**Programme title:** MSc Internet Engineering

**Final award (BSc, MA etc):** MSc

**UCAS code:** N/A

**Cohort(s) to which this programme specification is applicable:** From 2008/09 Entry

**Awarding institution/body:** University College London

**Teaching institution:** University College London

**Faculty:** Engineering Sciences

**Parent Department:** Electronic and Electrical Engineering

**Departmental web page address:** [www.ee.ucl.ac.uk/masters](http://www.ee.ucl.ac.uk/masters)

**Method of study:** Full Time

**Criteria for admission to the programme:** Minimum of 2:i UK degree or equivalent in Electronic Engineering or related subject. [https://www.ee.ucl.ac.uk/masters](https://www.ee.ucl.ac.uk/masters)

**Length of the programme:** One calendar year full-time

**Level on Framework for Higher Education Qualifications (FHEQ):** 7
Internet Engineering is concerned with developing, providing and maintaining infrastructure, products, processes and services for society. Internet Engineering addresses the complete life-cycle of a digital (packet switched) telecommunications system, process or service, from conception, through design and manufacture, to decommissioning and disposal, within the constraints imposed by economic, legal, social, cultural and environmental considerations. Internet Engineering relies on three core elements, namely scientific principles, mathematics and ‘realisation’. Scientific principles clearly underpin all engineering, while mathematics is the language used to communicate parameters, model and optimise solutions. Realisation encapsulates the whole range of creative abilities which distinguish the engineer from the scientist; to conceive, make and actually bring to fruition something which has never existed before. This creativity and innovation to develop economically viable and ethically sound sustainable solutions is an essential and distinguishing characteristic of engineering, shared by the many diverse, established and emerging disciplines within engineering.

The UK Standard for Professional Engineering Competence (2010) sets out five main areas of competence expected for Chartered Engineers, each covering a number of different aspects:

A Use of general and specialist engineering knowledge and understanding
B Application of appropriate theoretical and practical methods
C Technical and commercial leadership and management
D Effective interpersonal and communication skills
E Commitment to professional standards and recognition of obligations to society, the profession and the environment.
Brief outline of the structure of the programme and its assessment methods: (see guidance notes)

<table>
<thead>
<tr>
<th>Board of Examiners:</th>
<th>I) Name of Board of Examiners:</th>
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<tbody>
<tr>
<td></td>
<td>Communications Programmes Board</td>
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</table>

| Professional body accreditation (if applicable): | Institution of Engineering and Technology (IET) | Date of next scheduled accreditation visit: 2018 |

All modules are taught within one week of lectures (6 hours per day for 4 days). A week of self-study is allowed after the module teaching finishes and this is followed by a 3-4 hour discussion and tutorial session. Modules are assessed within two to four weeks of the tutorial session.

All students take 6 modules as the basis to their programme – in this case MSc Internet Engineering – which comprise 2 core modules and 4 compulsory modules, and then select 3 optional modules which could be from any of our programmes although some restrictions will apply – see “Programme Structure”, section 3, at the end of this document.

- **2 core modules**
  1) Introduction to Telecommunications Network (15 Credits EXAM 2 ½ hours)
  2) Professional Development Module (In-class assignment and presentations)

- **4 Compulsory Modules**
  - Mobile Communications Systems (15 Credits EXAM 2 ½ hours)
  - Software for Network and Services Design (15 Credits Assignment <5,000 words)
  - Next Generation Networks (15 Credits Assignment <5,000 words)
  - Introduction to IP Networks (15 Credits EXAM 2 ½ hours)

- **3 Options from the following (although these may be extended)**
  - Communications Systems Modelling (15 Credits EXAM 2 hours & Lab Assignment)
  - Network Planning and Operations (15 Credits Assignment <5,000 words)
  - Internet Multimedia Systems (15 Credits EXAM 2 ½ hours)
  - Telecommunications Business Environment (5 days teaching; 15 Credits Assignment <5,000 words)
  - Data Networks and Protocols (15 Credits EXAM 2 ½ hours)
  - Network and Services Management (15 Credits EXAM 2 ½ hours)

- **Project and dissertation:** 18-20 weeks of supervised study assessed by viva and written report Dissertation (60 Credits <12,000 words)
EDUCATIONAL AIMS OF THE PROGRAMME:

