

**REGULATIONS FOR THE DEGREES OF
MASTER OF SCIENCE IN ENGINEERING (MSc[Eng])
MASTER OF SCIENCE IN COMPUTER SCIENCE (MSc[CompSc]), AND
MASTER OF SCIENCE IN ELECTRONIC COMMERCE AND INTERNET
COMPUTING (MSc[ECOM&ICOMP])**

Applicable to students admitted in the academic year 2018-19 and thereafter.

(See also General Regulations and Regulations for Taught Postgraduate Curricula)

The degrees of MSc(Eng), MSc(CompSc) and MSc(ECOM&ICOMP) are each a postgraduate degree awarded for the satisfactory completion of a prescribed curriculum in the Faculty of Engineering.

For the MSc(Eng) degree, the major part of the curriculum must include courses offered in one of the following fields: building services engineering, electrical and electronic engineering, energy engineering, environmental engineering, geotechnical engineering, industrial engineering and logistics management, infrastructure project management, mechanical engineering, structural engineering, and transportation engineering.

The MSc(Eng), MSc(CompSc) and MSc(ECOM&ICOMP) curricula are offered in part-time and full-time modes.

MSc1 Admission requirements

To be eligible for admission to the curriculum leading to the degree of MSc(Eng) / MSc(CompSc) / MSc(ECOM&ICOMP), a candidate shall:

- (a) comply with the General Regulations;
- (b) comply with the Regulations for Taught Postgraduate Curricula;
- (c) hold (i) a Bachelor's degree of this University in a relevant field; or
(ii) a relevant qualification of equivalent standard from this University or from another university or comparable institution accepted for this purpose; and
- (d) satisfy the examiners in a qualifying examination if required.

MSc2 Qualifying Examination

- (a) A qualifying examination may be set to test the candidate's academic ability or his/her ability to follow the curriculum prescribed. It shall consist of one or more written papers or their equivalent and may include a dissertation.
- (b) A candidate who is required to satisfy the examiners in a qualifying examination shall not be permitted to register until he/she has satisfied the examiners in the examination.

MSc3 Period of Study

The curriculum of the degree of MSc(Eng)/MSc(CompSc)/MSc(ECOM&ICOMP) shall normally extend over one academic year of full-time study or two academic years of part-time study. Candidates shall not be permitted to extend their studies beyond the maximum period of registration of two academic years of full-time study or three academic years of part-time study, unless otherwise permitted or required by the Board of Faculty. For both full-time and part-time modes, the period of study shall include any assessment to be held during and/or at the end of each semester.

MSc4 Curriculum Requirements

To complete the curriculum, a candidate shall, within the prescribed maximum period of registration stipulated in Regulation MSc3 above:

- (a) satisfy the requirements prescribed in TPG6 of the Regulations for Taught Postgraduate Curricula;
 - (b) take not fewer than 72 credits of courses, in the manner specified in these regulations and syllabuses and pass all courses as specified in the syllabuses;
 - (c) follow courses of instruction and complete satisfactorily all prescribed practical / laboratory work; and
 - (d) satisfy the examiners in all forms of assessment as may be required in either
 - (i) 72 credits of courses which must include a dissertation of 24 credits or a project of 12 credits as capstone experience; or
 - (ii) at least 60 credits of courses successfully completed at this University (which must include a dissertation of 24 credits or a project of 12 credits) and not more than 12 credits of courses successfully completed at this or another university before admission to the MSc(Eng) / MSc(CompSc) / MSc(ES&IComp) and approved by the Board of the Faculty.
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MSc5 Dissertation or project report

- (a) A candidate who is permitted to select a dissertation or a project is required to submit the dissertation or the project report by a date specified by the Board of Examiners.
 - (b) All candidates shall submit a statement that the dissertation or the project report represents his/her own work undertaken after the registration as a candidate for the degree.
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MSc6 Selection of Courses

- (a) A candidate shall select courses according to the guidelines stipulated in the syllabuses for the degree of MSc(Eng)/MSc(CompSc)/MSc(ES&IComp).
 - (b) Selection of study patterns, as stipulated in the respective syllabus, shall be subject to the approval of the Head of the Department concerned.
 - (c) Candidates shall select their courses in accordance with these regulations and the guidelines specified in the syllabuses before the beginning of each academic year.
 - (d) Changes to the selection of courses may be made only during the add/drop period of the semester in which the course begins, and such changes shall not be reflected in the transcript of the candidate.
 - (e) Subject to the approval of the Committee on Taught Postgraduate Curricula on the recommendation of the Head of the Department concerned, a candidate may in exceptional circumstances be permitted to select additional course(s).
 - (f) Requests for changes after the designated add/drop period of the semester shall be subject to the approval of the Committee on Taught Postgraduate Curricula. Withdrawal from courses beyond the designated add/drop period will be subject to the approval of the Committee on Taught Postgraduate Curricula.
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MSc7 Assessment

- (a) The written examination for each course shall be held after the completion of the prescribed course of study for that course, and not later than January, May or

August immediately following the completion of the course of study for that course unless otherwise specified in the syllabuses.

- (b) A candidate, who is unable to complete the requirements within the prescribed maximum period of registration specified in Regulation MSc3 because of illness or circumstances beyond his/her control, may apply for permission to extend his/her period of studies.
- (c) A candidate who has failed to satisfy the examiners in any course(s) is required to make up for failed course(s) in the following manners:
 - (i) undergoing re-assessment/re-examination in the failed course(s); or
 - (ii) repeating the failed course(s) by undergoing instruction and satisfying the assessments; or
 - (iii) taking another course in lieu and satisfying the assessment requirements.
- (d) A candidate who has failed to satisfy the examiners in his/her dissertation or project report may be required to submit or resubmit a dissertation or a project report on the same subject within a period specified by the Board of Examiners.
- (e) In accordance with G9(h) of the General Regulation and TPG8(d) of the Regulations for Taught Postgraduate Curricula, there shall be no appeal against the results of examinations and all other forms of assessment.

MSc8 Grading system

Individual courses shall be graded according to the following grading system as determined by the Board of Examiners:

Standard	Grade	Grade Point
Excellent	A+	4.3
	A	4.0
	A-	3.7
Good	B+	3.3
	B	3.0
	B-	2.7
Satisfactory	C+	2.3
	C	2.0
	C-	1.7
Pass	D+	1.3
	D	1.0
Fail	F	0

MSc9 Discontinuation of Studies

Unless otherwise permitted by the Board of the Faculty, a candidate will be recommended for discontinuation of their studies in accordance with General Regulation G12 if he/she has:

- (a) failed to pass 12 credits in an academic year; or
- (b) failed to satisfy the examiners at a second attempt in his/her dissertation or project report within the specified period; or
- (c) failed to achieve a cumulative grade point average* (CGPA) of 1.0 or higher for two consecutive semesters with course enrolment; or
- (d) exceeded the maximum period of registration specified in Regulation MSc3.

** At the end of each semester, a cumulative grade point average (CGPA) for all courses, except cross-listed undergraduate courses and outside curriculum requirement optional courses as specified in the syllabuses, taken by a student (including failed courses) at the time of calculation is computed.*

MSc10 Advanced Standing

Advanced standing may be granted to candidates in recognition of studies completed successfully before admission to the curriculum in accordance with TPG3 of the Regulations for Taught Postgraduate Curricula. Candidates who are awarded Advanced Standing will not be granted any further credit transfer for those studies for which Advanced Standing has been granted. The amount of credits to be granted for Advanced Standing shall be determined by the Board of the Faculty, in accordance with the following principles:

- (a) a candidate may be granted a total of not more than 20% of the total credits normally required under a curriculum for Advanced Standing unless otherwise approved by the Senate; and
 - (b) credits granted for advanced standing shall not be included in the calculation of the GPA but will be recorded on the transcript of the candidate.
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MSc11 Award of Degree

To be eligible for the award of the degree of MSc(Eng) / MSc(CompSc) / MSc(ES&IComp), a candidate shall:

- (a) comply with the General Regulations and the Regulations for Taught Postgraduate Curricula;
 - (b) complete the curriculum and satisfy the examiners in accordance with the regulations set out; and
 - (c) achieve a cumulative grade point average (CGPA) of 1.0 or higher
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MSc12 Assessment results

On successful completion of the curriculum, candidates who have shown exceptional merit of achieving a cumulative grade point average (CGPA) of 3.6 or higher may be awarded a mark of distinction, and this mark shall be recorded on the candidates' degree diploma.

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER SCIENCE (MSc[CompSc])

This syllabus is applicable to students admitted to the curriculum in the academic year 2019-20 and thereafter.

Definition and Terminology

Stream of study – a specialisation in the curriculum selected by a candidate which can be General, Cyber Security, Financial Computing and Multimedia Computing.

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Subject group – a subset of courses in the list of discipline courses which have the same specialisation.

Stream specific course – any course in a subject group which corresponds to the specialisation of the stream of study.

Elective course – any Taught Postgraduate level course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc in Computer Science that are not classified as discipline courses.

Capstone Experience – a 12-credit project or a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

	Enrolment Mode of 10 courses + Project		Enrolment Mode of 8 courses + Dissertation	
	General Stream	Cyber Security / Financial Computing / Multimedia Computing Stream	General Stream	Cyber Security / Financial Computing / Multimedia Computing Stream
Course Category	No. of Credits		No. of Credits	
Discipline Courses	Not less than 48	Not less than 48 [Include at least 24 credits in Stream Specific Courses in the candidate's corresponding stream of study]	Not less than 36	Not less than 36 [Include at least 24 credits in Stream Specific Courses in the candidate's corresponding stream of study]
Elective Courses	Not more than 12		Not more than 12	
Capstone Experience	12		24	
Total	72		72	

Enrolment Mode

Candidates are required to successfully complete 72 credits to graduate. They can do that by studying in one of the following enrolment modes:

- (a) 10 courses (each equivalent to 6 credits) + Project (equivalent to 12 credits) OR
- (b) 8 courses (each equivalent to 6 credits) + Dissertation (equivalent to 24 credits)

Course Selection

Candidates shall select courses in accordance with the regulations of the degree. For General Stream, candidate can choose any discipline courses listed below in any subject group, and undertake a dissertation or a project (COMP7704 or COMP7705) in any area in computer science. In addition, to qualify as a graduate of Cyber Security, Financial Computing or Multimedia Computing Stream, candidates must pass at least 4 stream specific courses (at least 24 credits in total) in the corresponding subject group, and undertake a dissertation or a project (COMP7704 or COMP7705) in the area of the corresponding stream.

