Syllabus

IT – Networking & Cybersecurity

Year 1 & Year 2

Kings Cornerstone International College

Unit 1: Programming

Unit code	**D/615/1618**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

Programming involves describing processes and procedures which are derived from algorithms. The ability to program is what sets apart a developer and an end user. Typically the role of the developer is to instruct a device (such as a computer) to carry out instructions; the instructions are known as source code and is written in a language that is converted into something the device can understand. The device executes the instructions it is given.

Algorithms help to describe the solution to a problem or task; by identifying the data and the process needed to represent the problem or task *and* the set of steps needed to produce the desired result.

Programming languages typically provide the representation of both the data and the process; they provide control constructs and data types (which can be numbers, words, and objects, and be constant or variable).

The control constructs are used to represent the steps of an algorithm in a convenient yet unambiguous fashion. Algorithms require constructs that can perform sequential processing, selection for decision-making, and iteration for repetitive control. Any programming language that provides these basic features can be used for algorithm representation.

This unit introduces students to the core concepts of programming with an introduction to algorithms and the characteristics of programming paradigms.

Among the topics included in this unit are: introduction to algorithms, procedural, object-orientated & event-driven programming, security considerations, the integrated development environment and the debugging process.

On successful completion of this unit students will be able to design and implement algorithms in a chosen language within a suitable Integrated Development Environment (IDE). This IDE will be used to develop and help track any issues with the code.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Define basic algorithms to carry out an operation and outline the process of programming an application.

LO2. Explain the characteristics of procedural, object-orientated and event-driven programming.

LO3. Implement basic algorithms in code using an IDE.

LO4. Determine the debugging process and explain the importance of a coding standard.

Essential Content

LO1 **Define basic algorithms to carry out an operation and outline the process of programming an application**

Algorithm definition:

Writing algorithms to carry out an operation, e.g. Bubble sort.

The relationship between algorithms and code.

The generation process of code; the roles of the pre-processor, compiler and linker, interpreter.

LO2 **Explain the characteristics of procedural, object-orientated and event-driven programming**

Characteristics of code:

Definitions of: data types (the role of constants/variables), methods (including input/output), control structures, iteration, scope, parameter passing, classes, inheritance and events.

Key components of an IDE with a brief explanation each component.

Use of addition of advanced text editors to view code, such as Notepad++, Atom, Sublime text, etc

LO3 **Implement basic algorithms in code using an IDE**

Implementation:

Developing simple applications which implements basic algorithms covered in LO1, using the features of a suitable language and IDE. Consider possible security concerns and how these could be solved.

LO4 **Determine the debugging process and explain the importance of a coding standard**

Review and reflection:

Documentation of the debugging process in the IDE, with reference to watch lists, breakpoints and tracing.

How the debugging process can be used to help developers fix vulnerabilities, defects and bugs in their code.

What a coding standard is and its benefits when writing code.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Define basic algorithms to carry out an operation and outline the process of programming an application</td><td rowspan="2">D1 Evaluate the implementation of an algorithm in a suitable language and the relationship between the written algorithm and the code variant.</td></tr>
<tr><td>P1 Provide a definition of what an algorithm is and outline the process in building an application.</td><td>M1 Determine the steps taken from writing code to execution.</td></tr>
<tr><td colspan="2">LO2 Explain the characteristics of procedural, object-orientated and event-driven programming</td><td rowspan="2">D2 Critically evaluate the source code of an application which implements the procedural, object-orientated and event driven paradigms, in terms of the code structure and characteristics.</td></tr>
<tr><td>P2 Give explanations of what procedural, object-orientated and event-driven paradigms are; their characteristics and the relationship between them.</td><td>M2 Compare and contrast the procedural, object orientated and event driven paradigms used in given source code of an application</td></tr>
<tr><td colspan="2">LO3 Implement basic algorithms in code using an IDE</td><td rowspan="2">D3 Evaluate the use of an IDE for development of applications contrasted with not using an IDE.</td></tr>
<tr><td>P3 Write a program that implements an algorithm using an IDE.</td><td>M3 Use the IDE to manage the development process of the program.</td></tr>
<tr><td colspan="2">LO4 Determine the debugging process and explain the importance of a coding standard</td><td rowspan="2">D4 Critically evaluate why a coding standard is necessary in a team as well as for the individual.</td></tr>
<tr><td>P4 Explain the debugging process and explain the debugging facilities available in the IDE.
P5 Outline the coding standard you have used in your code.</td><td>M4 Evaluate how the debugging process can be used to help develop more secure, robust applications.</td></tr>
</table>

Recommended Resources

This unit does not specify which programme language should be used to deliver this content – this decision can be made by the tutor.

Examples of languages that are used in industry are C#, Python, Ruby, Java, but any language which will allow the student to achieve the Learning Outcomes is acceptable.

Textbooks

AHO, A. V. et al. (1987) *Data Structures and Algorithms*. 1st Ed. Addison-Wesley.

HUNT, A. et al. (2000) *The Pragmatic Programmer: From Journeyman to Master*. 1st Ed. Addison-Wesley.

MCCONNELL, S. (2004) *Code Complete: A Practical Handbook of Software Construction*. 2nd Ed. Microsoft Press.

Unit 2: Networking

Unit code	**H/615/1619**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

Computer networks are the driving force behind the evolution of computer systems and allow users to access data, hardware and services regardless of their location. Being knowledgeable about the underlying principles of networking is of vital importance to all IT professionals. Networking is an environment that is increasingly complex and under continuous development.

Complex computer networking has connected the world by groups of small networks through internet links to support global communications. It supports access to digital information anytime, anywhere using many applications like e-mail, audio and video transmission, including the World Wide Web, and this has opened the floodgates to the availability of information.

The aim of this unit is to provide students with wider background knowledge of computer networking essentials, how they operate, protocols, standards, security considerations and the prototypes associated with a range of networking technologies.

Students will explore a range of hardware, with related software, and will configure and install these to gain knowledge of networking systems. A range of networking technologies will be explored to deliver a fundamental knowledge of Local Area Networking (LAN), Wide Area Networking (WAN) and their evolution to form large-scale networks and the protocol methodologies related to IP data networks will be explored.