1. To provide students with advanced knowledge and understanding of Internet engineering systems, with special emphasis on Internet technologies, their analysis and design techniques and of details of new concepts and technologies relevant to the area.
2. To provide thorough coverage of research methods based on the underlying scientific and engineering principles of engineering related to Internet technologies.
3. To equip the students with the scientific and intellectual tools required to define and formulate research problems, and to detail the methodologies needed to address them.
4. To equip the students with the scientific and intellectual tools required to design and analyse key engineering processes related to Internet systems.
5. To enhance the students’ ability to apply mathematical modelling techniques and computer modelling tools in problems and methods related to Internet engineering and to assess their limitations.
6. To develop awareness of the trends of technology and standardisation developments of Internet engineering systems, at the physical, medium access, network and application layers.
7. To provide detailed knowledge of new and upcoming technologies related to Internet technologies, industries and standards.
8. To get exposed to industrial designs and processes and to innovations in the Internet sector of the Internet Engineering industry.
9. To develop deep knowledge of standards and the Internet engineering commercial environments and standardisation processes and to be able to contribute to such processes through appreciation of their contexts, economic and regulatory drivers and limitations.
10. To provide knowledge and skills to allow for independent learning, both individually and within a group.
11. To provide knowledge and skills required for critical assessment of research work (of self and others).
12. To provide a wide range of intellectual, practical and transferable skills that will allow students to develop careers in industry or academia.
INTENDED LEARNING OUTCOMES:

The MSc in Internet Engineering programme is designed to give specialization in the field of Internet Engineering for an enhanced preparation for an industrial career or further specialized studies in the field, e.g. PhD work or work in an R&D laboratory in the sector. It includes substantially increased depth of study beyond that of a corresponding BEng (Hons), and an increased emphasis on industrial relevance. The dissertation project within the MSc in Internet Engineering programme includes an individual research/design project with strong industrial relevance and involvement. The programme provides opportunities for students to develop and demonstrate knowledge and understanding, skills, qualities and other attributes in the following areas.

Knowledge and understanding - Graduates will be able to

- Use knowledge of underlying principles, mainly mathematics and computer science on which modern communications theory and systems are based, including complex numbers, matrix algebra, differential equations, transform theory, to tackle a wide range of tasks, including analysis and design of methods and systems at the medium access, network and application layers of the communications stack.
- Understand and apply the fundamental principles that underpin digital communications systems, including Fourier and Laplace Equations, control theory, information theory (e.g. source and channel coding principles) and principles of programming for embedded and networked real-time systems.
- Analyse and design complex software systems, e.g. software components for networked services, interrupt and port handling for packet switched communications and the Internet Protocol (IP), real-time control flow for the Transmission Control Protocol (TCP), and the principles of network management systems.
- Draw on materials from a range of courses in Internet engineering and related disciplines in order to solve problems in Internet systems and protocols including demonstrating depth and breadth to their learning.
- Apply business and management techniques that are relevant to Internet engineering.
- Explain the role of telecommunications in society and the constraints within which their engineering judgement will be exercised.
- Understand the professional and ethical responsibilities of Internet engineers.
- Appreciate the national and international role of a Internet systems engineer and the impact of related engineering solutions in a global context.
- Demonstrate a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study or area of professional practice.