A. Cyber Security

COMP7806	Topic in information security
COMP7901	Legal protection of digital property
COMP7903	Digital investigation and forensics
COMP7904	Information security: attacks and defense
COMP7905	Reverse engineering and malware analysis
COMP7906	Introduction to cyber security

B. Financial Computing

COMP7103	Data mining
COMP7405	Techniques in computational finance
COMP7406	Software development for quantitative finance
COMP7407	Securities transaction banking
COMP7408	Distributed ledger and blockchain technology
COMP7802	Introduction to financial computing
COMP7808	Topic in financial computing
COMP7906	Introduction to cyber security

C. Multimedia Computing

COMP7502	Image processing and computer vision
COMP7503	Multimedia technologies
COMP7504	Pattern recognition and applications
COMP7505	User interface design and development
COMP7506	Smart phone apps development
COMP7507	Visualization and visual analytics
COMP7604	Game design and development
COMP7807	Topic in multimedia computing

D. Other discipline courses

COMP7104	Advanced database systems
COMP7105	Advanced topics in data science
COMP7201	Analysis and design of enterprise applications in UML
COMP7305	Cluster and cloud computing
COMP7308	Introduction to unmanned systems

COMP7309	Quantum computing and artificial intelligence
COMP7404	Computational intelligence and machine learning
COMP7606	Deep learning
COMP7801	Topic in computer science
COMP7805	Topic in computer network and systems
COMP7809	Topic in artificial intelligence

Candidate may select no more than 2 courses (at most 12 credits in total) offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Programme Director and Course coordinators concerned.

MSc(CompSc) Course descriptions

The following is a list of discipline courses offered by the Department of Computer Science for the MSc(CompSc) curriculum. The list below is not final and some courses may not be offered every year.

All courses are assessed through examination and / or coursework assessment, the weightings of which are subject to approval by the Board of Examiners.

COMP7103 Data mining (6 credits)

Data mining is the automatic discovery of statistically interesting and potentially useful patterns from large amounts of data. The goal of the course is to study the main methods used today for data mining and on-line analytical processing. Topics include Data Mining Architecture; Data Preprocessing; Mining Association Rules; Classification; Clustering; On-Line Analytical Processing (OLAP); Data Mining Systems and Languages; Advanced Data Mining (Web, Spatial, and Temporal data).

COMP7104 Advanced database systems (6 credits)

The course will study some advanced topics and techniques in database systems, with a focus on the aspects of big data analytics, algorithms, and system design & organisation. It will also survey the recent development and progress in selected areas. Topics include: query optimization, spatial-spatiotemporal data management, multimedia and time-series data management, information retrieval and XML, data mining.

COMP7105 Advanced topics in data science (6 credits)

This course will introduce selected advanced computational methods and apply them to problems in data analysis and relevant applications.

COMP7201 Analysis and design of enterprise applications in UML (6 credits)

This course presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include: overview of software engineering and object-oriented concepts; unified process and Unified Modelling Language (UML); use-case modelling and object modelling; dynamic modelling using sequence diagrams and state machines; object-oriented design; user interface design; introducing design patterns and enterprise applications; shortcomings of UML and remedies. Emphasis will be given on hands-on exercises with the use of CASE tools.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7305 Cluster and cloud computing (6 credits)

This course offers an overview of current cloud technologies, and discusses various issues in the design and implementation of cloud systems. Topics include cloud delivery models (SaaS, PaaS, and IaaS) with motivating examples from Google, Amazon, and Microsoft; virtualization techniques implemented in Xen, KVM, VMWare, and Docker; distributed file systems, such as Hadoop file system; MapReduce and Spark programming models for large-scale data analysis, networking techniques in hyper-scale data centers. The students will learn the use of Amazon EC2 to deploy applications on cloud, and implement a novel cloud computing application on a Xen-enabled PC cluster as part of their term project.

Prerequisites: The students are expected to install various open-source cloud software in their Linux cluster, and exercise the system configuration and administration. Basic understanding of Linux operating system and some programming experiences (C/C++, Java, or Python) in a Linux environment are required.

COMP7308 Introduction to unmanned systems (6 credits)

To study the theory and algorithms in unmanned systems. Topics include vehicle modelling, vehicle control, state estimation, perception and mapping, motion planning, and deep learning related techniques.

COMP7309 Quantum computing and artificial intelligence (6 credits)

This course offers an introduction to the interdisciplinary fields of quantum computation and quantum AI. The focus will lie on an accessible introduction to the elementary concepts of quantum mechanics, followed by a comparison between computer science and information science in the quantum domain. The theoretical capability of quantum computers will be illustrated by analyzing fundamental algorithms of quantum computation and its potential applications in AI. Finally, the ethics of quantum computation and the potential impact of quantum computers on society will be discussed.

COMP7404 Computational intelligence and machine learning (6 credits)

This course will teach a broad set of principles and tools that will provide the mathematical, algorithmic and philosophical framework for tackling problems using Artificial Intelligence (AI) and Machine Learning (ML). AI and ML are highly interdisciplinary fields with impact in different applications, such as, biology, robotics, language, economics, and computer science. AI is the science and engineering of making intelligent machines, especially intelligent computer programs, while ML refers to the changes in systems that perform tasks associated with AI. Ethical issues in advanced AI and how to prevent learning algorithms from acquiring morally undesirable biases will be covered.

Topics may include a subset of the following: problem solving by search, heuristic (informed) search, constraint satisfaction, games, knowledge-based agents, supervised learning, unsupervised learning; learning theory, reinforcement learning and adaptive control and ethical challenges of AI and ML.

Pre-requisites: Nil, but knowledge of data structures and algorithms, probability, linear algebra, and programming would be an advantage.

COMP7405 Techniques in computational finance (6 credits)

This course introduces the major computation problems in the field of financial derivatives and various computational methods/techniques for solving these problems. The lectures start with a short introduction on various financial derivative products, and then move to the derivation of the mathematical models employed in the valuation of these products, and finally come to the solving techniques for the models.

Pre-requisites: No prior finance knowledge is required. Students are assumed to have basic competence in calculus and probability (up to the level of knowing the concepts of random variables, normal distributions, etc.). Knowledge in at least one programming language is required for the assignments/final project.

COMP7406 Software development for quantitative finance (6 credits)

This course introduces the tools and technologies widely used in industry for building applications for Quantitative Finance. From analysis and design to development and implementation, this course covers: modeling financial data and designing financial application using UML, a de facto industry standard for object oriented design and development; applying design patterns in financial application; basic skills on translating financial mathematics into spreadsheets using Microsoft Excel and VBA; developing Excel C++ add-ins for financial computation.

Pre-requisites: This course assumes basic understanding of financial concepts covered in COMP7802. Experience in C++/C programming is required.

COMP7407 Securities transaction banking (6 credits)

The course introduces the business and technology scenarios in the field of Transaction Banking for financial markets. It balances the economic and financial considerations for products and markets with the organizational and technological requirements to successfully implement a banking function in this scenario and is a crossover between studies of economics, finance and information technology.

COMP7408 Distributed ledger and blockchain technology (6 credits)

In this course, students will learn the key technical elements behind the blockchain (or in general, the distributed ledger) technology and some advanced features, such as smart contracts, of the technology. Variations, such as permissioned versus permissionless and private blockchains, and the available blockchain platforms will be discussed.

Students will also learn the following issues: the security, efficiency, and the scalability of the technology. Cyber-currency (e.g. Bitcoin) and other typical application examples in areas such as finance will also be introduced.

Prerequisites: COMP7906 Introduction to cyber security or ICOM6045 Fundamentals of e-commerce security

COMP7502 Image processing and computer vision (6 credits)

To study the theory and algorithms in image processing and computer vision. Topics include image representation; image enhancement; image restoration; mathematical morphology; image compression; scene understanding and motion analysis.

COMP7503 Multimedia technologies (6 credits)

This course presents fundamental concepts and emerging technologies for multimedia computing. Students are expected to learn how to develop various kinds of media communication, presentation, and manipulation techniques. At the end of course, students should acquire proper skill set to utilize, integrate and synchronize different information and data from media sources for building specific multimedia applications. Topics include media data acquisition methods and techniques; nature of perceptually encoded information; processing and manipulation of media data; multimedia content organization and analysis; trending technologies for future multimedia computing.

COMP7504 Pattern recognition and applications (6 credits)

To study techniques in pattern recognition. Topics include statistical decision theory; density estimation; dimension reduction; discriminant functions; unsupervised classification and clustering; neural network; hidden Markov model; and selected applications in pattern recognition such as characters and speech recognition.

COMP7505 User interface design and development (6 credits)

For technology products and services, the user experience is a major key to success. With advanced development of processors, sensors, and new algorithms and software tools, more powerful and expressive user interfaces can be implemented to improve human computer interaction and operation. The course will study matching input and output devices with user capabilities, software and hardware considerations, interface design methodologies, and future interface technologies. All of these topics will be supported and demonstrated with current research and actual case studies.

COMP7506 Smart phone apps development (6 credits)

Smart phones have become very popular in recent years. According to a study, by 2020, 70% of the world's population is projected to own a smart phone, an estimated total of almost 6.1 billion smartphone users in the world. Smart phones play an important role in mobile communication and applications.

Smart phones are powerful as they support a wide range of applications (called apps). Most of the time, smart phone users just purchase their favorite apps wirelessly from the vendors. There is a great potential for software developer to reach worldwide users.

This course aims at introducing the design issues of smart phone apps. For examples, the smart phone screen is usually much smaller than the computer monitor. We have to pay special attention to this aspect in order to develop attractive and successful apps. Various modern smart phone apps development environments and programming techniques (such as Java for Android phones and Swift for iPhones) will also be introduced to facilitate students to develop their own apps.

Students should have basic programming knowledge.

COMP7507 Visualization and visual analytics (6 credits)

This course introduces the basic principles and techniques in visualization and visual analytics, and their applications. Topics include human visual perception; color; visualization techniques for spatial, geospatial and multivariate data, graphs and networks; text and document visualization; scientific visualization; interaction and visual analysis.

COMP7604 Game design and development (6 credits)

The course studies the basic concepts and techniques for digital game design and development. Topics include: game history and genres, game design process, game production, 2D/3D graphics, physics, audio/visual design, artificial intelligence.