On successful completion of this unit students will gain knowledge and skills to successfully install, operate and troubleshoot a small network; and the operation of IP data networks, router, switching technologies, IP routing technologies, IP services and basic troubleshooting. Supporting a range of units in the Higher National suite, this unit underpins the principles of networks for all and enables students to work towards their studies in vendor units, if applicable.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Examine networking principles and their protocols.

LO2. Explain networking devices and operations.

LO3. Design efficient networked systems.

LO4. Implement and diagnose networked systems.

Essential Content

LO1 Examine networking principles and their protocols

Introduction to Networks:

Impact of networks on daily lives, the basic requirements of a reliable network, employment opportunities in the networking field, network common network attacks, network trends e.g. BYOD

Role of networks:

Purpose, benefits, resource implications, communications (e.g. transmission mediums), working practice, commercial opportunity, information sharing, collaboration.

System types:

Peer-based, client-server, cloud, cluster, centralised, virtualised.

Networking standards:

Conceptual models e.g. OSI model, TCP/IP model; standards: e.g. IEEE 802.x.

Topology:

Network representation Logical e.g. Ethernet, Token Ring; physical e.g. star, ring, bus, mesh, tree, ring.

Protocols:

Purpose of protocols; adherence, routed protocols e.g. IPv4 (addressing, subnetting, VLSM), IPv6 (addressing); Global unicast, Multicast, Link local, Unique local, EUI 64, Auto configuration, ICMP, FTP, HTTP, SMTP, POP3, SSL; management of protocols for addressing.

LO2 Explain networking devices and operations

Networking devices:

Servers; hub, routers; switches; multilayer switch (including their operating systems e.g. CISCO IOS, etc), firewall, HIDS, repeaters; bridges; wireless devices; access point (wireless/wired), content filter, Load balancer, Modem, Packet shaper, VPN concentrator.

Networking software:

Client software, server software, client operating system, server operating system, Firewall.

Server type:

Web, file, database, combination, virtualisation, terminal services server.

Server selection:

Cost, purpose, operating system requirement.

Workstation:

Hardware e.g. network card, cabling; permissions; system bus; local-system architecture e.g. memory, processor, I/O devices.

LO3 **Design efficient networked systems**

Bandwidth:

Expected average load; anticipated peak load; local internet availability; cost constraints, throughput.

Users:

Quality expectations, concept of system growth.

Networking services and applications:

DHCP; static vs dynamic IP addressing, reservations, scopes, leases, options (DNS servers, Suffixes), IP helper, DHCP relay, DNS records, Dynamic DNS.

Communications:

Suited to devices, suited to users, supportive of lifestyle desires, supportive of commercial requirements, security requirements, quality of service needs.

Scalable:

Able to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend changes, protocol utilisation, addressing.

Selection of components:

Supporting infrastructure needs; supporting connectivity requirements.

LO4 **Implement and diagnose networked systems**

Devices:

Installation of communication devices, allocation of addresses, local client configuration, server configuration, server installation, security considerations.

Verification of configuration and connectivity:

Installation of internet work communication medium, ping, extended ping, traceroute, telnet, SSH.

System monitoring:

Utilisation, bandwidth needs, monitoring user productivity and security of the system.

Maintenance schedule:

Backups, upgrades, security, auditing.

Diagnose and resolve layer 1 problems:

Framing, CRC, Runts, Giants, Dropped packets, late collisions, Input/Output errors.

Policy review:

Bandwidth, resource availability.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine networking principles and their protocols</td><td rowspan="5">LO1 & 2

D1 Critically evaluate the topology protocol selected for a given scenario to demonstrate the efficient utilisation of a networking system.</td></tr>
<tr><td>P1 Discuss the benefits and constraints of different network types and standards.

P2 Explain the impact of network topology, communication and bandwidth requirements.</td><td>M1 Compare common networking principles and how protocols enable the effectiveness of networked systems.</td></tr>
<tr><td colspan="2">LO2 Explain networking devices and operations</td></tr>
<tr><td>P3 Discuss the operating principles of networking devices and server types.

P4 Discuss the inter-dependence of workstation hardware with relevant networking software.</td><td>M2 Explore a range of server types and justify the selection of a server, considering a given scenario regarding cost and performance optimisation.</td></tr>
<tr><td colspan="2">LO3 Design efficient networked systems</td></tr>
<tr><td>P5 Design a networked system to meet a given specification.

P6 Test and evaluate the design to meet the requirements and analyse user feedback with the aim of improving efficiency.</td><td>M3 Install and configure network services and applications on your choice.</td><td>D2 Design a maintenance schedule to support the networked system.</td></tr>
<tr><td colspan="2">LO4 Implement and diagnose networked systems</td><td rowspan="3">D3 Use critical reflection to evaluate own work and justify valid conclusions.</td></tr>
<tr><td>P7 Implement a networked system based on a prepared design.

P8 Document and analyse test results against expected results.</td><td>M4 Recommend potential enhancements for the networked systems.</td></tr>
</table>

Recommended Resources

Textbooks

Burgess, M. (2003) *Principles of Network and System Administration*. 2nd Ed. John Wiley and Sons Ltd.

Hallberg, B. (2005) *Networking: A Beginner's Guide*. 4th Ed. Osborne/McGraw-Hill US.

Limoncelli, T. and Hogan, C. (2001) *The Practice of System and Network Administration*. Addison-Wesley.

Lowe, D. (2005) *Networking All-in-One Desk Reference for Dummies*. 2nd Ed. Hungry Minds Inc.

Olifer, N. and Olifer, V. (2005) *Computer Networks: Principles, Technologies and Protocols for Network Design*. John Wiley and Sons Ltd.

Stallings, W. (2003) *Data and Computer Communications*. 7th Ed. (Prentice Hall)

Subramanian, M. (2000) *Network Management: An Introduction to Principles and Practice*. Addison-Wesley.

Tanenbaum, A. (2002) *Computer Networks*. Prentice Hall PTR.

Journals

The Institute of Engineering and Technology

Unit 3: Professional Practice

Unit code	**Y/615/1620**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

The need to be effective as a communicator, critical thinker, analyser, team worker and interpreter is essential. Within the workplace these skills are needed on a daily basis to show proficiency in designated tasks as part of a job role. The development of academic competence, and also the continuation of life-long learning and Continuing Professional Development (CPD), is required to ensure that individuals have a valued set of interpersonal skills that can be applied to any situation or environment.