Skills and other attributes -- Graduates will be able to

- Deal with complex issues both systematically and creatively, make sound judgments in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences.
- Demonstrate self-direction and originality in tackling and solving problems and act autonomously in planning and implementing tasks at a professional or equivalent level.
- Continue to advance their knowledge and understanding, and to develop new skills to a high level.
- Have the qualities and transferrable skills necessary for employment in circumstances requiring the independent learning ability required for continuing professional development, the exercise of initiative and personal responsibility, and decision-making and sound judgment in complex and unpredictable situations.
- Use a combination of general and specialist engineering and computer science knowledge and understanding to optimise the application of existing and emerging technology.
- Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems
- Use software necessary for Internet systems analysis and design, including Matlab, network simulators, Java, C/C++, Python and other scripting languages, if required in projects or labs.
- Demonstrate practical transferrable engineering skills such as programming, system design and development, through the range of labs, assignments (both individual and group ones) and projects that permeate the programme.
- Apply advanced knowledge in certain areas as appropriate to programme options chosen,
- Undertake a large-scale supervised research project in academia or industry and present the results of this work in a written report and oral presentation.
- Work effectively in communications systems-based individual and group assignments.
- Explain in depth the managerial and economic factors facing a professional Internet systems engineer.
- Interpret specifications and document their solutions to Internet engineering problems so that others can follow and validate their work.
- Apply professional engineering practice and judgement in project work.
- Appreciate and practice professional skills, including appreciation of sustainability, commercial risk and ethics and understanding of electronic and electrical engineering in the wider context of engineering in general.
Intellectual skills – Graduates will be able to
- Demonstrate a comprehensive understanding of techniques applicable to their own research or advanced scholarship.
- Demonstrate originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline.
- Show originality in tackling and solving problems.
- Understand how the boundaries of knowledge are advanced through research.
- Demonstrate a conceptual understanding that enables the student to evaluate critically current research and advanced scholarship in the discipline.
- Demonstrate a conceptual understanding that enables the student to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses.
- Apply appropriate quantitative mathematical, scientific and engineering tools to the analysis of problems.
- Analyse and solve problems pertinent to Internet Systems, applying rigour in any related mathematics and software/hardware design.
- Design Internet systems hardware or software systems, components or processes to meet a need.
- Be creative in the solution of problems and in the development of designs.
- Integrate knowledge and understanding of other scientific, mathematical, computational, software, or engineering disciplines in order to support their specialisation.
- Formulate and test hypotheses modifying the hypotheses depending on the data obtained.
- Evaluate designs, processes and products and make improvements.
- Take a holistic approach in solving problems and designing systems, applying professional judgements to balance risks, costs, benefits, safety, reliability, aesthetics and environmental impact.

Characteristics – MSc in Internet Engineering Graduates will
- Be rational and pragmatic, interested in the practical steps necessary for a concept to become reality.
- Strive to achieve sustainable solutions to problems and have strategies for being creative, innovative and overcoming difficulties by employing their knowledge in a flexible manner.
- Be numerate and highly computer literate, and capable of attention to detail.
- Be cost and value-conscious, and aware of the social, cultural, environmental, health and safety, and wider professional responsibilities they should display.
- Appreciate the international dimension to engineering, commerce and communication.
- When faced with an ethical issue be able to formulate and operate within appropriate codes of conduct.
- Adopt a professional outlook, capable of team working, effective communicators, and able to exercise responsibility.

PROGRAMME OUTCOMES:

The programme provides opportunities for students to develop and demonstrate knowledge and understanding, qualities, skills and other attributes in the following areas:

A: Knowledge and understanding
<table>
<thead>
<tr>
<th>Knowledge and understanding of:</th>
<th>Teaching/learning methods and strategies:</th>
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<tbody>
<tr>
<td>- Key technologies and their underpinning scientific principles that make up network architectures and systems of the Internet and telecommunications networks.</td>
<td>- The main teaching and learning methods are based on the use of intensive, 4-5 day lecture based courses supported by tutorials, and private study.</td>
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<tr>
<td>- Mathematical and analytical methods used to model, analyse and design communication systems.</td>
<td>- Each module is supported by a three-hour tutorial session where the module content is discussed and where discussions are based on the material taught and at least one full week of individual study and problem/exercise solving.</td>
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<tr>
<td>- Advanced computer simulation and modelling systems used in communications.</td>
<td>- The core technical modules are designed to provide knowledge of the key technologies and their underlying principles. This is done by providing the methods to analyse systems and their key components, and develop, through lectures and discussions, critical awareness of new problems and technologies.</td>
</tr>
<tr>
<td>- Computer systems and programming languages used for operating telecommunication networks.</td>
<td>- Some modules include seminars and workshops to support the students.</td>
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<tr>
<td>- The industrial and regulatory standards and standardisation frameworks.</td>
<td>- Most modules include an invited industrial lecture.</td>
</tr>
<tr>
<td>- The Internet and ICT business and commercial environments and the constraints they place on the design and operation of communication systems and networks.</td>
<td>- Laboratory sessions are used to provide comprehensive knowledge of up-to-date systems and techniques for use in research.</td>
</tr>
<tr>
<td>- The design processes of Internet subsystems and integration into systems, taking into consideration the physical and higher layers.</td>
<td>- Discussion forums and supplementary learning material provided through a virtual learning environment.</td>
</tr>
<tr>
<td>- Developing and emerging technologies in telecommunication networks and communication systems.</td>
<td>- Individual one-to-one regular tuition sessions during the project work. These include detailed technical discussions plus teaching of research methods.</td>
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</table>