Prerequisites: Basic programming skill, e.g. C++ or Java, is required

COMP7606 Deep learning (6 credits)

Machine learning is a fast growing field in computer science and deep learning is the cutting edge technology that enables machines to learn from large-scale and complex datasets. Ethical implications of deep learning and its applications will be covered first and the course will focus on how deep neural networks are applied to solve a wide range of problems in areas such as natural language processing, image processing, financial predictions, game playing and robotics. Topics covered include linear and logistic regression, artificial neural networks and how to train them, recurrent neural networks, convolutional neural networks, deep reinforcement learning, and unsupervised feature learning. Popular deep learning software, such as TensorFlow, will also be introduced.

COMP7801 Topic in computer science (6 credits)

Selected topics that are of current interest will be discussed.

COMP7802 Introduction to financial computing (6 credits)

This course introduces the students to different aspects of financial computing in the investment banking area. The topics include yield curve construction in practice, financial modelling and modern risk management practice, etc. Financial engineering is an area of growing demand. The course is a combination of financial product knowledge, financial mathematics and computational techniques. This course will be suitable for students who want to pursue a career in this fast growing area.

Prerequisites: This course does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in Excel spreadsheet operations is required to complete the assignments and final project.

COMP7805 Topic in computer network and systems (6 credits)

Selected topics in computer network and systems that are of current interest will be discussed.

COMP7806 Topic in information security (6 credits)

Selected topics in information security that are of current interest will be discussed.

COMP7807 Topic in multimedia computing (6 credits)

Selected topics in multimedia computing that are of current interest will be discussed.

COMP7808 Topic in financial computing (6 credits)

Selected topics in financial computing that are of current interest will be discussed.

COMP7809 Topic in artificial intelligence (6 credits)

Selected topics in artificial intelligence that are of current interest will be discussed.

COMP7901 Legal protection of digital property (6 credits)

This course introduces computer professionals to the various legal means of protecting digital property including computer software, algorithms, and any work or innovation in digital form. Focus is on the main issues in protecting digital property arising from developments in information technology, and their legal solutions. Topics covered include, but are not limited to, the following: 1) Copyright protection of software and websites, 2) Patent protection of software and algorithms, 3) Criminal sanctions against offences involving the digital technology.

Mutually exclusive with: ECOM6004 Legal aspects of IT and e-commerce

COMP7903 Digital investigation and forensics (6 credits)

This course introduces the fundamental principles of digital investigation and forensics. The course starts with a brief introduction to common computer crimes and digital evidence, and then moves on to the computer basics and network basics pertaining to digital forensics, and finally comes to the techniques for digital investigation and forensic examination.

COMP7904 Information security: attacks and defense (6 credits)

This is an ethical hacking course. In this course, we will teach students how to conduct ethical hacking so as to better protect a computer system in a company. Topics include physical security, password cracking, network hacking, operating system hacking, and application hacking. The course will also discuss R&D problems related to hacking and defence. The course will try to strike a balance between theory and practice so that students can understand the theories behind the hacking process as well as get enough hands-on exercises to perform ethical hacking and defense.

Prerequisites: Students are expected to have knowledge in university level mathematics and systems plus experience in programming.

COMP7905 Reverse engineering and malware analysis (6 credits)

This course provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases and hand-on analysis of malware samples. It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks. Various malware incidents will be covered, such as cases in Ransomware, banking-trojan, state-sponsored and APT attacks, cases in Stuxnet and malicious software attacks on Industrial Control System and IoT devices. With the experience of studying these cases and analyzing selected samples, the students will be able to understand the global cyber security landscape and its future impact. Hands-on exercises and in-depth discussion will be provided to enable students to acquire the required knowledge and skill set for defending and protecting an enterprise

network environment.

Students should have programming/development skills (Assembly, C, C++, Python) and knowledge in Operating System and computer network.

COMP7906 Introduction to cyber security (6 credits)

The aim of the course is to introduce different methods of protecting information and data in the cyber world, including the privacy issue. Topics include introduction to security; cyber attacks and threats; cryptographic algorithms and applications; network security and infrastructure.

Mutually exclusive with: ICOM6045 Fundamentals of e-commerce security

COMP7704 Dissertation (24 credits)

Candidate will be required to carry out independent work on a major project that will culminate in the writing of a dissertation.

COMP7705 Project (12 credits)

Candidate will be required to carry out independent work on a major project under the supervision of individual staff member. A written report is required.

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER SCIENCE (MSc[CompSc])

This syllabus is applicable to students admitted to the curriculum in the academic year 2018-19.

Definition and Terminology

Stream of study – a specialisation in the curriculum selected by a candidate which can be General, Cyber Security, Financial Computing and Multimedia Computing.

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Subject group – a subset of courses in the list of discipline courses which have the same specialisation.

Stream specific course – any course in a subject group which corresponds to the specialisation of the stream of study.

Elective course – any Taught Postgraduate level course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc in Computer Science that are not classified as discipline courses.

Capstone Experience – a 12-credit project or a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

	Enrolment Mode of 10 courses + Project		Enrolment Mode of 8 courses + Dissertation	
	General Stream	Cyber Security / Financial Computing / Multimedia Computing Stream	General Stream	Cyber Security / Financial Computing / Multimedia Computing Stream
Course Category	No. of Credits		No. of Credits	
Discipline Courses	Not less than 48	Not less than 48 [Include at least 24 credits in Stream Specific Courses in the candidate's corresponding stream of study]	Not less than 36	Not less than 36 [Include at least 24 credits in Stream Specific Courses in the candidate's corresponding stream of study]
Elective Courses	Not more than 12		Not more than 12	
Capstone Experience	12		24	
Total	72		72	

Enrolment Mode

Candidates are required to successfully complete 72 credits to graduate. They can do that by studying in one of the following enrolment modes:

- (a) 10 courses (each equivalent to 6 credits) + Project (equivalent to 12 credits) OR
- (b) 8 courses (each equivalent to 6 credits) + Dissertation (equivalent to 24 credits)

Course Selection

Candidates shall select courses in accordance with the regulations of the degree. For General Stream, candidate can choose any discipline courses listed below in any subject group, and undertake a dissertation or a project (COMP7704 or COMP7705) in any area in computer science. In addition, to qualify as a graduate of Cyber Security, Financial Computing or Multimedia Computing Stream, candidates must pass at least 4 stream specific courses (at least 24 credits in total) in the corresponding subject group, and undertake a dissertation or a project (COMP7704 or COMP7705) in the area of the corresponding stream.

A. Cyber Security

COMP7806	Topic in information security
COMP7901	Legal protection of digital property
COMP7903	Digital investigation and forensics
COMP7904	Information security: attacks and defense
COMP7905	Reverse engineering and malware analysis
COMP7906	Introduction to cyber security

B. Financial Computing

COMP7103	Data mining
COMP7405	Techniques in computational finance
COMP7406	Software development for quantitative finance
COMP7407	Securities transaction banking
COMP7408	Distributed ledger and blockchain technology
COMP7802	Introduction to financial computing
COMP7808	Topic in financial computing
COMP7906	Introduction to cyber security

C. Multimedia Computing

COMP7502	Image processing and computer vision
COMP7503	Multimedia technologies
COMP7504	Pattern recognition and applications
COMP7505	User interface design and development
COMP7506	Smart phone apps development
COMP7507	Visualization and visual analytics
COMP7604	Game design and development
COMP7605	Advanced multimedia data analysis and applications
COMP7807	Topic in multimedia computing

D. Other discipline courses

COMP7104	Advanced database systems
COMP7105	Advanced topics in data science
COMP7201	Analysis and design of enterprise applications in UML
COMP7203	Modern software design
COMP7205	Enterprise architecture
COMP7303	High-performance computing
COMP7304	The wireless Internet and mobile network

COMP7305	Cluster and cloud computing
COMP7306	Web technologies
COMP7307	Advanced real-time embedded systems and applications
COMP7308	Introduction to unmanned systems
COMP7309	Quantum computing and artificial intelligence
COMP7403	Computational molecular biology
COMP7404	Computational intelligence and machine learning
COMP7606	Deep learning
COMP7801	Topic in computer science
COMP7805	Topic in computer network and systems
COMP7809	Topic in artificial intelligence

Candidate may select no more than 2 courses (at most 12 credits in total) offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Programme Director and Course coordinators concerned.

MSc(CompSc) Course descriptions

The following is a list of discipline courses offered by the Department of Computer Science for the MSc(CompSc) curriculum. The list below is not final and some courses may not be offered every year.

All courses are assessed through examination and / or coursework assessment, the weightings of which are subject to approval by the Board of Examiners.

COMP7103 Data mining (6 credits)

Data mining is the automatic discovery of statistically interesting and potentially useful patterns from large amounts of data. The goal of the course is to study the main methods used today for data mining and on-line analytical processing. Topics include Data Mining Architecture; Data Preprocessing; Mining Association Rules; Classification; Clustering; On-Line Analytical Processing (OLAP); Data Mining Systems and Languages; Advanced Data Mining (Web, Spatial, and Temporal data).

COMP7104 Advanced database systems (6 credits)

The course will study some advanced topics and techniques in database systems, with a focus on the aspects of big data analytics, algorithms, and system design & organisation. It will also survey the recent development and progress in selected areas. Topics include: query optimization, spatial-spatiotemporal data management, multimedia and time-series data management, information retrieval and XML, data mining.

COMP7105 Advanced topics in data science (6 credits)

This course will introduce selected advanced computational methods and apply them to problems in data analysis and relevant applications.

COMP7201 Analysis and design of enterprise applications in UML (6 credits)

This course presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include: overview of software engineering and object-

oriented concepts; unified process and Unified Modelling Language (UML); use-case modelling and object modelling; dynamic modelling using sequence diagrams and state machines; object-oriented design; user interface design; introducing design patterns and enterprise applications; shortcomings of UML and remedies. Emphasis will be given on hands-on exercises with the use of CASE tools.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7203 Modern software design (6 credits)

The practice of software design has changed markedly in recent years as new approaches to design have gained broad acceptance and several have progressed to become mainstream techniques themselves. This course introduces the principles and practical application of these modern approaches. It first reviews the goals of software design and the qualities that differentiate good designs from bad ones. From this foundation it teaches elemental design patterns, classic design patterns and anti-patterns, refactoring, refactoring to patterns, test-driven design and design for test. Implementation issues, programming idioms and effective use of the language are introduced and discussed where appropriate.

Prerequisites: A course in software engineering or analysis and design of software systems. The course also requires the ability to program in Java and a basic understanding of the UML class and sequence diagrams.