This unit provides a foundation for good practice in a variety of contexts. The ability to communicate effectively using different tools and mediums will ensure that practical, research, design, reporting and presentation tasks are undertaken professionally and in accordance with various communication conventions. In everyday life the ability to apply critical reasoning and solve problems are necessary skills to enable task resolution and facilitate effective decision-making. Working with others in a group environment academically or within the workplace is an integral part of everyday life. Therefore, understanding the dynamics of teams in terms of culture, roles and responsibilities will ensure that there is a better understanding and awareness of the importance and value of teamwork. Continuing professional development, self-improvement and working towards various goals is an area that is encouraged in the workplace through the appraisals framework. In addition, professional development extends into higher levels of learning and the need to demonstrate effective research skills and academic reporting skills is also required.

Among the topics included in this unit are: the development of communication skills and communication literacy; the use of qualitative and quantitative data to demonstrate analysis, reasoning and critical thinking; and tasks that require the integration of others within a team-based scenario and planning and problem-solving.

On successful completion of this unit students will be able to demonstrate leadership skills through the dynamics of team working, and through reflective practice be able to evaluate the contributions made as an individual and also of others. As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Demonstrate a range of interpersonal and transferable communication skills to a target audience.

LO2 Apply critical reasoning and thinking to a range of problem-solving scenarios.

LO3 Discuss the importance and dynamics of working within a team and the impact of team working in different environments.

LO4 Examine the need for Continuing Professional Development (CPD) and its role within the workplace and for higher level learning.

Essential Content

LO1 **Demonstrate a range of interpersonal and transferable communication skills to a target audience**

Effective communication:

Verbal and non-verbal e.g. awareness and use of body language, openness and responsiveness, formal and informal dialogue and feedback to a range of different stakeholders; academic report writing; use of IT to enhance communication; use of source information to undertake research.

Interpersonal skills:

Soft skills e.g. personal effectiveness, working with others, use of initiative, negotiating skills, assertiveness skills and social skills.

Time management skills:

Prioritising workloads; setting objectives; using time effectively; making and keeping appointments; planning and scheduling tasks and activities.

LO2 **Apply critical reasoning and thinking to a range of problem-solving scenarios**

Specification of the problem:

Definition of the problem; analysis and clarification.

Identification of possible outcomes:

Identification and assessment of various alternative outcomes.

Tools and methods:

Use of problem-solving methods and tools.

Plan and implement:

Sources of information; solution methodologies; selection and implementation of the best corrective action e.g. timescale, stages, resources, critical path analysis.

Evaluation:

Evaluation of whether the problem was solved or not; measurement of solution against specification and desired outcomes; sustainability.

LO3 **Discuss the importance and dynamics of working within a team and the impact of team working in different environments**

Working with others:

Nature and dynamics of team and group work; informal and formal settings; purpose of teams and groups e.g. long-term corporate objectives/strategy; problem-solving and short-term development projects; flexibility/adaptability; team player.

Teams and team building:

Selecting team members e.g. specialist roles, skill and style/approach mixes; identification of team/work group roles; stages in team development e.g. team building, identity, loyalty, commitment to shared beliefs, team health evaluation; action planning; monitoring and feedback; coaching skills; ethics; effective leadership skills e.g. setting direction, setting standards, motivating, innovative, responsive, effective communicator, reliability, consistency.

LO4 **Examine the need for Continuing Professional Development (CPD) and its role within the workplace and for higher level learning**

Responsibilities:

Own responsibilities e.g. personal responsibility, direct and indirect relationships and adaptability, decision-making processes and skills, ability to learn and develop within the work role; other e.g. employment legislation, ethics, employment rights and responsibilities.

Performance objectives:

Setting and monitoring performance objectives, measurement tools for success and achievement.

Continuing Professional Development: lifelong learning, training and development, personal development, professional development.

Evidence criteria:

Production data, personnel data, judgemental data; rating methods e.g. ranking, paired comparison, checklist, management by objectives; skills audit (personal profile using appropriate self-assessment tools); evaluating self-management; personal and interpersonal skills.

Motivation and performance:

Application and appraisal of motivational theories and techniques, rewards and incentives; manager's role; self-motivational factors.

Development plan:

Current performance; future needs; opportunities and threats to career progression; aims and objectives; achievement dates; review dates; learning programme/activities; action plans; personal development plans.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Demonstrate a range of interpersonal and transferable communication skills to a target audience		**D1** Evaluate the effectiveness and application of interpersonal skills during the design and delivery of a training event.
P1 Demonstrate, using different communication styles and formats, that you can effectively design and deliver a training event for a given target audience. **P2** Demonstrate that you have used effective time management skills in planning an event.	**M1** Design a professional schedule to support the planning of an event, to include contingencies and justifications of time allocated.	
LO2 Apply critical reasoning and thinking to a range of problem-solving scenarios		**D2** Critique the process of applying critical reasoning to a given task/activity or event.
P3 Demonstrate the use of different problem-solving techniques in the design and delivery of an event. **P4** Demonstrate that critical reasoning has been applied to a given solution.	**M2** Research the use of different problem-solving techniques used in the design and delivery of an event. **M3** Justify the use and application of a range of solution methodologies.	

Pass	Merit	Distinction
LO3 Discuss the importance and dynamics of working within a team and the impact of team working in different environments		
P5 Discuss the importance of team dynamics in the success and/or failure of group work. **P6** Work within a team to achieve a defined goal.	**M4** Analyse team dynamics, in terms of the roles group members play in a team and the effectiveness in terms of achieving shared goals.	**D3** Provide a critical evaluation of your own role and contribution to a group scenario.
LO4 Examine the need for Continuing Professional Development (CPD) and its role within the workplace and for higher level learning		
P7 Discuss the importance of CPD and its contribution to own learning. **P8** Produce a development plan that outlines responsibilities, performance objectives and required skills, knowledge and learning for own future goals.	**M5** Compare and contrast different motivational theories and the impact they can have on performance within the workplace.	**D4** Evaluate a range of evidence criteria that is used as a measure for effective CPD.

Recommended Resources

Textbooks

Cottrell, S. (2001) *Critical Thinking Skills: Developing Effective Analysis and Argument*. 2nd Ed. Palgrave Macmillan.

