

Course Information Sheet

BSc (Hons) Computer Networks

Mode and course length – Full-Time (4 years)

Location – ARU Cambridge Campus

Awarding Body – Anglia Ruskin University. As a registered Higher Education provider Anglia Ruskin University is regulated by the Office for Students.

Overview

Get ready to enter an exciting, fast-changing world where your skills will be in high demand. Use our on-campus and virtual lab environments to learn how to set up complex networks. Take advantage of our relationship with Cisco Systems and gain the skills necessary for certification.

Learn to design, configure, install, manage and support networks in organisations of all sizes, from the relatively small to the multinational.

We'll begin by studying computer architecture, design principles and programming before exploring the design and implementation of small-scale and enterprise-wide computer networks, and learning about converged voice/data networks.

There's plenty of opportunity for practical work, including modelling networks and using advanced simulation tools to analyse performance. We'll also demonstrate the importance of security in network design and critically discuss the relevant ethical and legal issues.

Our stand-alone network lets you safely experiment with building complex networks. You'll learn to install and configure hardware, operating systems and software. We have Apple Mac Pro computers with dual boot (Windows/Mac OS X), featuring a wide range of CAD, database design and web software. Our virtual network lab means you can access our networking devices from anywhere at any time.

Course Delivery

Our courses are delivered through teaching and learning methods which provide students with the widest possible exposure to a modern and innovative higher education experience.

These methods vary and could include attendance at lectures and seminars, undertaking laboratory exercises or work-based activities, practical work, performances, presentations, field trips, other relevant visits and e-learning through Canvas, our online learning management system.

Each course is divided into a number of 'modules' which focus on particular areas, each of which has a specific approach to its delivery. This information is published to students for each module they take via the Module Definition Form (MDF) and Canvas.

Assessment

We'll assess you throughout the course so that you can measure your progress. Most of this assessment will be based on case studies, as well as class-based laboratory tests, group work, presentations and reports.

Fees

Information about your course fee including any annual fee increases or deposits (if required) can be found in your offer letter.

Modules

Core Modules

Year 1: Foundation in Engineering, Computing and Technology

This module will provide students with the necessary skills to begin studying at level 4 in Engineering, Computer Science and related courses.

Students will be introduced to the core skills necessary to succeed in higher education, including thinking critically, researching and referencing appropriately, demonstrating appropriate numeracy and ICT skills, and communicating effectively verbally and in writing.

In addition to these fundamental skills, Students will cover the subjects underpinning the technological disciplines. Fundamental mathematical skills will be covered, alongside pre-calculus, followed by an introduction to calculus and vector and matrix arithmetic. Students will also be introduced to Classical mechanics, and its application to real-world scenarios. Students will be introduced to the fundamentals of computer science, learning about the principles behind programming and applying them through a series of practical coding exercises. Students will undertake a multi-disciplinary group project as they learn about the collaborative nature of engineering, and design from a broader perspective of business.

The module is made up of the following 8 constituent elements:

- Interactive Learning Skills and Communication (ILSC)
- Information Communication Technology (ICT)
- Critical Thinking
- Maths for Scientists
- Maths for Engineers
- Physics for Engineers
- Fundamentals of Computing
- Engineering Design

Year 2: Learning and Skills Development for HE and Work

Students entering Higher Education will need specific study skills to enable them to maximise their learning potential and take advantage of opportunities available both in the academic setting and the workplace. Students will enter with different levels of skills and experience and may approach the module in a variety of ways. The module is intended to be both preparatory and supportive building a strong foundation for learning and later development. The module delivery will be organised to develop and underpin Level One study skills in the first half of the trimester with the focus moving towards individual formative support towards the end of the trimester. Students will develop and maintain a reflective learning log/blog to support this module and their continuing studies, the reflective log/blog to be used as the basis of tutorial work and formative assessment. Students will be expected to meet with their personal tutors to review their progress and actively seek out a mentor within the university community or workplace.

Year 2: Software Principles

This module introduces the fundamental concepts required to understand, design, implement and test high-level programming languages, Students will be introduced to a design methodology to help develop linear and hierarchical trains of thought from idea conception through design and implementation to testing. Using a simple interactive programming environment, students will discover how to create and use a wide variety of different basic and complex data structures. By the end of the module, students will be expected to be able to: Analyse a simple set of requirements; design appropriate data structures; select appropriate language syntax to manipulate program data; understand and use syntax for the implementation of conditional logic and repetition; be able to create simple scripts to perform a number of operations in turn to achieve a desired effect; demonstrate familiarity with the taxonomy of programming languages and the software development life-cycle; gain sufficient experience of a range of algorithm design techniques, such that, given a simple problem description, appropriate variables, decisions and repetitive actions can be identified and translated into appropriate code constructs.