COMP7205 Enterprise architecture (6 credits)

This course aims to teach students the practical skills in modeling and developing enterprise IT architectures. It covers different enterprise architecture frameworks, methodologies and practices (such as TOGAF and Zachman). Students will also learn common enterprise integration patterns for implementation of complex enterprise applications based on Service-Oriented Architecture (SOA). New architecture trends (e.g., cloud computing, shared-nothing architecture, column-based database) will also be introduced.

COMP7303 High-performance computing (6 credits)

This course offers an overview of state-of-the-art parallel architectures and programming languages. The students will learn the issues related to the performance of parallel algorithms, and how to design efficient parallel algorithms for parallel machines. Topics include milestones in the history of HPC and its applications; high-performance computing architectures; performance law; modern CPU design; interconnection network and routing techniques; memory hierarchy and cache coherence protocol; parallel algorithm design; parallel programming models and case studies of supercomputers.

COMP7304 The wireless Internet and mobile network (6 credits)

In the recent few years, many new kinds of wireless network such as mobile ad-hoc network and wireless sensor network are under intensive research by researchers worldwide. These networks enhance the quality of human life as they not only facilitate efficient communications among people, they also let people learn more about their surrounding environments. However, have you ever thought of the potential problems induced by these new kinds of networks?

This course aims at introducing to you various kinds of next generation wireless and mobile networks. We will highlight the scenarios, the characteristics and the technologies behind each kind of network.

Then based on their design, we will discuss the potential issues that can appear or even be caused by them. Next we will demonstrate how these issues can be resolved by computer science methodologies.

COMP7305 Cluster and cloud computing (6 credits)

This course offers an overview of current cloud technologies, and discusses various issues in the design and implementation of cloud systems. Topics include cloud delivery models (SaaS, PaaS, and IaaS) with motivating examples from Google, Amazon, and Microsoft; virtualization techniques implemented in Xen, KVM, VMWare, and Docker; distributed file systems, such as Hadoop file system; MapReduce and Spark programming models for large-scale data analysis, networking techniques in hyper-scale data centers. The students will learn the use of Amazon EC2 to deploy applications on cloud, and implement a novel cloud computing application on a Xen-enabled PC cluster as part of their term project.

Prerequisites: The students are expected to install various open-source cloud software in their Linux cluster, and exercise the system configuration and administration. Basic understanding of Linux operating system and some programming experiences (C/C++, Java, or Python) in a Linux environment are required.

COMP7306 Web technologies (6 credits)

This course aims to give students a basic understanding of various Web technologies and their industry applications. Fundamental XML concepts and techniques, such as XML Schema, XSLT, SAX, and DOM, will be introduced. New technologies related to Web 2.0, web services, service oriented architecture (SOA), and cloud computing will be studied, including RSS, ATOM, Ajax, SOAP, WSDL, ebXML.

Prerequisites: basic web programming knowledge, e.g. HTML, JavaScript, and Java.

COMP7307 Advanced real-time embedded systems and applications (6 credits)

This course's objective is to introduce advanced real-time scheduling techniques, design and implementation considerations for Embedded Systems. It covers topics on real-time scheduling algorithms, microcontroller architecture, Digital Signal Processors (DSP) architecture, System-on-Chips (SoC), real-time operating systems, and case studies on real-time applications.

Prerequisites: Students should have basic knowledge about operating systems.

COMP7308 Introduction to unmanned systems (6 credits)

To study the theory and algorithms in unmanned systems. Topics include vehicle modelling, vehicle control, state estimation, perception and mapping, motion planning, and deep learning related techniques.

COMP7309 Quantum computing and artificial intelligence (6 credits)

This course offers an introduction to the interdisciplinary fields of quantum computation and quantum AI. The focus will lie on an accessible introduction to the elementary concepts of quantum mechanics, followed by a comparison between computer science and information science in the quantum domain.

The theoretical capability of quantum computers will be illustrated by analyzing fundamental algorithms of quantum computation and its potential applications in AI. Finally, the ethics of quantum computation and the potential impact of quantum computers on society will be discussed.

COMP7403 Computational molecular biology (6 credits)

To introduce computational methods and data structures for analyzing biological data (e.g. DNA, RNA and protein sequences). Typical topics include basics of molecular biology; biological sequence analysis; indexing data structures; RNA secondary structure alignment/prediction and phylogeny.

COMP7404 Computational intelligence and machine learning (6 credits)

This course will teach a broad set of principles and tools that will provide the mathematical, algorithmic and philosophical framework for tackling problems using Artificial Intelligence (AI) and Machine Learning (ML). AI and ML are highly interdisciplinary fields with impact in different applications, such as, biology, robotics, language, economics, and computer science. AI is the science and engineering of making intelligent machines, especially intelligent computer programs, while ML refers to the changes in systems that perform tasks associated with AI. Ethical issues in advanced AI and how to prevent learning algorithms from acquiring morally undesirable biases will be covered.

Topics may include a subset of the following: problem solving by search, heuristic (informed) search, constraint satisfaction, games, knowledge-based agents, supervised learning, unsupervised learning; learning theory, reinforcement learning and adaptive control and ethical challenges of AI and ML.

Pre-requisites: Nil, but knowledge of data structures and algorithms, probability, linear algebra, and programming would be an advantage.

COMP7405 Techniques in computational finance (6 credits)

This course introduces the major computation problems in the field of financial derivatives and various computational methods/techniques for solving these problems. The lectures start with a short introduction on various financial derivative products, and then move to the derivation of the mathematical models employed in the valuation of these products, and finally come to the solving techniques for the models.

Pre-requisites: No prior finance knowledge is required. Students are assumed to have basic competence in calculus and probability (up to the level of knowing the concepts of random variables, normal distributions, etc.). Knowledge in at least one programming language is required for the assignments/final project.

COMP7406 Software development for quantitative finance (6 credits)

This course introduces the tools and technologies widely used in industry for building applications for Quantitative Finance. From analysis and design to development and implementation, this course covers: modeling financial data and designing financial application using UML, a de facto industry standard for object oriented design and development; applying design patterns in financial application; basic skills on translating financial mathematics into spreadsheets using Microsoft Excel and VBA; developing Excel C++ add-ins for financial computation.

Pre-requisites: This course assumes basic understanding of financial concepts covered in COMP7802. Experience in C++/C programming is required.

COMP7407 Securities transaction banking (6 credits)

The course introduces the business and technology scenarios in the field of Transaction Banking for financial markets. It balances the economic and financial considerations for products and markets with the organizational and technological requirements to successfully implement a banking function in this scenario and is a crossover between studies of economics, finance and information technology.

COMP7408 Distributed ledger and blockchain technology (6 credits)

In this course, students will learn the key technical elements behind the blockchain (or in general, the distributed ledger) technology and some advanced features, such as smart contracts, of the technology. Variations, such as permissioned versus permissionless and private blockchains, and the available blockchain platforms will be discussed.

Students will also learn the following issues: the security, efficiency, and the scalability of the technology. Cyber-currency (e.g. Bitcoin) and other typical application examples in areas such as finance will also be introduced.

Prerequisites: COMP7906 Introduction to cyber security or ICOM6045 Fundamentals of e-commerce security

COMP7502 Image processing and computer vision (6 credits)

To study the theory and algorithms in image processing and computer vision. Topics include image representation; image enhancement; image restoration; mathematical morphology; image compression; scene understanding and motion analysis.

COMP7503 Multimedia technologies (6 credits)

This course presents fundamental concepts and emerging technologies for multimedia computing. Students are expected to learn how to develop various kinds of media communication, presentation, and manipulation techniques. At the end of course, students should acquire proper skill set to utilize, integrate and synchronize different information and data from media sources for building specific multimedia applications. Topics include media data acquisition methods and techniques; nature of perceptually encoded information; processing and manipulation of media data; multimedia content organization and analysis; trending technologies for future multimedia computing.

COMP7504 Pattern recognition and applications (6 credits)

To study techniques in pattern recognition. Topics include statistical decision theory; density estimation; dimension reduction; discriminant functions; unsupervised classification and clustering; neural network; hidden Markov model; and selected applications in pattern recognition such as characters and speech recognition.

COMP7505 User interface design and development (6 credits)

For technology products and services, the user experience is a major key to success. With advanced development of processors, sensors, and new algorithms and software tools, more powerful and expressive user interfaces can be implemented to improve human computer interaction and operation. The course will study matching input and output devices with user capabilities, software and hardware

considerations, interface design methodologies, and future interface technologies. All of these topics will be supported and demonstrated with current research and actual case studies.

COMP7506 Smart phone apps development (6 credits)

Smart phones have become very popular in recent years. According to a study, by 2020, 70% of the world's population is projected to own a smart phone, an estimated total of almost 6.1 billion smartphone users in the world. Smart phones play an important role in mobile communication and applications.

Smart phones are powerful as they support a wide range of applications (called apps). Most of the time, smart phone users just purchase their favorite apps wirelessly from the vendors. There is a great potential for software developer to reach worldwide users.

This course aims at introducing the design issues of smart phone apps. For examples, the smart phone screen is usually much smaller than the computer monitor. We have to pay special attention to this aspect in order to develop attractive and successful apps. Various modern smart phone apps development environments and programming techniques (such as Java for Android phones and Swift for iPhones) will also be introduced to facilitate students to develop their own apps.

Students should have basic programming knowledge.

COMP7507 Visualization and visual analytics (6 credits)

This course introduces the basic principles and techniques in visualization and visual analytics, and their applications. Topics include human visual perception; color; visualization techniques for spatial, geospatial and multivariate data, graphs and networks; text and document visualization; scientific visualization; interaction and visual analysis.

COMP7604 Game design and development (6 credits)

The course studies the basic concepts and techniques for digital game design and development. Topics include: game history and genres, game design process, game production, 2D/3D graphics, physics, audio/visual design, artificial intelligence.

Prerequisites: Basic programming skill, e.g. C++ or Java, is required

COMP7605 Advanced multimedia data analysis and applications (6 credits)

This course's objective is to introduce advanced multimedia data analysis techniques, and the design and implementation of signal processing algorithms. It covers topics on Digital Filter Realization, Recursive and Non-Recursive filters, Frequency Domain Processing, Two-Dimensional Signal Processing, and application of multimedia signal processing to speech production and analysis, image and video processing.

COMP7606 Deep learning (6 credits)

Machine learning is a fast growing field in computer science and deep learning is the cutting edge technology that enables machines to learn from large-scale and complex datasets. Ethical implications of deep learning and its applications will be covered first and the course will focus on how deep neural networks are applied to solve a wide range of problems in areas such as natural language processing,

image processing, financial predictions, game playing and robotics. Topics covered include linear and logistic regression, artificial neural networks and how to train them, recurrent neural networks, convolutional neural networks, deep reinforcement learning, and unsupervised feature learning. Popular deep learning software, such as TensorFlow, will also be introduced.