Forde, C. (2006) *Professional Development, Reflection and Enquiry*. Sage Publications.

Megginson, D. and Whitaker, V. (2007) *Continuing Professional Development*. 2nd Ed. Chartered Institute of Personnel and Development.

Winstanley, D. (2005) *Personal Effectiveness: A guide to action*. Chartered Institute of Personnel and Development.

Journals

Journal of Group Dynamics

Professional Development in Education

Websites

www.thinkwatson.com	Critical Thinking Resources "Critical Thinking Correlation Studies" (Research)
ipda.org.uk	International Professional Development Association (General Reference)

Unit 4: Database Design & Development

Unit code	**H/615/1622**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

Organisations depend on their databases to provide information essential for their day-to-day operations and to help them take advantage of today's rapidly growing and maturing e-commerce opportunities. An understanding of database tools and technologies is an essential skill for designing and developing systems to support them.

Database systems continue to demand more complex data structures and interfaces, as applications get increasingly sophisticated. Most organisations collect and store large volumes of data, either on their own systems or in the cloud, and this data is used not just for the operational running of their business but also mined for other more intelligent and complex applications. Databases stand as the back-end of most systems used by organisations for their operations.

Database design and development is a fundamental and highly beneficial skill for computing students to master, regardless of their specialism.

The aim of this unit is to give students opportunities to develop an understanding of the concepts and issues relating to database design and development, as well as to provide the practical skills to translate that understanding into the design and creation of complex databases.

Topics included in this unit are: examination of different design tools and techniques; examination of different development software options; considering the development features of a fully functional robust solution covering data integrity, data validation, data consistency, data security and advanced database querying facilities across multiple tables; appropriate user interfaces for databases and for other externally linked systems; creating complex reports/dashboards, testing the system against the user and system requirements; and elements of complete system documentation.

On successful completion of this unit students will be able to use appropriate tools to design and develop a relational database system for a substantial problem. They will be able to test the system to ensure it meets user and system requirements and fully document the system by providing technical and user documentation. For practical purposes, this unit covers relational databases and related tools and techniques. A brief overview of object-oriented databases will also be covered.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Use an appropriate design tool to design a relational database system for a substantial problem.

LO2. Develop a fully functional relational database system, based on an existing system design.

LO3. Test the system against user and system requirements.

LO4. Produce technical and user documentation.

Essential Content

LO1 Use an appropriate design tool to design a relational database system for a substantial problem

The role of database systems e.g. as back-end systems, in e-commerce, for data mining applications etc.

Determining user and system requirements.

Design tools and techniques for a relational database system.

Logical design for relational databases e.g. tables, data elements, data types, indexes, primary/foreign keys, entity relationship modelling, referential integrity, data normalisation to third normal form.

Designs for data integrity, data validations, data security and data controls.

User interface design.

Output designs for user requirements.

Overview of object-oriented databases and their design tools.

LO2 Develop a fully functional relational database system, based on an existing system design

Consideration of database and platform options for system development.

Examination of different software development options for developing the relational database system.

Implementation of the physical data model based on the logical model.

Data stores, internal storage and external storage (e.g. the cloud).

Implementation of security elements in databases.

Relational databases with controls like data validation using; input masks, drop down lists, option buttons.

User interface for requirements, functionality, reliability, consistency and performance.

Consideration of interface links with other systems e.g. internet-based applications.

Data manipulation using appropriate query tools, including complex queries to query across multiple tables, and using functions and formulae.

Database maintenance and data manipulation: inserts, updates, amendments, deletions, data backup and recovery.

System reports using report writing tools and report generators, dashboards.

LO3 **Test the system against user and system requirements**

Identify elements of the system that need to be tested.

Consider data that should be used to fully test the system.

Match tests against user and system requirements.

Test procedures to be used: test plans, test models e.g. white box, black box; testing documentation.

Functional and system testing and testing the robustness of the system, including help menus, pop-ups, hot-spots, data validation checks.

LO4 **Produce technical and user documentation**

Technical and user documentation and their contents.

The documentation can include diagrams showing movement of data through the system, and flowcharts describing how the system works. Documentation could also extend to user guides and any initial design and implementation plans.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Use an appropriate design tool to design a relational database system for a substantial problem</td><td rowspan="2">D1 Evaluate the effectiveness of the design in relation to user and system requirements.</td></tr>
<tr><td>P1 Design a relational database system using appropriate design tools and techniques, containing at least four interrelated tables, with clear statements of user and system requirements.</td><td>M1 Produce a comprehensive design for a fully functional system which includes interface and output designs, data validations and data normalisation.</td></tr>
<tr><td colspan="2">LO2 Develop a fully functional relational database system, based on an existing system design</td><td rowspan="4">LO2 & 3
D2 Evaluate the effectiveness of the database solution in relation to user and system requirements, and suggest improvements.</td></tr>
<tr><td>P2 Develop the database system with evidence of user interface, output and data validations, and querying across multiple tables.
P3 Implement a query language into the relational database system.</td><td>M2 Implement a fully functional database system which includes system security and database maintenance.
M3 Assess whether meaningful data has been extracted through the use of query tools to produce appropriate management information.</td></tr>
<tr><td colspan="2">LO3 Test the system against user and system requirements</td></tr>
<tr><td>P4 Test the system against user and system requirements.</td><td>M4 Assess the effectiveness of the testing, including an explanation of the choice of test data used.</td></tr>
<tr><td colspan="2">LO4 Produce technical and user documentation</td><td rowspan="2">D3 Evaluate the database in terms of improvements needed to ensure the continued effectiveness of the system.</td></tr>
<tr><td>P5 Produce technical and user documentation.</td><td>M5 Produce technical and user documentation for a fully functional system, including diagrams showing movement of data through the system, and flowcharts describing how the system works.</td></tr>
</table>

Recommended Resources

Textbooks

Churcher, C. (2012) *Beginning Database Design: From Novice to Professional*. 2nd Ed. Apress.

Connolly, T. and Begg, C. (2014) *Database Systems: A Practical Approach to Design, Implementation and Management*. 6th Ed. Global Edition. Pearson.

Kroemke, D. and Auer, D. (2012) *Database Concepts: International Edition*. 6th Ed. Pearson.

Paulraj, P (2008). *Database Design and Development: An Essential Guide for IT Professional*. Wiley.