Year 2: Computer Modelling and Simulation

This module introduces the use of computer tools to solve engineering problems. It is intended to provide a sound understanding of the principles of generating a computer model, simulation or solution from a defined specification. The MATLAB software

package is introduced, which allows mathematical expressions and algorithms to be implemented using various command functions and simple software statements. Basic ideas of producing plots are presented; relevant toolboxes are also discussed, e.g. the Statistics and Machine Learning Toolbox. Students are also introduced to the basics of Python language. Fundamental issues like variables, strings, tuples, loops, control flow, plotting, file input/output, functions will be discussed. Students will learn the basic features of NumPy (Numerical Python) and will create data visualisations with Matplotlib. This module will also introduce the Pandas library for data analysis. Finally, students will learn how to solve problems by incorporating all the elements reviewed in the module and apply them in different scenarios. The emphasis in learning computer languages will be on a structured approach. The applications targeted will be in the area of modelling and solving technological problems relevant to students' course.

Year 2: Cyber Crime Fundamentals

This module provides an introduction to the main principles of security for IT and networked systems. Key areas of security are introduced, beginning with underlying concepts and threats, and then proceeding to address specific issues and technologies relating to host systems and networked environments. Issues relating to security design are also highlighted.

The module aims to familiarise students with the fundamentals of information security technologies and to develop an understanding of the various security threats and vulnerabilities. Consideration is given to core security pertaining to host systems and network environments.

The Cyber crime Fundamentals module is delivered as a mixture of theory, through a series of lectures, and practical implementation, through a series of guided laboratory exercises.

Year 2: Networked Systems

This module introduces students to the components and requirements of modern networked computer systems. In order to understand how such systems work it is necessary to consider the operating system, through the networking technology to the servers to be accessed. On completing this module, students will be able to specify, construct and maintain networked PC systems, and troubleshoot common hardware and software problems. Practical skills are underpinned by a sound theoretical foundation in computer systems and network architecture, including both local area networks (LANs) and wide area networks (WANs). Theoretical topics will be delivered in weekly lectures that will be consolidated through significant self-study. Laboratory sessions will enable students to gain the practical skills needed to construct, maintain and troubleshoot problems on networked computer systems.

Year 2: Operating Systems

This module will introduce students to the fundamental features of modern operating systems, their components and their use. It will look at key concepts including the kernel and its modes; memory and resource management; file systems, security and authentication; single and multi-tasking; interrupts, hardware and device drivers and command line and graphical user interfaces (GUI). The module will also introduce students to the command line interface (CLI) commands and scripting in both the Windows CLI and a Linux shell and allow them to develop simple scripts to automate activities in both operating system environments. It will also explain how each operating system stores configuration information and how (particularly in Linux/Unix) scripts can be used to modify the system configuration. No specific knowledge is needed before undertaking the module, however a basic user level familiarity with a GUI based operating system (such as Windows) will be useful. The skills acquired in the module will enable students to go on to study modules which involve topics such as system administration, network and server configuration and technical support all of which are key skills graduates need when working in the systems and network support industries.

Year 3: Network Routing and Switching Essentials

Computer networks are constantly evolving to keep pace with the changing needs of organizations in supporting their daily business. Users now expect instant access to company resources from anywhere and at any time. These resources not only include traditional data but also audio and video and voice.

There is also an increasing need for collaboration technologies that allow real-time sharing of resources between multiple remote individuals as though they were at the same physical location. The global Internet is a collection of networks, termed

Autonomous Systems (AS), that are linked together via high-speed communication links provided by telecommunication organisations. LAN switches provide the connection point for end users into the enterprise network and are also primarily responsible for the control of information within the LAN environment. Routers facilitate the movement of information between LANs and are generally unaware of individual hosts.

Due to the complexity and dynamic nature of networks, often networks employ dynamic routing protocols to dynamically establish the "best" path for routing the traffic, to achieve the maximum efficiency while maintain the ever-increased demand of reliability and security. This module focuses on the key concepts and protocols of network routing and switching. It covers basic routing and switching concepts, including static and default routing, Virtual Local Area Networks (VLANs), and inter-VLANs routing.

Dynamic protocols such as RIP, EIGRP and OSPF, and will be discussed and explored Network security using Access Control Lists will be introduced and the wider issues of network and Internet security considered. Other topics such as DHCP and NAT will also be covered.

The module is delivered as a mixture of theory, delivered through a series of lectures, and practical implementation, delivered through a series of guided laboratory exercises. In the lab sessions students will gain deep understanding on the routing and switching concepts with an emphasis on their hands-on-skills using hardware equipment in the laboratory and advanced network simulation tools that comply with industry standards.

