one tool and its underlying theory.  Software Production: Issues in program language selection to minimise failure. The software engineering process in the production of high-integrity software;  Correctness: Validation and verification - the advantages and disadvantages of testing and formal verification.
<b>Intended Learning Outcomes:</b> Students will be thoroughly familiar with issues surrounding safety-critical systems, including legal and ethical issues and hazard analysis. They will understand techniques for specifying and verifying high-integrity software. They will have experience in applying formal specification techniques to critical systems. They will be familiar with and have had experience in applying programming languages suitable for developing high-integrity software for critical systems.
<b>Assessment:</b> Examination 1 (60%) Coursework 2 (20%) Coursework 1 (20%)
<b>Resit Assessment:</b> Examination (Resit instrument) (100%)
<b>Assessment Description:</b> Standard Computer Science format unseen examination, duration 2hrs. The coursework consists of Assignment 1 - Programming tasks Assignment 2 - Case study
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation
<b>Assessment Feedback:</b> Coursework: small report on strength and weaknesses of each solution. Examination feedback summarising strengths and weaknesses of the class.
<b>Failure Redemption:</b> Resit exam and/or resubmit assignments as appropriate.
<b>Additional Notes:</b>  Created March 2015. Available to visiting and exchange students. No changes July 2015

<b>CSCM18 IT-Security: Cryptography and Network Security</b>	
<b>Credits: 15 Session: 2022/23 September-January</b>	
<b>Pre-requisite Modules:</b>	
<b>Co-requisite Modules:</b>	
<b>Lecturer(s):</b> Dr P Kumar, Dr P James	
<b>Format:</b> 30 hours lectures and labs	
<b>Delivery Method:</b> On-campus/virtual lectures and lab sessions.	
<b>Module Aims:</b> The aim of this course is to examine theoretical and practical aspects of computer and network security.	
<b>Module Content:</b> Security threats and their causes. Security criteria and models. Cryptography: including basic encryption, DES, AES, hash functions. Access Control. Security tools and frameworks: including IPSec, TLS, SSL, SSH and related tools. Vulnerabilities and attacks: including port scanning, packet sniffing, SQL injection. Security issues in wireless networks. Security on the cloud.	
<b>Intended Learning Outcomes:</b> Students will have the ability to identify security threats and their causes in today's computing infrastructures. Students will be able to explain in detail and apply techniques from Cryptography and Cryptanalysis. Students will synthesize the concepts of design, defensive programming, as well as their application to build robust and resilient systems. Students will be able to apply techniques to enhance the security of existing systems, and gain a critical awareness of the limits of these techniques. Students will be able to reflect and critique on cryptographic techniques and secure systems design.	
<b>Assessment:</b>	Examination 1 (70%) Coursework 1 (10%) Coursework 2 (10%) Laboratory work (10%)
<b>Resit Assessment:</b>	Examination (Resit instrument) (100%)
<b>Assessment Description:</b> Standard Computer Science format unseen examination (70%). 2 Courseworks and work done in a lab.	
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation	
<b>Assessment Feedback:</b> Outline solutions provided along with group and individual analytical feedback for courseworks. Examination feedback summarising strengths and weaknesses of the class.	
<b>Failure Redemption:</b> Resit exam.	
<b>Additional Notes:</b>  Available to visiting and exchange students.	

<b>CSCM23 Designing-in Trust, Understanding and Negotiation</b>
<b>Credits: 15 Session: 2022/23 September-January</b>
<b>Pre-requisite Modules:</b>
<b>Co-requisite Modules:</b>
<b>Lecturer(s):</b> Dr B Muller, Prof M Roggenbach, Dr AZ Wyner
<b>Format:</b>
<b>Delivery Method:</b> Lectures
<b>Module Aims:</b> This module explores state-of-the-art methods and concepts to assist responsible design and development of technology with the aim of creating reliable and trusted systems. The content of this module will be delivered by expert lecturers and practitioners in the areas of trusted computation, bias and explainability in automated decision making and decision support, ethical considerations for AI, argumentation and negotiation, as well as formal methods, such as verification of critical systems.
<b>Module Content:</b> - Data privacy in theory and practice - Standards and practice of ethically-aligned design for autonomous and intelligent systems - Notions of trust and trusted negotiations; argumentation - Explainable AI; counterfactuals - Formal methods and verification of system properties - Law and regulation for AI
<b>Intended Learning Outcomes:</b> Students will learn to: - Apply methods ensuring reliability, ethical standards, and legal compliance, as well as trust in technological systems - Throughout the development process - Appraise of the quality of data, including bias and provenance - Design explainable decision processes - Incorporate principles of data privacy - Develop systems that achieve trust through transparency - Incorporate formal methods into the development process to ensure safety and security.
<b>Assessment:</b> Coursework 1 (30%) Examination 1 (70%)
<b>Resit Assessment:</b> Examination (Resit instrument) (100%)
<b>Assessment Description:</b> Coursework (Assessment level marking - PGTM): Essay (individual) Examination, Assessment level marking - PGTM: Separate topics from each lecturer involved in teaching the module
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation
<b>Assessment Feedback:</b> Individual written feedback for coursework component, e.g., annotated essays.
<b>Failure Redemption:</b> Resit examination.
<b>Additional Notes:</b>
Created April 2019.