COMP7801 Topic in computer science (6 credits)

Selected topics that are of current interest will be discussed.

COMP7802 Introduction to financial computing (6 credits)

This course introduces the students to different aspects of financial computing in the investment banking area. The topics include yield curve construction in practice, financial modelling and modern risk management practice, etc. Financial engineering is an area of growing demand. The course is a combination of financial product knowledge, financial mathematics and computational techniques. This course will be suitable for students who want to pursue a career in this fast growing area.

Prerequisites: This course does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in Excel spreadsheet operations is required to complete the assignments and final project.

COMP7805 Topic in computer network and systems (6 credits)

Selected topics in computer network and systems that are of current interest will be discussed.

COMP7806 Topic in information security (6 credits)

Selected topics in information security that are of current interest will be discussed.

COMP7807 Topic in multimedia computing (6 credits)

Selected topics in multimedia computing that are of current interest will be discussed.

COMP7808 Topic in financial computing (6 credits)

Selected topics in financial computing that are of current interest will be discussed.

COMP7809 Topic in artificial intelligence (6 credits)

Selected topics in artificial intelligence that are of current interest will be discussed.

COMP7901 Legal protection of digital property (6 credits)

This course introduces computer professionals to the various legal means of protecting digital property including computer software, algorithms, and any work or innovation in digital form. Focus is on the main issues in protecting digital property arising from developments in information technology, and their legal solutions. Topics covered include, but are not limited to, the following: 1) Copyright

protection of software and websites, 2) Patent protection of software and algorithms, 3) Criminal sanctions against offences involving the digital technology.

Mutually exclusive with: ECOM6004 Legal aspects of IT and e-commerce

COMP7903 Digital investigation and forensics (6 credits)

This course introduces the fundamental principles of digital investigation and forensics. The course starts with a brief introduction to common computer crimes and digital evidence, and then moves on to the computer basics and network basics pertaining to digital forensics, and finally comes to the techniques for digital investigation and forensic examination.

COMP7904 Information security: attacks and defense (6 credits)

This is an ethical hacking course. In this course, we will teach students how to conduct ethical hacking so as to better protect a computer system in a company. Topics include physical security, password cracking, network hacking, operating system hacking, and application hacking. The course will also discuss R&D problems related to hacking and defence. The course will try to strike a balance between theory and practice so that students can understand the theories behind the hacking process as well as get enough hands-on exercises to perform ethical hacking and defense.

Prerequisites: Students are expected to have knowledge in university level mathematics and systems plus experience in programming.

COMP7905 Reverse engineering and malware analysis (6 credits)

This course provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases and hand-on analysis of malware samples. It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks. Various malware incidents will be covered, such as cases in Ransomware, banking-trojan, state-sponsored and APT attacks, cases in Stuxnet and malicious software attacks on Industrial Control System and IoT devices. With the experience of studying these cases and analyzing selected samples, the students will be able to understand the global cyber security landscape and its future impact. Hands-on exercises and in-depth discussion will be provided to enable students to acquire the required knowledge and skill set for defending and protecting an enterprise network environment.

Students should have programming/development skills (Assembly, C, C++, Python) and knowledge in Operating System and computer network.

COMP7906 Introduction to cyber security (6 credits)

The aim of the course is to introduce different methods of protecting information and data in the cyber world, including the privacy issue. Topics include introduction to security; cyber attacks and threats; cryptographic algorithms and applications; network security and infrastructure.

Mutually exclusive with: ICOM6045 Fundamentals of e-commerce security

COMP7704 Dissertation (24 credits)

Candidate will be required to carry out independent work on a major project that will culminate in the writing of a dissertation.

COMP7705 Project (12 credits)

Candidate will be required to carry out independent work on a major project under the supervision of individual staff member. A written report is required.

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER SCIENCE (MSc[CompSc])

This syllabus is applicable to students admitted to the curriculum in the academic year 2016-17 and 2017-18.

Definition and Terminology

Stream of study – a specialisation in the curriculum selected by a candidate which can be General, Financial Computing, Information Security and Multimedia Computing.

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Subject group – a subset of courses in the list of discipline courses which have the same specialisation.

Stream specific course – any course in a subject group which corresponds to the specialisation of the stream of study.

Elective course – any Taught Postgraduate level course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc in Computer Science that are not classified as discipline courses.

Capstone Experience – a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

	General Stream	Financial Computing / Information Security / Multimedia Computing Stream
Course Category	No. of Credits	No. of Credits
Discipline Courses	Not less than 36	Not less than 36 [Include at least 24 credits in Stream Specific Courses in the candidate's corresponding stream of study]
Elective Courses	Not more than 12	Not more than 12
Capstone Experience	24	24
Total	72	72

Course Selection

Candidates shall select courses in accordance with the regulations of the degree. For General Stream, candidate can choose any discipline courses listed below in any subject group, and undertake a dissertation (COMP7704) in any area in computer science. In addition, to qualify as a graduate of Financial Computing, Information Security or Multimedia Computing Stream, candidates must pass at least 4 stream specific courses (at least 24 credits in total) in the corresponding subject group, and undertake a dissertation (COMP7704) in the area of the corresponding stream.

A. Financial Computing

COMP7103	Data mining
COMP7405	Techniques in computational finance
COMP7406	Software development for quantitative finance
COMP7407	Securities transaction banking
COMP7408	Distributed ledger and blockchain technology
COMP7802	Introduction to financial computing
COMP7808	Topic in financial computing
COMP7906	Introduction to cyber security

B. Information Security

COMP7301	Computer and network security
COMP7804	E-commerce security cases and technologies
COMP7806	Topic in information security
COMP7901	Legal protection of digital property
COMP7903	Digital investigation and forensics
COMP7904	Information security: attacks and defense
COMP7905	Reverse engineering and malware analysis
COMP7906	Introduction to cyber security

C. Multimedia Computing

COMP7502	Image processing and computer vision
COMP7503	Multimedia technologies
COMP7504	Pattern recognition and applications
COMP7505	User interface design and development
COMP7506	Smart phone app development
COMP7507	Visualization and visual analytics
COMP7604	Game design and development
COMP7605	Advanced multimedia data analysis and applications
COMP7807	Topic in multimedia computing

D. Other discipline courses

COMP7104	Advanced database systems
COMP7201	Analysis and design of enterprise applications in UML
COMP7203	Modern software design
COMP7205	Enterprise architecture
COMP7303	High-performance computing
COMP7304	The wireless Internet and mobile network
COMP7305	Cluster and cloud computing
COMP7306	Web technologies
COMP7307	Advanced real-time embedded systems and applications
COMP7308	Introduction to unmanned systems
COMP7309	Quantum computing and artificial intelligence
COMP7403	Computational molecular biology
COMP7404	Computational intelligence and machine learning
COMP7506	Smart phone apps development
COMP7604	Game design and development
COMP7606	Deep learning
COMP7801	Topic in computer science
COMP7805	Topic in computer network and systems
COMP7809	Topic in artificial intelligence

Candidate may select no more than 2 courses offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Programme Director and Course coordinators concerned.

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COMP7103 Data mining (6 credits)

Data mining is the automatic discovery of statistically interesting and potentially useful patterns from large amounts of data. The goal of the course is to study the main methods used today for data mining and on-line analytical processing. Topics include Data Mining Architecture; Data Preprocessing; Mining Association Rules; Classification; Clustering; On-Line Analytical Processing (OLAP); Data Mining Systems and Languages; Advanced Data Mining (Web, Spatial, and Temporal data).

COMP7104 Advanced database systems (6 credits)

The course will study some advanced topics and techniques in database systems, with a focus on the aspects of big data analytics, algorithms, and system design & organisation. It will also survey the recent development and progress in selected areas. Topics include: query optimization, spatial-spatiotemporal data management, multimedia and time-series data management, information retrieval and XML, data mining.

COMP7105 Advanced topics in data science (6 credits)

This course will introduce selected advanced computational methods and apply them to problems in data analysis and relevant applications.

COMP7201 Analysis and design of enterprise applications in UML (6 credits)

This course presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include: overview of software engineering and object-oriented concepts; unified process and Unified Modelling Language (UML); use-case modelling and object modelling; dynamic modelling using sequence diagrams and state machines; object-oriented design; user interface design; introducing design patterns and enterprise applications; shortcomings of UML and remedies. Emphasis will be given on hands-on exercises with the use of CASE tools.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7203 Modern software design (6 credits)

The practice of software design has changed markedly in recent years as new approaches to design have gained broad acceptance and several have progressed to become mainstream techniques themselves. This course introduces the principles and practical application of these modern approaches. It first reviews the goals of software design and the qualities that differentiate good designs from bad ones. From this foundation it teaches elemental design patterns, classic design patterns and anti-patterns, refactoring, refactoring to patterns, test-driven design and design for test. Implementation issues, programming idioms and effective use of the language are introduced and discussed where appropriate.

Prerequisites: A course in software engineering or analysis and design of software systems. The course also requires the ability to program in Java and a basic understanding of the UML class and sequence diagrams.

COMP7205 Enterprise architecture (6 credits)

This course aims to teach students the practical skills in modeling and developing enterprise IT architectures. It covers different enterprise architecture frameworks, methodologies and practices (such as TOGAF and Zachman). Students will also learn common enterprise integration patterns for implementation of complex enterprise applications based on Service-Oriented Architecture (SOA). New architecture trends (e.g., cloud computing, shared-nothing architecture, column-based database) will also be introduced.

COMP7301 Computer and network security (6 credits)

The aim of the course is to introduce different methods of protecting information and data in computer and information systems from unauthorized disclosure and modification. Topics include introduction to security; cryptographic algorithms; cryptographic infrastructure; internet security; secure applications and electronic commerce.

Mutually exclusive with: COMP7906 Introduction to cyber security and ICOM6045 Fundamentals of e-commerce security

COMP7303 High-performance computing (6 credits)

This course offers an overview of state-of-the-art parallel architectures and programming languages. The students will learn the issues related to the performance of parallel algorithms, and how to design efficient parallel algorithms for parallel machines. Topics include milestones in the history of HPC and its applications; high-performance computing architectures; performance law; modern CPU design; interconnection network and routing techniques; memory hierarchy and cache coherence protocol; parallel algorithm design; parallel programming models and case studies of supercomputers.