**Specific topics include:**
- Telecommunications Systems
- Mobile and wireless systems
- Communications technologies
- Network Design and Planning
- Data Networks and Architectures
- Next Generation Networks
- Business aspects of Telecommunications

**Assessment:**
- Assessment is usually carried out three to four weeks after module teaching.
- Core modules are assessed by unseen written exam.
- Assessment methods of optional modules depend on the module taken where assessment is by exam, assignment or a mix of the two.
### Skills and other attributes

#### Intellectual (thinking) skills:

The course aims to enable the students to:

- Develop a holistic approach to the design processes and methodologies of Internet technologies by considering the multiple facets that must interoperate. These include technical, commercial and application considerations.
- Use knowledge of communications engineering fundamentals to design and specify components or subsystems within intra-domain and inter-domain networking.
- Apply knowledge of research methods to analyse and/or develop new technologies.
- Apply knowledge of communications principles to synthesise new concepts and generate research ideas.
- Analysis of complex engineering arguments encompassing design, commercial and business limitations and industrial requirements.
- Critical assessment and analysis of current research and research methodologies in Internet technologies.

#### Teaching/learning methods and strategies:

- The primary teaching methods will be through Lectures, tutorials and seminars within the associated modules.
- Intellectual skills will be reinforced and strengthened significantly throughout the process of the project.
- Specific lectures on research methods are given.
- Critical assessment of research literature and methodologies is supported through workshops and seminars (several occasions during the year).
- Laboratory sessions within a number of modules support the development of students' design skills.

#### Assessment:

- Assignments and exams including design exercises within modules.
- Specific Assignments include aspects of critical assessments of the literature and of "others" designs and systems.
- The output of these skills will also be assessed in the project, which is assessed by dissertation.
### C: Skills and other attributes

#### Practical skills (able to):
- In the modules a number of practical design skills will be developed.
- Programming in JAVA will be developed.
- Additional practical skills developed by student will largely depend on the research topic followed for their dissertation.
- Communicate effectively in writing and through presentations.
- Practice research techniques in a specialised research topic.
- Apply mathematical and computer modelling and analysis appropriate to unfamiliar problems.
- Apply appropriate computer simulation tools to investigate a research question.
- Design, construct and undertake an experiment investigation to test a theory.
- Analyse the results of an experiment, simulation or other investigation.

#### Teaching/learning methods and strategies:
- Basic skills will be support in specific modules by Laboratory and workshop sessions, as well as seminars on basic research methodologies and techniques.
- Programming is taught through a specific, computer laboratory based module.
- The primary teaching method used in the research project is direct supervision by a member of academic staff with support of a second assessor.

#### Assessment:
- Exams and Assignments within the modules and the dissertation.
- JAVA programming is assessed through a programming assignment.
Transferable skills (able to):

The programme will enable students to:

- Learn complex topics independently.
- Work on new topics demonstrating initiative and creativity.
- Write well-structured complex reports.
- Write brief reports and executive summaries of complex arguments.
- Present work to an audience with mixed knowledge and skills.
- Use appropriate resources and citation methods.
- Study and evaluate a variety of research material of a kind that they will not have used as undergraduates.
- Provide a critical assessment of their own work and that of others.
- Make a contribution to the research topic by following through their ideas.
- Critical assessment of own work.
- Group work and team skills.
- Time management and organisational skills.

Teaching/learning methods and strategies:

These skills will be promoted through the dissertation and the transferable skills module.

Part of the transferable skills module will be provided by UCL CALT through the PDM (Professional Development Module) and the Personal and Professional Skills Development of UCL [http://www.ucl.ac.uk/myp/](http://www.ucl.ac.uk/myp/)

https://www.ucl.ac.uk/calt/.

The main mode of teaching and learning for many of these skills will be the direct supervision of the research project by a member of academic staff. This interaction will focus on the development of skills.