Year 3: Data Security

Information technology has created a world that is increasingly virtual in nature. Both private individuals and businesses alike suffer the same vulnerabilities in managing access to valuable information that is increasingly being stored remotely. Whilst the public and industry professionals wrestle with the escalating complexity and variation in the ways that information is compromised, we see the emergence of the harnessing of digital insecurities as a weapon on an international stage. This module introduces some of the key concepts that lie at the heart of information security, but viewed at the more fundamental data level. It provides a critical insight into the often misunderstood or poorly defined issues of data security and thereby offers the student a springboard to the study of information security at level 6. After studying this module the student will understand how and why the digital data systems we use everyday pose such a threat to individuals and businesses, where solutions are possible and where they might prove difficult or impossible. A key issue will be the fundamental weakness that humans introduce into the technology. Students are expected to augment the content delivered by lectures with independent study of their own on a weekly (or even daily basis) in order to remain current with developing threats.

Year 3: Project Management and Quality Assurance

Any graduate working in the IT field will find themselves part of a project team. For projects to proceed successfully it is important for all members of the team to be aware of their roles and responsibilities. It is therefore essential that graduates should have knowledge of the structure of IT projects, the tools and techniques used for planning, monitoring and controlling such projects, and their role as a member of such a team. This module will introduce students to the tools and techniques commonly used in IT based projects. Students will be given the opportunity to practice with the tools to enhance their understanding and competence. At every stage within any artefact development it is necessary to ensure correct quality monitoring and control procedures are in place. The quality assurance portion of this module helps the student to develop an understanding of the range of techniques which can be used to promote quality and their cost/benefit issues. A range of verification and validation procedures will be presented and practiced. Students will be introduced to the standards relevant to IT projects and the relevant accreditation procedures discussed. The learning in this module is mainly through taught sessions with practical and theoretical tutorial sessions involving formative exercises. The specialist resource required is a computer based project management tool such as MS Project

Year 3: Networking Technologies

This module in computer networking follows on from "Computer Network Principles (Level 6)" and focuses on LAN Switching and WAN Technologies. The module is in two parts: the first part focuses on switching basics and intermediate routing. It covers topics such as: advanced IP addressing techniques, intermediate routing, CLI configuration of Ethernet switches and Virtual LANs; the second part focuses on WAN technologies. It covers topics such as: Network Address Translation (NAT), DHCP, WAN technologies, Optical networking, and Network Management. The module covers the material to enable students to take an optional test to achieve the Cisco certification "Interconnecting Cisco Networking Devices". Students who study both Computer Network Fundamentals and Networking Technologies will be able to take an optional test to achieve the Cisco

Certified Networking Associate (CCNA) award which is highly regarded by employers in this area.

Year 4: Advanced Network Protocols

This module is an advanced course in the design, implementation and troubleshooting of network routing and switching protocols within the context of the business needs for networks to have high performance, be secure and resilient. The module focuses on the study of deployment of advanced networking protocols within both a large organisation and those used by the global Internet.

The module will cover the advanced deployment of both interior and exterior routing protocols, such as OSPF and BGP; enterprise switching protocols, such as VTP, STP and HSRP; Quality of Service and IPv6, to provide high performance, secure and resilient networks. Students will also develop their network troubleshooting skills so that they can successfully solve networking issues.

The module is delivered as a series of lectures and laboratory sessions using industry standard networking equipment and toolsets. Students will have access to both dedicated networking laboratories and a remote networking laboratory (NETLAB) that will allow them to undertake laboratory exercises in a flexible manner to suit their individual needs.

Year 4: Final Project

The individual Final Project module allows students to engage in a substantial piece of individual research and / or product development work, focused on a topic relevant to their specific discipline. The topic may be drawn from a variety of sources including: Anglia Ruskin research groups, previous / current work experience, the company in which they are currently employed, an Anglia Ruskin lecturer suggested topic or a professional subject of their specific interest (if suitable supervision is available). The project topic will be assessed for suitability to ensure sufficient academic challenge and satisfactory supervision by an academic member of staff. The chosen topic will require the student to identify / formulate problems and issues, conduct literature reviews, evaluate information, investigate and adopt suitable development methodologies, determine solutions, develop hardware, software and/or media artefacts as appropriate, process data, critically appraise and present their finding using a variety of media. Regular meetings with the project supervisor should take place, so that the project is closely monitored and steered in the right direction. The project developed in this module is the most substantial piece of work that the student is producing during their undergraduate studies. Thus, the choice of project topic and the quality of the work is likely to bear a great influence on the student's career / employability. Therefore, the module will also include aspects of Personal Development Plan and CV preparation. The students are strongly advised to allocate appropriate attention, time and effort to this module. The successful completion of the module will increase students' employability, as they will acquire skills directly applicable to real world projects.