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with motivating examples from Google, Amazon, and Microsoft; virtualization techniques implemented in Xen, KVM, VMWare, and Docker; distributed file systems, such as Hadoop file system; MapReduce and Spark programming models for large-scale data analysis, networking techniques in hyper-scale data centers. The students will learn the use of Amazon EC2 to deploy applications on cloud, and implement a novel cloud computing application on a Xen-enabled PC cluster as part of their term project.

Prerequisites: The students are expected to install various open-source cloud software in their Linux cluster, and exercise the system configuration and administration. Basic understanding of Linux operating system and some programming experiences (C/C++, Java, or Python) in a Linux environment are required.

COMP7306 Web technologies (6 credits)

This course aims to give students a basic understanding of various Web technologies and their industry applications. Fundamental XML concepts and techniques, such as XML Schema, XSLT, SAX, and DOM, will be introduced. New technologies related to Web 2.0, web services, service oriented architecture (SOA), and cloud computing will be studied, including RSS, ATOM, Ajax, SOAP, WSDL, ebXML.

Prerequisites: basic web programming knowledge, e.g. HTML, JavaScript, and Java.

COMP7307 Advanced real-time embedded systems and applications (6 credits)

This course's objective is to introduce advanced real-time scheduling techniques, design and implementation considerations for Embedded Systems. It covers topics on real-time scheduling algorithms, microcontroller architecture, Digital Signal Processors (DSP) architecture, System-on-Chips (SoC), real-time operating systems, and case studies on real-time applications.

Prerequisites: Students should have basic knowledge about operating systems.

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Topics may include a subset of the following: problem solving by search, heuristic (informed) search, constraint satisfaction, games, knowledge-based agents, supervised learning, unsupervised learning; learning theory, reinforcement learning and adaptive control and ethical challenges of AI and ML.

Pre-requisites: Nil, but knowledge of data structures and algorithms, probability, linear algebra, and programming would be an advantage.

COMP7405 Techniques in computational finance (6 credits)

This course introduces the major computation problems in the field of financial derivatives and various computational methods/techniques for solving these problems. The lectures start with a short introduction on various financial derivative products, and then move to the derivation of the mathematical models employed in the valuation of these products, and finally come to the solving techniques for the models.

Pre-requisites: No prior finance knowledge is required. Students are assumed to have basic competence in calculus and probability (up to the level of knowing the concepts of random variables, normal distributions, etc.). Knowledge in at least one programming language is required for the assignments/final project.

COMP7406 Software development for quantitative finance (6 credits)

This course introduces the tools and technologies widely used in industry for building applications for Quantitative Finance. From analysis and design to development and implementation, this course covers: modeling financial data and designing financial application using UML, a de facto industry standard for object oriented design and development; applying design patterns in financial application; basic skills on translating financial mathematics into spreadsheets using Microsoft Excel and VBA; developing Excel C++ add-ins for financial computation.

Pre-requisites: This course assumes basic understanding of financial concepts covered in COMP7802. Experience in C++/C programming is required.

COMP7407 Securities transaction banking (6 credits)

The course introduces the business and technology scenarios in the field of Transaction Banking for financial markets. It balances the economic and financial considerations for products and markets with the organizational and technological requirements to successfully implement a banking function in this scenario and is a crossover between studies of economics, finance and information technology.

COMP7408 Distributed ledger and blockchain technology (6 credits)

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Students will also learn the following issues: the security, efficiency, and the scalability of the technology. Cyber-currency (e.g. Bitcoin) and other typical application examples in areas such as finance will also be introduced.

Prerequisites: COMP7301 Computer and network security or COMP7906 Introduction to cyber security or ICOM6045 Fundamentals of e-commerce security

COMP7502 Image processing and computer vision (6 credits)

To study the theory and algorithms in image processing and computer vision. Topics include image representation; image enhancement; image restoration; mathematical morphology; image compression; scene understanding and motion analysis.

COMP7503 Multimedia technologies (6 credits)

This course presents fundamental concepts and emerging technologies for multimedia computing. Students are expected to learn how to develop various kinds of media communication, presentation, and manipulation techniques. At the end of course, students should acquire proper skill set to utilize, integrate and synchronize different information and data from media sources for building specific multimedia applications. Topics include media data acquisition methods and techniques; nature of perceptually encoded information; processing and manipulation of media data; multimedia content organization and analysis; trending technologies for future multimedia computing.

COMP7504 Pattern recognition and applications (6 credits)

To study techniques in pattern recognition. Topics include statistical decision theory; density estimation; dimension reduction; discriminant functions; unsupervised classification and clustering; neural network; hidden Markov model; and selected applications in pattern recognition such as characters and speech recognition.

COMP7505 User interface design and development (6 credits)

For technology products and services, the user experience is a major key to success. With advanced development of processors, sensors, and new algorithms and software tools, more powerful and expressive user interfaces can be implemented to improve human computer interaction and operation. The course will study matching input and output devices with user capabilities, software and hardware

considerations, interface design methodologies, and future interface technologies. All of these topics will be supported and demonstrated with current research and actual case studies.

COMP7506 Smart phone apps development (6 credits)

Smart phones have become very popular in recent years. According to a study, by 2020, 70% of the

world's population is projected to own a smart phone, an estimated total of almost 6.1 billion smartphone users in the world. Smart phones play an important role in mobile communication and applications.

Smart phones are powerful as they support a wide range of applications (called apps). Most of the time, smart phone users just purchase their favorite apps wirelessly from the vendors. There is a great potential for software developer to reach worldwide users.

This course aims at introducing the design issues of smart phone apps. For examples, the smart phone screen is usually much smaller than the computer monitor. We have to pay special attention to this aspect in order to develop attractive and successful apps. Various modern smart phone apps development environments and programming techniques (such as Java for Android phones and Swift for iPhones) will also be introduced to facilitate students to develop their own apps.

Students should have basic programming knowledge.

COMP7507 Visualization and visual analytics (6 credits)

This course introduces the basic principles and techniques in visualization and visual analytics, and their applications. Topics include human visual perception; color; visualization techniques for spatial, geospatial and multivariate data, graphs and networks; text and document visualization; scientific visualization; interaction and visual analysis.

COMP7604 Game design and development (6 credits)

The course studies the basic concepts and techniques for digital game design and development. Topics include: game history and genres, game design process, game production, 2D/3D graphics, physics, audio/visual design, artificial intelligence.

Prerequisites: Basic programming skill, e.g. C++ or Java, is required

COMP7605 Advanced multimedia data analysis and applications (6 credits)

This course's objective is to introduce advanced multimedia data analysis techniques, and the design and implementation of signal processing algorithms. It covers topics on Digital Filter Realization, Recursive and Non-Recursive filters, Frequency Domain Processing, Two Dimensional Signal Processing, and application of multimedia signal processing to speech production and analysis, image and video processing.

COMP7606 Deep learning (6 credits)

Machine learning is a fast growing field in computer science and deep learning is the cutting edge technology that enables machines to learn from large-scale and complex datasets. Ethical implications of deep learning and it's applications will be covered first and the course will focus on how deep neural networks are applied to solve a wide range of problems in areas such as natural language processing,

image processing, financial predictions, game playing and robotics. Topics covered include linear and logistic regression, artificial neural networks and how to train them, recurrent neural networks, convolutional neural networks, deep reinforcement learning, and unsupervised feature learning. Popular deep learning software, such as TensorFlow, will also be introduced.

COMP7801 Topic in computer science (6 credits)

Selected topics that are of current interest will be discussed.

COMP7802 Introduction to financial computing (6 credits)

This course introduces the students to different aspects of financial computing in the investment banking area. The topics include yield curve construction in practice, financial modelling and modern risk management practice, etc. Financial engineering is an area of growing demand. The course is a combination of financial product knowledge, financial mathematics and computational techniques. This course will be suitable for students who want to pursue a career in this fast growing area.

Prerequisites: This course does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in Excel spreadsheet operations is required to complete the assignments and final project.

COMP7804 E-commerce security cases and technologies (6 credits)

This course provides students knowledge about modern e-commerce security, through the study of various cases. It covers fundamental concepts in security technology so as to equip the students with enough background knowledge in security, and then covers the impact of the modern e-commerce environment to the changing demand of security. After that a bundle of cases will be covered, such as cases in communication security, cases in Internet security, cases in data security including personal data protection in both client-side and server-side, and application security cases. With the experience of studying these cases, the students will be asked to assess or design security solutions to some given e-commerce security problems, so as to acquire the ability to apply the learnt security technology to real-life cases.

Mutually exclusive with: COMP7905 Reverse engineering and malware analysis

COMP7805 Topic in computer network and systems (6 credits)

Selected topics in computer network and systems that are of current interest will be discussed.

COMP7806 Topic in information security (6 credits)

Selected topics in information security that are of current interest will be discussed.

COMP7807 Topic in multimedia computing (6 credits)

Selected topics in multimedia computing that are of current interest will be discussed.

COMP7808 Topic in financial computing (6 credits)

Selected topics in financial computing that are of current interest will be discussed.

COMP7809 Topic in artificial intelligence (6 credits)

Selected topics in artificial intelligence that are of current interest will be discussed.

COMP7901 Legal protection of digital property (6 credits)

This course introduces computer professionals to the various legal means of protecting digital property including computer software, algorithms, and any work or innovation in digital form. Focus is on the main issues in protecting digital property arising from developments in information technology, and their legal solutions. Topics covered include, but are not limited to, the following: 1) Copyright protection of software and websites, 2) Patent protection of software and algorithms, 3) Criminal sanctions against offences involving the digital technology.

Mutually exclusive with: ECOM6004 Legal aspects of IT and e-commerce

COMP7903 Digital investigation and forensics (6 credits)

This course introduces the fundamental principles of digital investigation and forensics. The course starts with a brief introduction to common computer crimes and digital evidence, and then moves on to the computer basics and network basics pertaining to digital forensics, and finally comes to the techniques for digital investigation and forensic examination.

COMP7904 Information security: attacks and defense (6 credits)

This is an ethical hacking course. In this course, we will teach students how to conduct ethical hacking so as to better protect a computer system in a company. Topics include physical security, password cracking, network hacking, operating system hacking, and application hacking. The course will also discuss R&D problems related to hacking and defence. The course will try to strike a balance between theory and practice so that students can understand the theories behind the hacking process as well as get enough hands-on exercises to perform ethical hacking and defense.

Prerequisites: Students are expected to have knowledge in university level mathematics and systems plus experience in programming.