<b>CSCM28 Security Vulnerabilities and Penetration Testing</b>	
<b>Credits: 15 Session: 2022/23 January-June</b>	
<b>Pre-requisite Modules:</b>	
<b>Co-requisite Modules:</b>	
<b>Lecturer(s):</b> Dr P James	
<b>Format:</b> 30 hours lectures and labs	
<b>Delivery Method:</b> On-campus/virtual lectures and lab sessions.	
<b>Module Aims:</b> The aim of this course is to examine methodological and practical aspects of cyber security threats and analysis techniques.	
<p><b>Module Content:</b> Security threats and their causes.  Vulnerabilities and attacks: including port scanning, packet sniffing, SQL injection.  Countermeasures for attacks.  Security analysis tools and frameworks: including Kali Linux and Metasploit.  Shell code.  Legal and ethical issues of ethical hacking.  Social Engineering.  Methodologies for penetration testing.</p>	
<p><b>Intended Learning Outcomes:</b> Students will have the ability to identify security threats and their causes in today's computing infrastructures.  Students will be able to explain in detail a number of methodologies for security analysis of a system.  Students will have practical experience in recognising vulnerabilities and will be able to defend against them.  Students will be able to apply techniques of penetration testing to existing systems, and gain a critical awareness of the limits of these techniques.</p>	
<b>Assessment:</b>	Examination 1 (50%) Coursework 1 (10%) Coursework 2 (10%) Laboratory work (30%)
<b>Resit Assessment:</b>	Examination (Resit instrument) (100%)
<b>Assessment Description:</b> Standard Computer Science format unseen examination (60%). 2 Courseworks and work done in a lab.	
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation	
<b>Assessment Feedback:</b> Outline solutions provided along with group and individual analytical feedback for coursework. Examination feedback summarising strengths and weaknesses of the class.	
<b>Failure Redemption:</b> Resit exam.	
<b>Additional Notes:</b>	
Available to visiting and exchange students.	

<b>CSCM29 Blockchain, Cryptocurrencies and Smart Contracts</b>	
<b>Credits: 15 Session: 2022/23 January-June</b>	
<b>Pre-requisite Modules:</b>	
<b>Co-requisite Modules:</b>	
<b>Lecturer(s):</b> Dr AG Setzer	
<b>Format:</b> 30 hours including presentation and consultation hours	
<b>Delivery Method:</b> On-campus/virtual lectures and lab sessions.	
<b>Module Aims:</b> This is a module on modern blockchain technology and its major applications. It will give an overview on the technological setup of major cryptocurrencies, and introduce the blockchain as a concept for determining the order of events in a distributed database. In addition, it will discuss the implementation of smart contracts and summarise the current state of the art of security issues in cryptocurrencies, blockchain technology, and smart contracts.	
<b>Module Content:</b> Introduction to cryptocurrencies, blockchain technology and smart contracts History of cryptocurrencies. From the model of a bank to the Bitcoin model. The Bitcoin client. Transactions, keys, addresses, wallets. The Bitcoin network. Mining and consensus. An overview over other cryptocurrencies. History and Philosophy of Ethereum. Smart contracts. Smart contract development using Solidity. Security of Smart Contracts.	
<b>Intended Learning Outcomes:</b> Students will be able to  - explain blockchain technology and critically evaluate its current and future applicability, -- explain the theoretical concepts behind cryptocurrencies and blockchain technology, and be able to critically reflect on issues surrounding their application, - - explain the concepts behind smart contracts, be able to apply them in a lab environment, and critically evaluate their applicability as a technology, -- undertake a research project on a topic in the areas of cryptocurrencies, blockchain technology, and smart contracts or develop and document software related to these areas, -- apply blockchain technology to scenarios in a lab and critically evaluate its usability potential in the real world.	
<b>Assessment:</b>	Examination 1 (60%) Coursework 1 (20%) Coursework 2 (20%)
<b>Resit Assessment:</b> Examination (Resit instrument) (100%)	
<b>Assessment Description:</b> Standard Computer Science format unseen examination, duration 2hrs. Coursework 1: Java-based exercise (Java programming skills required) Coursework 2: Solidity coursework	
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation	
<b>Assessment Feedback:</b> Outline solutions provided along with group and individual analytical feedback for courseworks. Examination feedback summarising strengths and weaknesses of the class.	
<b>Failure Redemption:</b> Resit exam and/or resubmit assignments as appropriate.	
<b>Additional Notes:</b>  Created January 2018. Available to visiting and exchange students.	