Stephens, R. (2008) *Beginning Database Design Solutions*. Wrox.

Journals

International Journal of Database Management Systems

Journal of Database Management

The Computer Journal

Journal of Systems Analysis and Software Engineering

Journal of Emerging Trends in Computing and Information Sciences

Websites

www.lynda.com	Database Training (Tutorials)
mva.microsoft.com	Microsoft Virtual Academy "Database Development" (Training)
mva.microsoft.com/ebooks	Microsoft Virtual Academy "Microsoft Press" (E-Books)

Unit 5: Security

Unit code	**K/615/1623**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

Security is one of the most important challenges modern organisations face. Security is about protecting organisational assets, including personnel, data, equipment and networks from attack through the use of prevention techniques in the form of vulnerability testing/security policies and detection techniques, exposing breaches in security and implementing effective responses.

The aim of this unit is to provide students with knowledge of security, associated risks and how security breaches impact on business continuity. Students will examine security measures involving access authorisation, regulation of use, implementing contingency plans and devising security policies and procedures.

This unit introduces students to the detection of threats and vulnerabilities in physical and IT security, and how to manage risks relating to organisational security.

Among the topics included in this unit are Network Security design and operational topics, including address translation, DMZ, VPN, firewalls, AV and intrusion detection systems. Remote access will be covered, as will the need for frequent vulnerability testing as part of organisational and security audit compliance.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Assess risks to IT security.

LO2 Describe IT security solutions.

LO3 Review mechanisms to control organisational IT security.

LO4 Manage organisational security.

Essential Content

LO1 Assess risks to IT security

IT security risks:

Risks: unauthorised use of a system; unauthorised removal or copying of data or code from a system; damage to or destruction of physical system assets and environment; damage to or destruction of data or code inside or outside the system; naturally occurring risks.

Organisational security: business continuance; backup/restoration of data; audits; testing procedures e.g. data, network, systems, operational impact of security breaches, WANs, intranets, wireless access systems.

LO2 Describe IT security solutions

IT security solution evaluation:

Network Security infrastructure: evaluation of NAT, DMZ, FWs.

Network performance: RAID, Main/Standby, Dual LAN, web server balancing.

Data security: explain asset management, image differential/incremental backups, SAN servers.

Data centre: replica data centres, virtualisation, secure transport protocol, secure MPLS routing, segment routing and remote access methods/procedures for third-party access.

Security vulnerability: logs, traces, honeypots, data mining algorithms, vulnerability testing.

LO3 Review mechanisms to control organisational IT security

Mechanisms to control organisational IT security:

Risk assessment and integrated enterprise risk management: network change management, audit control, business continuance/disaster recovery plans, potential loss of data/business, intellectual property, hardware and software; probability of occurrence e.g. disaster, theft; staff responsibilities; Data Protection Act; Computer Misuse Act; ISO 31000 standards.

Company regulations: site or system access criteria for personnel; physical security types e.g. biometrics, swipe cards, theft prevention.

LO4 **Manage organisational security**

Manage organisational security:

Organisational security: policies e.g. system access, access to internet email, access to internet browser, development/use of software, physical access and protection, 3rd party access, business continuity, responsibility matrix.

Controlling security risk assessments and compliance with security procedures and standards e.g. ISO/IEC 17799:2005 Information Technology (Security Techniques – code of practice for information security management); informing colleagues of their security responsibilities and confirming their understanding at suitable intervals; using enterprise risk management for identifying, evaluating, implementing and follow up of security risks according to ISO 31000 standards.

Security: tools e.g. user log-on profiles to limit user access to resources; online software to train and update staff; auditing tools to monitor resource access; security audits; penetration testing; ethical hacking; gathering and recording information on security; initiating suitable actions for remediation.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Assess risks to IT security		**LO1 & 2** **D1** Evaluate a minimum of three of physical and virtual security measures that can be employed to ensure the integrity of organisational IT security.
P1 Identify types of security risks to organisations. **P2** Describe organisational security procedures.	**M1** Propose a method to assess and treat IT security risks.	
LO2 Describe IT security solutions		
P3 Identify the potential impact to IT security of incorrect configuration of firewall policies and third-party VPNs. **P4** Show, using an example for each, how implementing a DMZ, static IP and NAT in a network can improve Network Security.	**M2** Discuss three benefits to implement network monitoring systems with supporting reasons.	
LO3 Review mechanisms to control organisational IT security		**D2** Consider how IT security can be aligned with organisational policy, detailing the security impact of any misalignment.
P5 Discuss risk assessment procedures. **P6** Explain data protection processes and regulations as applicable to an organisation.	**M3** Summarise the ISO 31000 risk management methodology and its application in IT security. **M4** Discuss possible impacts to organisational security resulting from an IT security audit.	
LO4 Manage organisational security		**D3** Evaluate the suitability of the tools used in an organisational policy.
P7 Design and implement a security policy for an organisation. **P8** List the main components of an organisational disaster recovery plan, justifying the reasons for inclusion.	**M5** Discuss the roles of stakeholders in the organisation to implement security audit recommendations.	

Recommended Resources

Textbooks

Alexander, D. et al. (2008) *Information Security Management Principles*. BSC.

Steinberg, R. (2011) *Governance, Risk Management, and Compliance: It Can't Happen to Us – Avoiding Corporate Disaster While Driving Success*. Wiley.

Tipton, H. (2010) *Information Security Management Handbook*. 4th Ed. Auerbach Pubs.

Websites

www.bcs.org	British Computer Society (General Reference)
www.bsa.org.uk	Business Software Alliance (General Reference)
www.fast.org.uk	Federation Against Software Theft (General Reference)
www.ico.gov.uk	Information Commissioners Office (General Reference)

Unit 6: Managing a Successful Computing Project

Unit code	**T/615/1625**
Unit type	**Core unit**
Unit level	**4**
Credit value	**15**

Introduction

This unit is assessed by a Pearson-set assignment. The project brief will be set by the centre, based on a theme provided by Pearson (this will change annually). The theme and chosen project within the theme will enable students to explore and examine a relevant and current topical aspect of computing in the context of a business environment.