COMP7905 Reverse engineering and malware analysis (6 credits)

This course provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases and hand-on analysis of malware samples. It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks. Various malware incidents will be covered, such as cases in Ransomware, banking-trojan, state-sponsored and APT attacks, cases in Stuxnet and malicious software attacks on Industrial Control System and IoT devices. With the experience of studying these cases and analyzing selected samples, the students will be able to understand the global cyber security landscape and its future impact. Hands-on exercises and in-depth discussion will be provided to enable students to acquire the required knowledge and skill set for defending and protecting an enterprise network environment.

Students should have programming/development skills (Assembly, C, C++, Python) and knowledge in Operating System and computer network.

Mutually exclusive with: COMP7804 E-commerce security cases and technologies

COMP7906 Introduction to cyber security (6 credits)

The aim of the course is to introduce different methods of protecting information and data in the cyber world, including the privacy issue. Topics include introduction to security; cyber attacks and threats; cryptographic algorithms and applications; network security and infrastructure.

Mutually exclusive with: COMP7301 Computer and network security and ICOM6045 Fundamentals of e-commerce security

COMP7704 Dissertation (24 credits)

Candidate will be required to carry out independent work on a major project that will culminate in the writing of a dissertation.

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER SCIENCE (MSc[CompSc])

Applicable to students admitted in the academic year 2015-2016.

The curriculum has four different streams: General Stream, Information Security, Multimedia Computing, and Financial Computing. Each candidate is required to follow a prescribed course of study comprising 12 modules, out of which the candidate has to pass at least 10 modules selected from the modules listed below. To qualify as a graduate of Information Security, Multimedia Computing, or Financial Computing Stream, the candidate must pass at least 4 modules in the corresponding subject group, and undertake a dissertation (COMP7704) in the area of the corresponding stream. For General Stream, the candidate can freely choose from the four subject groups below, and undertake a dissertation (COMP7704) in any area in computer science.

Students may select no more than 2 modules offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All module selection will be subject to approval by the Programme Director and Course coordinators concerned.

All modules are assessed through examination (0%-100%) and/or coursework assessment (0%-100%)

Subject Groups

A. Financial Computing

COMP7103 Data mining
COMP7405 Techniques in computational finance
COMP7406 Software development for quantitative finance
COMP7407 Securities transaction banking
COMP7408 Distributed ledger and blockchain technology
COMP7802 Introduction to financial computing
COMP7808 Topic in financial computing
COMP7906 Introduction to cyber security

B. Information Security

COMP7301 Computer and network security
COMP7804 E-commerce security cases and technologies
COMP7806 Topic in information security
COMP7901 Legal protection of digital property
COMP7903 Digital investigation and forensics
COMP7904 Information security: attacks and defense
COMP7905 Reverse engineering and malware analysis
COMP7906 Introduction to cyber security

C. Multimedia Computing

COMP7502 Image processing and computer vision
COMP7503 Multimedia technologies
COMP7504 Pattern recognition and applications
COMP7505 User interface design and development
COMP7506 Smart phone apps development
COMP7507 Visualization and visual analytics
COMP7604 Game design and development
COMP7605 Advanced multimedia data analysis and applications
COMP7807 Topic in multimedia computing

D. Other discipline modules

COMP7104	Advanced database systems
COMP7201	Analysis and design of enterprise applications in UML
COMP7203	Modern software design
COMP7205	Enterprise architecture
COMP7303	High-performance computing
COMP7304	The wireless Internet and mobile network
COMP7305	Cluster and cloud computing
COMP7306	Web technologies
COMP7307	Advanced real-time embedded systems and applications
COMP7308	Introduction to unmanned systems
COMP7309	Quantum computing and artificial intelligence
COMP7403	Computational molecular biology
COMP7404	Computational intelligence and machine learning
COMP7506	Smart phone apps development
COMP7604	Game design and development
COMP7606	Deep learning
COMP7801	Topic in computer science
COMP7805	Topic in computer network and systems
COMP7809	Topic in artificial intelligence

The following is a list of discipline modules offered by the Department of Computer Science. The list below is not final and some modules may not be offered every year.

COMP7103 Data mining

Data mining is the automatic discovery of statistically interesting and potentially useful patterns from large amounts of data. The goal of the module is to study the main methods used today for data mining and on-line analytical processing. Topics include Data Mining Architecture; Data Preprocessing; Mining Association Rules; Classification; Clustering; On-Line Analytical Processing (OLAP); Data Mining Systems and Languages; Advanced Data Mining (Web, Spatial, and Temporal data).

COMP7104 Advanced database systems

The module will study some advanced topics and techniques in database systems, with a focus on the aspects of big data analytics, algorithms, and system design & organisation. It will also survey the recent development and progress in selected areas. Topics include: query optimization, spatial-spatiotemporal data management, multimedia and time-series data management, information retrieval and XML, data mining.

COMP7105 Advanced topics in data science

This module will introduce selected advanced computational methods and apply them to problems in data analysis and relevant applications.

COMP7201 Analysis and design of enterprise applications in UML

This module presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include: overview of software engineering and object-

oriented concepts; unified process and Unified Modelling Language (UML); use-case modelling and object modelling; dynamic modelling using sequence diagrams and state machines; object-oriented design; user interface design; introducing design patterns and enterprise applications; shortcomings of UML and remedies. Emphasis will be given on hands-on exercises with the use of CASE tools.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7203 Modern software design

The practice of software design has changed markedly in recent years as new approaches to design have gained broad acceptance and several have progressed to become mainstream techniques themselves. This module introduces the principles and practical application of these modern approaches. It first reviews the goals of software design and the qualities that differentiate good designs from bad ones. From this foundation it teaches elemental design patterns, classic design patterns and anti-patterns, refactoring, refactoring to patterns, test-driven design and design for test. Implementation issues, programming idioms and effective use of the language are introduced and discussed where appropriate.

Prerequisites: A course in software engineering or analysis and design of software systems. The course also requires the ability to program in Java and a basic understanding of the UML class and sequence diagrams.

COMP7205 Enterprise architecture

This module aims to teach students the practical skills in modeling and developing enterprise IT architectures. It covers different enterprise architecture frameworks, methodologies and practices (such as TOGAF and Zachman). Students will also learn common enterprise integration patterns for implementation of complex enterprise applications based on Service-Oriented Architecture (SOA). New architecture trends (e.g., cloud computing, shared-nothing architecture, column-based database) will also be introduced.

COMP7301 Computer and network security

The aim of the module is to introduce different methods of protecting information and data in computer and information systems from unauthorized disclosure and modification. Topics include introduction to security; cryptographic algorithms; cryptographic infrastructure; internet security; secure applications and electronic commerce.

Mutually exclusive with: COMP7906 Introduction to cyber security and ICOM6045 Fundamentals of e-commerce security

COMP7303 High-performance computing

This module offers an overview of state-of-the-art parallel architectures and programming languages. The students will learn the issues related to the performance of parallel algorithms, and how to design efficient parallel algorithms for parallel machines. Topics include milestones in the history of HPC and its applications; high-performance computing architectures; performance law; modern CPU design;

interconnection network and routing techniques; memory hierarchy and cache coherence protocol; parallel algorithm design; parallel programming models and case studies of supercomputers.

COMP7304 The wireless Internet and mobile network

In the recent few years, many new kinds of wireless network such as mobile ad-hoc network and wireless sensor network are under intensive research by researchers worldwide. These networks enhance the quality of human life as they not only facilitate efficient communications among people, they also let people learn more about their surrounding environments. However, have you ever thought of the potential problems induced by these new kinds of networks?

This module aims at introducing to you various kinds of next generation wireless and mobile networks. We will highlight the scenarios, the characteristics and the technologies behind each kind of network. Then based on their design, we will discuss the potential issues that can appear or even be caused by them. Next we will demonstrate how these issues can be resolved by computer science methodologies.

COMP7305 Cluster and cloud computing

This module offers an overview of current cloud technologies, and discusses various issues in the design and implementation of cloud systems. Topics include cloud delivery models (SaaS, PaaS, and IaaS) with motivating examples from Google, Amazon, and Microsoft; virtualization techniques implemented in Xen, KVM, VMWare, and Docker; distributed file systems, such as Hadoop file system; MapReduce and Spark programming models for large-scale data analysis, networking techniques in hyper-scale data centers. The students will learn the use of Amazon EC2 to deploy applications on cloud, and implement a novel cloud computing application on a Xen-enabled PC cluster as part of their term project.

Prerequisites: The students are expected to install various open-source cloud software in their Linux cluster, and exercise the system configuration and administration. Basic understanding of Linux operating system and some programming experiences (C/C++, Java, or Python) in a Linux environment are required.

COMP7306 Web technologies

This module aims to give students a basic understanding of various Web technologies and their industry applications. Fundamental XML concepts and techniques, such as XML Schema, XSLT, SAX, and DOM, will be introduced. New technologies related to Web 2.0, web services, service oriented architecture (SOA), and cloud computing will be studied, including RSS, ATOM, Ajax, SOAP, WSDL, ebXML.

Prerequisites: basic web programming knowledge, e.g. HTML, JavaScript, and Java.

COMP7307 Advanced real-time embedded systems and applications

This module's objective is to introduce advanced real-time scheduling techniques, design and implementation considerations for Embedded Systems. It covers topics on real-time scheduling algorithms, microcontroller architecture, Digital Signal Processors (DSP) architecture, System-on-Chips (SoC), real-time operating systems, and case studies on real-time applications.

Prerequisites: Students should have basic knowledge about operating systems.

COMP7308 Introduction to unmanned systems

To study the theory and algorithms in unmanned systems. Topics include vehicle modelling, vehicle control, state estimation, perception and mapping, motion planning, and deep learning related techniques.

COMP7309 Quantum computing and artificial intelligence

This module offers an introduction to the interdisciplinary fields of quantum computation and quantum AI. The focus will lie on an accessible introduction to the elementary concepts of quantum mechanics, followed by a comparison between computer science and information science in the quantum domain. The theoretical capability of quantum computers will be illustrated by analyzing fundamental algorithms of quantum computation and its potential applications in AI. Finally, the ethics of quantum computation and the potential impact of quantum computers on society will be discussed.

COMP7403 Computational molecular biology

To introduce computational methods and data structures for analyzing biological data (e.g. DNA, RNA and protein sequences). Typical topics include basics of molecular biology; biological sequence analysis; indexing data structures; RNA secondary structure alignment/prediction and phylogeny.