# CSCM38 Advanced Topics: Artificial Intelligence and Cyber Security

**Credits: 15 Session: 2022/23 January-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Prof SA Shaikh

**Format:** 20 lectures, 5 x 1hr seminars, 3 x 2hr labs, 2 drop-in hours.

**Delivery Method:** On-campus/virtual lectures and lab sessions.

**Module Aims:** This module introduces students to the state-of-the-art methods and research topics of artificial intelligence,

cyber security, including quantum computing, data science, deep learning and reinforcement learning. The inspiration behind these approaches will be discussed, along with their relative merits for application in cyber security.

**Module Content:** 1. Advanced AI Topics: Deep Supervised Learning: Advanced Topics on CNNs, RNNs and GNNs.

2. Advanced AI Topics: Deep Unsupervised Learning: Advanced Topics on AE, Autoregression Models, Flow, GANs.

3. Data Security: Federated Learning, Differential Privacy in Learning.

4. Model Security: Adversarial Attack and Defense, Robustness Testing.

5. AI for Cybersecurity: Malicious Intrusion Detection etc

**Intended Learning Outcomes:** Student will be able

- to demonstrate a broad knowledge of the state-of-the-art concepts and techniques of artificial intelligence (AI) for cyber security,
- to appraise vulnerabilities and risks introduced by AI,
- to compare and contrast different analysis methods for cyber security problems,
- to carry out independent research on AI and data science topics related to cyber security.

They should further be able

to transfer the knowledge to solve cyber security problems, from a computation, artificial intelligence and data science perspective.

**Assessment:** Coursework 1 (50%)

Coursework 2 (50%)

**Resit Assessment:** Coursework reassessment instrument (100%)

**Assessment Description:** Two coursework assignments (50% each)

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Individual written feedback and cohort feedback

**Failure Redemption:** Resubmit coursework as appropriate.

**Additional Notes:**

Updated July 2019. Available to visiting and exchange students

<b>CSCM48 Web Application Development</b>	
<b>Credits: 15 Session: 2022/23 September-January</b>	
<b>Pre-requisite Modules:</b>	
<b>Co-requisite Modules:</b>	
<b>Lecturer(s):</b> Dr SP Walton	
<b>Format:</b> 18 hours lectures, 12 hours labs	
<b>Delivery Method:</b> On-campus/virtual lectures and lab sessions.	
<b>Module Aims:</b> The module will develop the principles and technologies used for building web-based systems. Practical experience of building web systems will be gained via laboratories and coursework. Existing high programming skill and experience is essential for this module.	
<b>Module Content:</b> The history of web application development. HTML and CSS: Introduction and Good Practices. Web Application Design. MVC driven web applications Security and identity in web applications Web development using Javascript and AJAX	
<b>Intended Learning Outcomes:</b> Students will have a systematic understanding of the key aspects of current web programming principles and technologies. Students will be able to plan and deliver a web application to a deadline. Students will be able to create web applications following methodological good practice. Students will be able to design secure web applications and evaluate their effectiveness. Students will be able to design web applications which provide basic analytics for system administrators.	
<b>Assessment:</b>	Coursework 1 (10%) Coursework 2 (20%) Coursework 3 (70%)
<b>Resit Assessment:</b> Coursework reassessment instrument (100%)	
<b>Assessment Description:</b> Coursework 1 and 2 – 30% - Code Review and code submission.  An important part of working in a software engineering organisation is code reviews. In this process engineers look at each other's code to spot bugs and ensure standards are being adhered to. You will submit a source file from your project to be reviews by another student and review another student's source file. You will be assessed both on your adherence to standards with your source code and the quality of your code review.  Coursework 3 – 70% - Implementation.  You will submit the implementation of a small web application. You will be asked to evaluate this by answering a series of questions referencing your implementation. This will assess both your knowledge of the theory and ability to apply that in practice.	
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation	
<b>Assessment Feedback:</b> Feedback during Presentation of work. Outline solutions provided along with group and individual analytical feedback for courseworks. Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.	
<b>Failure Redemption:</b> Resit examination and/or resubmit coursework(s) as appropriate	
<b>Additional Notes:</b> Students taking this module must have good programming skills (i.e., be a competent programmer in any standard programming language) as this module requires significant programming ability.	
Updated August 2019. Available to visiting and exchange students.	