In order to ensure that client expectations are met in terms of requirements, deadlines and the estimated cost, the work to deliver new computer systems or services to business organisations, or to revamp the existing ones, is always organised in projects. Therefore, skilful, knowledgeable and experienced project managers have always been in demand. It is projected that 15.7 million new project management roles will be created around the world by 2020.

The aim of this unit is to offer students an opportunity to demonstrate the skills required for managing and implementing a project. They will undertake independent research and investigation for carrying out and executing a computing project which meets appropriate aims and objectives.

On successful completion of this unit students will have the confidence to engage in decision-making, problem-solving and research activities using project management skills. They will have the fundamental knowledge and skills to enable them to investigate and examine relevant computing concepts within a work-related context, determine appropriate outcomes, decisions or solutions and present evidence to various stakeholders in an acceptable and understandable format.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Establish project aims, objectives and timeframes based on the chosen theme.

LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project.

LO3 Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis.

LO4 Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance.

Essential Content

LO1 Establish project aims, objectives and timeframes based on the chosen theme

Project management:

What is project management and what does it involve?

The key stages of project management.

The advantages of using project management and why it is important.

Initiation of the project and project planning phase:

Scoping a project – defining objectives, scope, purpose and deliverables to be produced.

Steps and documentation required in the initiation phase.

Developing the project plan, including planning for timescales and time management, cost, quality, change, risk and issues.

The work breakdown structure.

Use of Bar and Gantt Charts for effective planning.

LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project

Project execution phase:

Selecting appropriate methods of information gathering, data collection and material resourcing.

The distinct phases which support a coherent and logical argument.

Use of secondary research to inform a primary empirical study.

Qualitative and quantitative research methods.

Field work:

Selecting a sample of the consumer market, businesses or individuals (those who meet certain characteristics relevant to the research theme) is used to gather data (qualitative or quantitative).

Sampling approaches and techniques, including probability and non-probability sampling.

Ethics, reliability and validity:

All research should be conducted ethically – how is this achieved and reported?

Research should also be reliable (similar results achieved from a similar sample) and valid (the research should measure what it aimed to measure).

Analysing information and data:

Using data collection tools such as interviews and questionnaires.

Using analytical techniques such as trend analysis, coding or typologies.

LO3 **Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis**

Communicating outcomes:

Consider the method (e.g. written, verbal) and the medium (e.g. report, online, presentation).

Both method and medium will be influenced by the project research and its intended audience.

Convincing arguments:

All findings/outcomes should be convincing and presented logically where the assumption is that the audience has little or no knowledge of the project process.

Developing evaluative conclusions.

Critical and objective analysis and evaluation:

Secondary and primary data should be critiqued and considered with an objective mindset.

Objectivity results in more robust evaluations where an analysis justifies a judgement.

LO4 **Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance**

Reflection for learning and practice:

The difference between reflecting on performance and evaluating a project – the former considers the research process, information gathering and data collection, the latter the quality of the research argument and use of evidence.

The cycle of reflection:

To include reflection in action and reflection on action.

How to use reflection to inform future behaviour, particularly directed towards sustainable performance.

Reflective writing:

Avoiding generalisation and focusing on personal development and the research journey in a critical and objective way.

Generalisation:

Many studies result in generalised findings. Research which has its basis in a specific field such as Human Resource Management (HRM) and in a specific context should avoid generalised conclusions.

Outcomes should be specific and actionable.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Establish project aims, objectives and timeframes based on the chosen theme</td><td rowspan="5">LO1 & 2

D1 Critically evaluate the project management process and appropriate research methodologies applied.</td></tr>
<tr><td>P1 Devise project aims and objectives for a chosen scenario.

P2 Produce a project management plan that covers aspects of cost, scope, time, quality, communication, risk and resources.

P3 Produce a work breakdown structure and a Gantt Chart to provide timeframes and stages for completion.</td><td>M1 Produce a comprehensive project management plan, milestone schedule and project schedule for monitoring and completing the aims and objectives of the project.</td></tr>
<tr><td colspan="2">LO2 Conduct small-scale research, information gathering and data collection to generate knowledge to support the project</td></tr>
<tr><td>P4 Carry out small-scale research by applying qualitative and quantitative research methods appropriate for meeting project aims and objectives.</td><td>M2 Evaluate the accuracy and reliability of different research methods applied.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis		
P5 Analyse research and data using appropriate tools and techniques. **P6** Communicate appropriate recommendations as a result of research and data analysis to draw valid and meaningful conclusions.	**M3** Evaluate the selection of appropriate tools and techniques for accuracy and authenticity to support and justify recommendations.	**LO3** **D2** Critically evaluate the research and data analysis tools used in the project development stages..
LO4 Reflect on the value gained from conducting the project and its usefulness to support sustainable organisational performance		
P7 Reflect on the value of undertaking the research to meet stated objectives and own learning and performance.	**M4** Evaluate the value of the project management process and use of quality research to meet stated objectives and support own learning and performance.	**LO4** **D3** Critically evaluate how the project supports sustainable organisational performance.

Additional Evidence Requirements

In addition to the above assessment criteria, students will also be required to complete a project logbook to record ideas, changes and developments as they progress and complete the project.

Recommended Resources

Textbooks

Costley, C., Elliot, G. and Gibbs, P. (2010) *Doing Work Based Research: Approaches to Enquiry for Insider-researchers*. London: SAGE.

Dawson, C. (2016) *Projects in Computing and Information Systems: A Student's Guide*. UK: Pearson Education.

Flick, U. (2011) *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project*. London: SAGE.

Gray, D. (2009) *Doing Research in the Real World*. 2nd Ed. London: SAGE.

Guay, M., Schreiber, D. and Briones, S. (2016) *The Ultimate Guide to Project Management: Learn everything you need to successfully manage projects and get them done*. Free Kindle Edition. US: Zapier Inc.

Lock, D. (2013) *Project Management 8th Edition*. UK: Routledge.

Pinto, J.K. (2015) *Project Management: Achieving Competitive Advantage* 4th Ed. Pearson.

Journals

International Journal of Quantitative and Qualitative Research
Qualitative Research Journal

Websites

www.gov.uk/government/publications	Department of Business Innovations and Skills "Guidelines for managing projects – How to organise, plan and control projects." (Report)

Unit 13: Computing Research Project

Unit code	**T/615/1639**
Unit type	**Core**
Unit level	**5**
Credit value	**30**

Introduction

This unit is assessed by a Pearson-set assignment. Students will choose their own project based on a theme provided by Pearson (this will change annually). The project must be related to their specialist pathway of study (unless the student is studying the general computing pathway). This will enable students to explore and examine a relevant and current topical aspect of computing in the context of a business environment and their chosen specialist pathway.