Year 4: Network Modelling and Simulation

The massive growth and complexity of the Internet and enterprise networks there is a growing demand for network practitioners to be able to both model and simulate networks to ascertain the impact on network performance of proposed changes to the network. This module focuses on the modelling of network components, such as switches and routers, and the discrete event simulation of complex networking environments to ascertain the impact of changes to proposed networks or the planning of new networks using the industry standard simulation tool OPNET. The module will be delivered by a series of lecturers, covering the basic principles and concepts, and laboratory-based practical experimentation using OPNET.

Year 4: Advanced Networking Technologies

Traditionally large scale networks, including the Internet, have a distributed control structure in that key networking components, such as routers and switches, operate autonomously making routing and switching decisions based on acquired knowledge communicated from other devices or from information within the data packet, such as IP or MAC address. Software Defined Networks (SDN) provide more centralised control by removing the control intelligence from the physical devices (routers/switches) to a centralised server. The server, controlled by suitable software, sends control signals to the physical devices of the network to inform them how to route traffic. The potential benefits of such systems are simpler and standardised physical networking devices and more efficient network switching by having a more centralised and knowledgeable understanding of the overall aims and objectives of the entire network and its users.

The purpose of this module is to introduce students to the principles and implementation methods of SDN using predefined

sandbox network and SDN controller. Students will study network programming to interact with SDN controllers via predefined API calls and will apply this knowledge to perform network control and management.

The module will be delivered by a mixture of lectures, tutorials and workshops and will be supported, initially, by sandbox networks provided as part of the new Emerging Technologies course within the Cisco Networking Academy Program.

Optional Modules

(Subject to availability)

Year 3: Network Streaming Technology

Much of the traffic on the Internet and an increasing amount of traffic within a business is streamed media. This traffic may be made up of video clips from sources such as YouTube or Lynda, catch up services such as iPlayer or Now TV, business applications such as VoIP and video conferencing or the real-time streaming of concerts or world events. This module will look at the infrastructure, protocols, encoding, encapsulation and applications used in the streaming of media.

The module starts by considering the effect of bandwidth on the rate at which data can be sent over a medium and then considers the data rate required by a variety of different types of audio and video media. The way in which the media is encoded, compressed and encapsulated is then investigated and the resulting bandwidth requirements discussed.

Issues and approaches to multicasting are considered as are the protocols that are commonly used for real-time streaming. This will include the techniques and protocols of VoIP and video conferencing as well as architectures based on technologies such as uPnP, DLNA and Miracast.

The techniques, protocols and applications will be presented and discussed in the lecture whilst the practical will be used to implement, configure and analyse streaming applications so the network traffic and performance of the end devices can be assessed.

Year 3: Network Security

Organisations are increasingly relying on their information systems therefore there is a greater need to ensure that the underlying network infrastructure been used by these systems is secure. This module sets out essential concepts and skills relating to the ability to design, implement and support the security of networked devices and to use the current best practices in network security. It will develop in the students a working knowledge of network security principles, tools and configurations. The module will start by identifying modern network security threats and the impact they have within an organisation. It will then describe how to secure network devices, how to deploy authentication, authorisation and accounting and how to deploy network security technology such as firewalls and intrusion prevention systems. The module will also cover cryptography, LAN security considerations and the implementation of endpoint and layer 2 security features. Methods for implementing data confidentiality and integrity will be described along with the implementation of secure virtual private networks.

The Network Security module is delivered as a mixture of theory, through a series of lectures, and practical implementation, through a series of guided laboratory exercises based on the CCNA Security curricula.

The module is delivered as part of the curriculum offered by the Cisco Networking Academy Program, a well-established partnership between academia and industry to provide up to date knowledge and skills required by industry

Year 4: Information Security

Information security has become a central, but ill-defined feature of modern systems. Traditionally, information security has been poorly understood and rarely integrated into system design. With the growth of high bandwidth internet, eCommerce, eBusiness and Virtual Private Networks, security has become a centre-stage issue. However, organisations and businesses find themselves missing the necessary skills and knowledge, especially of the wider security picture, that is needed to develop effective security strategies. This module will equip students to fill that skill gap by introducing them to many key aspects of information security as well as taking a broader view of the information security problems facing industry and commerce today. The module will, for example, take students through a comprehensive overview of the problem, motives and techniques of

'hackers', the inherent security problems built into information technology itself and the role played by encryption techniques. It does not deal with practical, low-level or product-specific issues. Importantly, it has been identified that, often, user behaviour itself creates significant vulnerabilities and the module focuses on the role of people and the part played by poor user discipline. Students will be expected to extend the scope of the module by researching and documenting some of the latest known weaknesses and threats faced by information systems today.