<b>CSCM85 Modelling and Verification Techniques</b>	
<b>Credits: 15 Session: 2022/23 September-January</b>	
<b>Pre-requisite Modules:</b>	
<b>Co-requisite Modules:</b>	
<b>Lecturer(s):</b> Dr U Berger	
<b>Format:</b>	20 hours lectures; 2 x 3 practicals; 4 problem consultation hours.
<b>Delivery Method:</b> primarily on campus	
<b>Module Aims:</b> This module will give an overview of the landscape and the state of the art of current modelling and verification techniques. One particular tool for software verification will be studied in depth. Students will gain hands-on experience in using that tool.	
<b>Module Content:</b> Overview of techniques for formal verification. Interactive theorem proving, automated theorem proving and model checking. Introduction to one specific logic for modelling and verification. Techniques for modelling of software using verification tools. Practical verification of software examples.	
<b>Intended Learning Outcomes:</b> The students will have - gained an thorough overview of the landscape and the state of the art of current modelling and verification techniques - acquired a deep understanding of one particular verification tool and know how to translate practical and mathematical problems into its notation - obtained hands-on experience in practical verification.	
<b>Assessment:</b>	Examination 1 (70%) Coursework 1 (15%) Laboratory work (15%)
<b>Resit Assessment:</b> Examination (Resit instrument) (100%)	
<b>Assessment Description:</b> Standard format Computer Science exam (2 hours), and coursework:  Assignment 1: Mathematical and logical foundations of concurrent processes. Assignment 2: Advanced modelling and verification in the process language CSP. Lab: Modelling and verification in CSP using the process tools ProBE and FDR.	
<b>Moderation approach to main assessment:</b> Second marking as sampling or moderation	
<b>Assessment Feedback:</b> Outline solutions provided along with group and individual analytical feedback for courseworks. Examination feedback summarising strengths and weaknesses of the class. Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.	
<b>Failure Redemption:</b> Resit examination and/or resubmit coursework(s) as appropriate	
<b>Additional Notes:</b>  Available to visiting students	

# CSCM88 Network and Wireless Security

**Credits: 15 Session: 2022/23 January-June**

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Lecturer(s):** Dr P Kumar

**Format:** 30 hours lectures and labs

**Delivery Method:** On campus lectures and labs.

**Module Aims:** Low cost networked computers add eyes and ears (or sensors) and arms, legs and voices (or actuators) to the Internet – called the Internet of Things (IoT) connected smart objects. Networking technologies play a critical role in almost all modern software-based systems, whether the fixed networks of computers, or the growing pervasive devices which have increasingly diverse profiles of network connectivity. As a result, they provide a potential vector for many forms of attack and are an ideal location for many threat mitigations and isolation technologies.

**Module Content:** Overview of Cryptography -- Basic encryption and decryption: terminology, substitution, stream, and block ciphers; characteristics of good ciphers. Symmetric and asymmetric encryption. Encryption algorithms: DES, RSA, AES, etc. Hashing.

Network fundamentals -- TCP/IP, SSL/TLS review, tools for network analysis, routing algorithms, threat modelling, network attachment protections: RADIUS, EAP, 802.1x, etc.

Network defense -- Form of firewalls, behaviours and design, and layered protections

Intrusion detection -- Techniques for detecting abnormal patterns of behaviours.

Mobile Network systems -- Security complexities introduced by mobility, security architecture and protocols.

Security in wireless sensor networks (WSN) -- WSN architectures and protocols, security threats, cryptographic primitives, key establishment and distribution, security of ZigBee WSNs, security of Industrial-IoT devices (as a case study), formal verification, and future trends.

Case Studies -- AKA (Authentication and Key Agreement): 4/5G security; IoT security – 6LowPAN and CoAP IETF standards.

**Intended Learning Outcomes:** 1) Students will have the ability to identify security vulnerabilities and their causes in modern networking infrastructures.

2) Students will be able to explain and apply techniques from networking protocols.

3) Students will be able to apply skills learned to designing and developing secure emerging wireless networks.

4) Students will be able to apply techniques to enhance the security of existing networks and gain a critical awareness of the limits of these techniques.

**Assessment:** Examination 1 (70%)  
Laboratory work (30%)

**Resit Assessment:** Examination (Resit instrument) (100%)

**Assessment Description:** Standard Computer Science format unseen examination.  
Project based lab.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Assessment Feedback:** Outline solutions provided along with group and individual analytical feedback for courseworks.

Examination feedback summarising strengths and weaknesses of the class.

**Failure Redemption:** Resit exam.

**Additional Notes:**

Available to students on Specialist Master programmes.