The aim of this unit is to offer students the opportunity to engage in sustained research in a specific field of study. The unit enables students to demonstrate the capacity and ability to identify a research theme, to develop research aims, objectives and outcomes, and to present the outcomes of such research in both written and verbal formats. The unit also encourages students to reflect on their engagement in the research process during which recommendations for future, personal development are key learning points.

On successful completion of this unit students will have the confidence to engage in problem-solving and research activities which are part of the function of a manager. Students will have the fundamental knowledge and skills to enable them to investigate workplace issues and problems, determine appropriate solutions and present evidence to various stakeholders in an acceptable and understandable format.

As a result they will develop skills such as communication literacy, critical thinking, analysis, synthesis, reasoning and interpretation which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Examine appropriate research methodologies and approaches as part of the research process.

LO2 Conduct and analyse research relevant to a computing research project.

LO3 Communicate the outcomes of a research project to identified stakeholders.

LO4 Reflect on the application of research methodologies and concepts.

Essential Content

LO1 Examine appropriate research methodologies and approaches as part of the research process

Developing a research proposition:

The importance of developing methodical and valid propositions as the foundation for a research project.

Rationale: the purpose and significance for research question or hypothesis.

The value of the philosophical position of the researcher and the chosen methods.

Use of Saunders's research onion as a guide to establishing a methodological approach.

Literature review:

Conceptualisation of the research problem or hypothesis.

The importance of positioning a research project in context of existing knowledge.

Significance and means of providing benchmarks by which data can be judged.

Qualitative, quantitative and mixed method research:

Key theoretical frameworks for research.

Advantages and limitations of qualitative and quantitative research approaches and methods.

LO2 Conduct and analyse research relevant for a business research project

Research as a process:

Research has distinct phases which support a coherent and logical argument. This includes using secondary research to inform a primary, empirical, study.

Selecting a sample:

The importance of gathering data and information (qualitative or quantitative) to support research analysis.

Selecting sample types and sizes that are relevant to the research.

Considering sampling approaches and techniques, including probability and non-probability sampling.

Ethics, reliability and validity:

Research should be conducted ethically. How is this achieved and reported?

Research should also be reliable (similar results would be achieved from a similar sample) and valid (the research measures what it aimed to measure).

Analysing data:

Using data collection tools such as interviews and questionnaires.

Using analytical techniques such as trend analysis, coding or typologies.

LO3 Communicate the outcomes of a research project to identified stakeholders

Stakeholders:

Who are they?

Why would they be interested in the research outcomes?

What communication method do they expect?

Communicating research outcomes:

Consideration of different methods of communicating outcomes (e.g. written word, spoken word) and the medium (e.g. report, online, presentation). The method and medium will be influenced by the research and its intended audience.

Convincing arguments:

No matter what the method/medium, all research should be convincing and presented logically where the assumption is that the audience has little or no knowledge of the research process.

The importance of developing evaluative conclusions.

LO4 **Reflect on the application of research methodologies and concepts**

Reflection for learning and practice:

Difference between reflecting on performance and evaluating a research project. The former considers the research process; the latter considers the quality of the research argument and use of evidence.

Reflection on the merits, limitations and potential pitfalls of the chosen methods.

The cycle of reflection:

To include reflection in action and reflection on action.

Considering how to use reflection to inform future behaviour and future considerations.

Reflective writing:

Avoiding generalisation and focusing on personal development and the research journey in a critical and objective way.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine appropriate research methodologies and approaches as part of the research process</td><td rowspan="5">LO1 & LO2

D1 Critically evaluate research methodologies and processes in application to a computing research project to justify chosen research methods and analysis.</td></tr>
<tr><td>P1 Produce a research proposal that clearly defines a research question or hypothesis supported by a literature review.

P2 Examine appropriate research methods and approaches to primary and secondary research.</td><td>M1 Evaluate different research approaches and methodology and make justifications for the choice of methods selected based on philosophical/theoretical frameworks.</td></tr>
<tr><td colspan="2">LO2 Conduct and analyse research relevant for a business research project</td></tr>
<tr><td>P3 Conduct primary and secondary research using appropriate methods for a computing research project that consider costs, access and ethical issues.

P4 Apply appropriate analytical tools, analyse research findings and data.</td><td>M2 Discuss merits, limitations and pitfalls of approaches to data collection and analysis.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Communicate the outcomes of a research project to identified stakeholders		
P5 Communicate research outcomes in an appropriate manner for the intended audience.	**M3** Communicate outcomes to the intended audience demonstrating how outcomes meet set research objectives.	**D2** Communicate critical analysis of the outcomes and make valid, justified recommendations.
LO4 Reflect on the application of research methodologies and concepts		
P6 Reflect on the effectiveness of research methods applied for meeting objectives of the computing research project. **P7** Consider alternative research methodologies and lessons learnt in view of the outcomes.	**M4** Analyse results in recommended actions for improvements and future research considerations.	**D3** Demonstrate reflection and engagement in the resource process leading to recommended actions for future improvement.

Recommended Resources

Textbooks

Cornford, T. (2005) *Project Research in Information Systems: A Student's Guide*. Paperback. Macmillan.

Costley, C., Elliot, G. and Gibbs, P. (2010) *Doing Work Based Research: Approaches to Enquiry for Insider-researchers*. London: SAGE.

Fink, A. (2009) *Conducting Research Literature Reviews: From the Internet to Paper*. 3rd Ed. Sage Inc.

Flick, U. (2011) *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project*. London: SAGE.

Gray, D. (2009) *Doing Research in the Real World*. 2nd Ed. London: SAGE.

Saunders, M, Lewis, P and Thornhill, A. (2012) *Research methods for Business Students*. 6th Ed. Harlow: Pearson.

Wellington, J. (2000) *Educational Research: Contemporary Issues and Practical Approaches*. Continuum International Publishing Group Ltd.