COMP7404 Computational intelligence and machine learning

This module will teach a broad set of principles and tools that will provide the mathematical, algorithmic and philosophical framework for tackling problems using Artificial Intelligence (AI) and Machine Learning (ML). AI and ML are highly interdisciplinary fields with impact in different applications, such as, biology, robotics, language, economics, and computer science. AI is the science and engineering of making intelligent machines, especially intelligent computer programs, while ML refers to the changes in systems that perform tasks associated with AI. Ethical issues in advanced AI and how to prevent learning algorithms from acquiring morally undesirable biases will be covered.

Topics may include a subset of the following: problem solving by search, heuristic (informed) search, constraint satisfaction, games, knowledge-based agents, supervised learning, unsupervised learning; learning theory, reinforcement learning and adaptive control and ethical challenges of AI and ML.

Pre-requisites: Nil, but knowledge of data structures and algorithms, probability, linear algebra, and programming would be an advantage.

COMP7405 Techniques in computational finance

This module introduces the major computation problems in the field of financial derivatives and various computational methods/techniques for solving these problems. The lectures start with a short introduction on various financial derivative products, and then move to the derivation of the mathematical models employed in the valuation of these products, and finally come to the solving techniques for the models.

Pre-requisites: No prior finance knowledge is required. Students are assumed to have basic competence in calculus and probability (up to the level of knowing the concepts of random variables, normal distributions, etc.). Knowledge in at least one programming language is required for the assignments/final project.

COMP7406 Software development for quantitative finance

This module introduces the tools and technologies widely used in industry for building applications for Quantitative Finance. From analysis and design to development and implementation, this module covers: modeling financial data and designing financial application using UML, a de facto industry standard for object oriented design and development; applying design patterns in financial application; basic skills on translating financial mathematics into spreadsheets using Microsoft Excel and VBA; developing Excel C++ add-ins for financial computation.

Pre-requisites: This module assumes basic understanding of financial concepts covered in COMP7802. Experience in C++/C programming is required.

COMP7407 Securities transaction banking

The module introduces the business and technology scenarios in the field of Transaction Banking for financial markets. It balances the economic and financial considerations for products and markets with the organizational and technological requirements to successfully implement a banking function in this scenario and is a crossover between studies of economics, finance and information technology.

COMP7408 Distributed ledger and blockchain technology

In this module, students will learn the key technical elements behind the blockchain (or in general, the distributed ledger) technology and some advanced features, such as smart contracts, of the technology. Variations, such as permissioned versus permissionless and private blockchains, and the available blockchain platforms will be discussed.

Students will also learn the following issues: the security, efficiency, and the scalability of the technology. Cyber-currency (e.g. Bitcoin) and other typical application examples in areas such as finance will also be introduced.

Prerequisites: COMP7301 Computer and network security or COMP7906 Introduction to cyber security or ICOM6045 Fundamentals of e-commerce security

COMP7502 Image processing and computer vision

To study the theory and algorithms in image processing and computer vision. Topics include image representation; image enhancement; image restoration; mathematical morphology; image compression; scene understanding and motion analysis.

COMP7503 Multimedia technologies

This module presents fundamental concepts and emerging technologies for multimedia computing. Students are expected to learn how to develop various kinds of media communication, presentation, and manipulation techniques. At the end of course, students should acquire proper skill set to utilize, integrate and synchronize different information and data from media sources for building specific multimedia applications. Topics include media data acquisition methods and techniques; nature of perceptually encoded information; processing and manipulation of media data; multimedia content organization and analysis; trending technologies for future multimedia computing.

COMP7504 Pattern recognition and applications

To study techniques in pattern recognition. Topics include statistical decision theory; density estimation; dimension reduction; discriminant functions; unsupervised classification and clustering; neural network; hidden Markov model; and selected applications in pattern recognition such as characters and speech recognition.

COMP7505 User interface design and development

For technology products and services, the user experience is a major key to success. With advanced development of processors, sensors, and new algorithms and software tools, more powerful and expressive user interfaces can be implemented to improve human computer interaction and operation. The module will study matching input and output devices with user capabilities, software and hardware considerations, interface design methodologies, and future interface technologies. All of these topics will be supported and demonstrated with current research and actual case studies.

COMP7506 Smart phone apps development

Smart phones have become very popular in recent years. According to a study, by 2020, 70% of the world's population is projected to own a smart phone, an estimated total of almost 6.1 billion smartphone users in the world. Smart phones play an important role in mobile communication and applications.

Smart phones are powerful as they support a wide range of applications (called apps). Most of the time, smart phone users just purchase their favorite apps wirelessly from the vendors. There is a great potential for software developer to reach worldwide users.

This module aims at introducing the design issues of smart phone apps. For examples, the smart phone screen is usually much smaller than the computer monitor. We have to pay special attention to this aspect in order to develop attractive and successful apps. Various modern smart phone apps development environments and programming techniques (such as Java for Android phones and Swift for iPhones) will also be introduced to facilitate students to develop their own apps.

Students should have basic programming knowledge.

COMP7507 Visualization and visual analytics

This module introduces the basic principles and techniques in visualization and visual analytics, and their applications. Topics include human visual perception; color; visualization techniques for spatial, geospatial and multivariate data, graphs and networks; text and document visualization; scientific visualization; interaction and visual analysis.

COMP7604 Game design and development

The module studies the basic concepts and techniques for digital game design and development. Topics include: game history and genres, game design process, game production, 2D/3D graphics, physics, audio/visual design, artificial intelligence.

Prerequisites: Basic programming skill, e.g. C++ or Java, is required

COMP7605 Advanced multimedia data analysis and applications

This module's objective is to introduce advanced multimedia data analysis techniques, and the design and implementation of signal processing algorithms. It covers topics on Digital Filter Realization, Recursive and Non-Recursive filters, Frequency Domain Processing, Two-Dimensional Signal Processing, and application of multimedia signal processing to speech production and analysis, image and video processing.

COMP7606 Deep learning

Machine learning is a fast growing field in computer science and deep learning is the cutting edge technology that enables machines to learn from large-scale and complex datasets. Ethical implications of deep learning and its applications will be covered first and the module will focus on how deep neural networks are applied to solve a wide range of problems in areas such as natural language processing, image processing, financial predictions, game playing and robotics. Topics covered include linear and logistic regression, artificial neural networks and how to train them, recurrent neural networks, convolutional neural networks, deep reinforcement learning, and unsupervised feature learning. Popular deep learning software, such as TensorFlow, will also be introduced.

COMP7704 Dissertation (4 modules)

Candidate will be required to carry out independent work on a major project that will culminate in the writing of a dissertation.

COMP7801 Topic in computer science

Selected topics that are of current interest will be discussed.

COMP7802 Introduction to financial computing

This module introduces the students to different aspects of financial computing in the investment banking area. The topics include yield curve construction in practice, financial modelling and modern risk management practice, etc. Financial engineering is an area of growing demand. The module is a combination of financial product knowledge, financial mathematics and computational techniques. This module will be suitable for students who want to pursue a career in this fast growing area.

Prerequisites: This module does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in Excel spreadsheet operations is required to complete the assignments and final project.

COMP7804 E-commerce security cases and technologies

This module provides students knowledge about modern e-commerce security, through the study of various cases. It covers fundamental concepts in security technology so as to equip the students with enough background knowledge in security, and then covers the impact of the modern e-commerce environment to the changing demand of security. After that a bundle of cases will be covered, such as cases in communication security, cases in Internet security, cases in data security including personal data protection in both client-side and server-side, and application security cases. With the experience of studying these cases, the students will be asked to assess or design security solutions to some given

e-commerce security problems, so as to acquire the ability to apply the learnt security technology to real-life cases.

Mutually exclusive with: COMP7905 Reverse engineering and malware analysis

COMP7805 Topic in computer network and systems

Selected topics in computer network and systems that are of current interest will be discussed.

COMP7806 Topic in information security

Selected topics in information security that are of current interest will be discussed.

COMP7807 Topic in multimedia computing

Selected topics in multimedia computing that are of current interest will be discussed.

COMP7808 Topic in financial computing

Selected topics in financial computing that are of current interest will be discussed.

COMP7809 Topic in artificial intelligence

Selected topics in artificial intelligence that are of current interest will be discussed.

COMP7901 Legal protection of digital property

This module introduces computer professionals to the various legal means of protecting digital property including computer software, algorithms, and any work or innovation in digital form. Focus is on the main issues in protecting digital property arising from developments in information technology, and their legal solutions. Topics covered include, but are not limited to, the following: 1) Copyright protection of software and websites, 2) Patent protection of software and algorithms, 3) 4) Criminal sanctions against offences involving the digital technology.

Mutually exclusive with: ECOM6004 Legal aspects of IT and e-commerce

COMP7903 Digital investigation and forensics

This module introduces the fundamental principles of digital investigation and forensics. The module starts with a brief introduction to common computer crimes and digital evidence, and then moves on to the computer basics and network basics pertaining to digital forensics, and finally comes to the techniques for digital investigation and forensic examination.

COMP7904 Information security: attacks and defense

This is an ethical hacking module. In this module, we will teach students how to conduct ethical hacking so as to better protect a computer system in a company. Topics include physical security, password

cracking, network hacking, operating system hacking, and application hacking. The module will also discuss R&D problems related to hacking and defence. The module will try to strike a balance between theory and practice so that students can understand the theories behind the hacking process as well as get enough hands-on exercises to perform ethical hacking and defense.

Prerequisites: Students are expected to have knowledge in university level mathematics and systems plus experience in programming.

COMP7905 Reverse engineering and malware analysis

This module provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases and hand-on analysis of malware samples. It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks. Various malware incidents will be covered, such as cases in Ransomware, banking-trojan, state-sponsored and APT attacks, cases in Stuxnet and malicious software attacks on Industrial Control System and IoT devices. With the experience of studying these cases and analyzing selected samples, the students will be able to understand the global cyber security landscape and its future impact. Hands-on exercises and in-depth discussion will be provided to enable students to acquire the required knowledge and skill set for defending and protecting an enterprise network environment.

Students should have programming/development skills (Assembly, C, C++, Python) and knowledge in Operating System and computer network.

Mutually exclusive with: COMP7804 E-commerce security cases and technologies

COMP7906 Introduction to cyber security

The aim of the module is to introduce different methods of protecting information and data in the cyber world, including the privacy issue. Topics include introduction to security; cyber attacks and threats; cryptographic algorithms and applications; network security and infrastructure.

Mutually exclusive with: COMP7301 Computer and network security and ICOM6045 Fundamentals of e-commerce security