Assessment:

- The writing skills are assessed through assignments and the different elements of project assessment (executive summary and final dissertation).
- Presentation skills are assessed as part of the project work.

The following reference points were used in designing the programme:

- the relevant Subject Benchmark Statements [http://www.qaa.ac.uk/AssuringStandardsAndQuality/subject-guidance/Pages/Subject-benchmark-statements.aspx](http://www.qaa.ac.uk/AssuringStandardsAndQuality/subject-guidance/Pages/Subject-benchmark-statements.aspx)
- the programme specifications for UCL degree programmes in relevant subjects (where applicable);
- UCL teaching and learning policies;
- staff research.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each course unit/module can be found in the departmental course handbook. The accuracy of the information contained in this document is reviewed annually by UCL and may be checked by the Quality Assurance Agency.

Programme Organiser(s) Name(s): Dr Yiannis Andreopoulos (Course Director) and Professor Izzat Darwazeh (Postgraduate Tutor)

Date of Production: 12th Nov. 2013
<table>
<thead>
<tr>
<th>Date of Review:</th>
<th>October 2018</th>
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<tbody>
<tr>
<td>Date approved by Head of Department:</td>
<td>November 2013</td>
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<tr>
<td>Date approved by Chair of Departmental Teaching Committee:</td>
<td>November 2013</td>
</tr>
<tr>
<td>Date approved by Faculty Teaching Committee</td>
<td>November 2013</td>
</tr>
</tbody>
</table>
MSc in Internet Engineering:

PROGRAMME STRUCTURE – 2014-15

General

The diagram below details the core, compulsory and the optional modules available for the MSc in Internet Engineering. Please see Section 3 below for module acronym definitions. Each module comprises 15 UCL Credits. The dissertation project comprises 60 UCL Credits and 180 UCL Credits are required for the award of the MSc in Internet Engineering. The Scheme of Award description is given in Section 4 below.

1. Module Selection

2. Dissertation Project

The dissertation report represents an important part of the MSc in Internet Engineering degree. Not only does it represent one third of the final mark, but the project work offers a unique opportunity to focus on a problem with enough depth to write a professional document about it.

3. Module Definitions

Below are definitions of all of the modules along with the module leader.
PDM - Professional Development Module  
Module Leaders – Dr Yiannis Andreopoulos and Dr Kit Wong  

ITN - Introduction to Telecommunications Networks  
Module Leader – Professor Izzat Darwazeh  

IPN - Introduction to IP Networks  
Module Leader – Dr Miguel Rio  

MCS – Mobile Communications Systems  
Module Leader – Professor Izzat Darwazeh  

TBE – Telecommunications Business Environment  
Module Leader – Dr Clive Poole  

SNS – Software for Network Services and Design  
Module Leader – Dr Miguel Rio  

CSM – Communications Systems Modeling  
Module Leader – Dr Kit Wong  

NPO – Network Planning and Operations  
Module Leader – Professor Andy Valdar  

NGN – Next Generation Networks  
Module Leader – Dr Clive Poole  

NSM – Network and Services Management  
Module Leader – Professor George Pavlou  

IMS – Internet Multimedia Systems  
Module Leader – Dr Ioannis Andreopoulos  

DNP – Data Networks and Protocols  
Module Leader – Dr Miguel Rodrigues  

3. Scheme of Award and Award Categories

For an award of the MSc degree students must have completed 180 UCL credits and passed at least 75% of assessed work with a pass mark of 50%. A maximum of 25% of a programme's taught element, excluding the dissertation, may be condoned at 40–49%.

Pass: Students must obtain an average of at least 50% across all taught modules (with not more than 2 marks condoned (40% < 49%), and at least 50% in the Research Project.

Merit: An award of Merit will be made where: the overall mark, based on 180 credits, is 60% or greater and the mark for the dissertation is 65% or greater and there are no marks below 50%, no condoned marks, no re-sits, and all marks are based on first attempts.

Distinction: The criteria for the award of a distinction are that the mark for the dissertation is 70% or more, and the overall weighted mark (combining the taught elements and the dissertation) is 70% or greater and there are no marks below 50%, no condoned marks, no re-sits, and all marks are based on first attempts.