Journals

International Journal of Quantitative and Qualitative Research

Qualitative Research Journal

Links

This unit links to the following related units:

Unit 3: Professional Practice

Unit 6: Managing a Successful Computing Project

Unit 9: Software Development Lifecycles

Unit 14: Business Intelligence

Unit code	**M/615/1641**
Unit type	**Core**
Unit level	**5**
Credit value	**15**

Introduction

Data and information is core to any organisation and business process. The necessity of having meaningful information is the key driver for effective decision-making and problem-solving. Business intelligence has evolved from technologies such as decision support systems (DSS) to include tools and methods associated with data mining, data integration, data quality and data warehousing in conjunction with other information management systems and applications.

This unit introduces students to a range of tools, techniques and technologies for acquiring data and processing this into meaningful information that can be used to support business functions and processes.

Within this unit students will examine the concept of business processing in terms of data capture, conversion and information output. Students will also be required to define the tools and technologies associated with business intelligence functionality. The use of a business intelligence tool/s and techniques is also required to demonstrate an understanding of a given problem. Finally, students will be expected to evaluate the impact of business intelligence for effective decision-making.

On successful completion of this unit students will be able to appreciate the importance of business intelligence in terms of optimising decision-making and performance. By exploring the tools, techniques and systems that support business intelligence students will have an awareness of the role and contribution that these technologies and methodologies have and their importance to organisations.

As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Discuss business processes and the mechanisms used to support business decision-making.

LO2 Compare the tools and technologies associated with business intelligence functionality.

LO3 Demonstrate the use of business intelligence tools and technologies.

LO4 Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used.

Essential Content

LO1 Discuss business processes and the mechanisms used to support business decision-making

Business process model:

Data input and capture, data processing/conversion and information output, security considerations; unstructured and semi-structured data.

Tactical and operational decisions, the business process model, business intelligence functionality.

Analyse and compare the systems and technologies associated with business intelligence.

Mechanisms:

Application software, databases, which are used to collect and store intelligence.

Systems that are used to manage, analyse and display business intelligence to support the decision-making process; the importance of reliable data; impacts of reliable data in businesses.

Business processes:

Management e.g. supporting decision-making, problem-solving; operational e.g. sales, purchasing and marketing; support e.g. accounting, technical supporting processes; improving the efficiency of a business process e.g. forecasting, decision-making, predictive reasoning; automating processes e.g. print runs, salary slips etc.

LO2 Compare the tools and technologies associated with business intelligence functionality

Support for business decisions:

Operational tactical and strategic. Operational examples could include product positioning or pricing. Tactical decisions could include financial outlays to gain competitive advantage. Strategic business decisions could include priorities, goals setting and forecasting for the future, global diversification etc.

Business intelligence functionality:

Analysing data, decision-making, problem-solving, designing more intuitive/innovative systems.

Systems and technologies:

Information systems at an operational, tactical and strategic level. Transaction processing, management information systems, decision support systems, expert systems.

LO3 **Demonstrate the use of business intelligence tools and technologies**

Tools and techniques:

Descriptive and predictive analysis, predictive modelling e.g. forecasting, use of statistical models to predict and identify trends. Data mining techniques to find anomalies, cluster patterns and/or relationships between data sets. Converting data into visual information using charts, graphs, histograms and other visual mediums.

Solutions:

Supporting a business process e.g. end user requirements, systems requirement, application to automate procedures. Designing a tool, program or package that can perform a specific task to support problem-solving or decision-making at an advanced level.

Uses:

For example, designing an application to solve a specific user need or system requirement. Create an e-commerce function for a website to support a specific business process, design a program for a specific end user that will support another application or process.

Design considerations:

Addressing a user or system requirement; designing a user-friendly and functional interface; considering user engagement and interaction with the designed solution; customisation of the solution to satisfy the user and system requirements.

LO4 **Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used**

Recognise the legal, social, ethical and professional issues involved in the exploitation of computer technology.

Cybersecurity management:

Understanding the personal, organisational and legal/regulatory context in which these tools could be used, the risks of such use and the constraints (such as time, finance and people) that may affect how cybersecurity is implemented.

Evaluation criteria:

Enhanced or improved operations e.g. more efficient, faster results, more user-friendly, higher productivity, extended target audience, more competitive, more profitable, improved customer service.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Discuss business processes and the mechanisms used to support business decision-making</td><td rowspan="2">D1 Evaluate the benefits and drawbacks of using application software as a mechanism for business processing.</td></tr>
<tr><td>P1 Examine, using examples, the terms 'Business Process' and 'Supporting Processes'.</td><td>M1 Differentiate between unstructured and semi-structured data within an organisation.</td></tr>
<tr><td colspan="2">LO2 Compare the tools and technologies associated with business intelligence functionality</td><td rowspan="2">D2 Compare and contrast a range of information systems and technologies that can be used to support organisations at operational, tactical and strategic levels.</td></tr>
<tr><td>P2 Compare the types of support available for business decision-making at varying levels within an organisation.</td><td>M2 Justify, with specific examples, the key features of business intelligence functionality.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Demonstrate the use of business intelligence tools and technologies		
P3 Determine, with examples, what business intelligence is and the tools and techniques associated with it. **P4** Design a business intelligence tool, application or interface that can perform a specific task to support problem-solving or decision-making at an advanced level.	**M3** Customise the design to ensure that it is user-friendly and has a functional interface.	**D3** Provide a critical review of the design in terms of how it meets a specific user or business requirement and identify what customisation has been integrated into the design.
LO4 Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used		
P5 Discuss how business intelligence tools can contribute to effective decision-making. **P6** Explore the legal issues involved in the secure exploitation of business intelligence tools.	**M4** Conduct research to identify specific examples of organisations that have used business intelligence tools to enhance or improve operations.	**D4** Evaluate how organisations could use business intelligence to extend their target audience and make them more competitive within the market, taking security legislation into consideration.

Recommended Resources

Textbooks

Boyer, J. (2010) *Business Intelligence Strategy*. MC Press (US).

Jeston, J. and Nelis, J. (2014) *Business Process Management*. 3rd Ed. Routledge.

Kolb, J. (2013) *Business Intelligence in Plain Language: A practical guide to Data Mining and Business Analytics*. CreateSpace Independent Publishing Platform.

Marr, B. (2015) Big Data: *Using Smart Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance*. 1st Ed. John Wiley & Sons, Ltd.

Journals

International Journal of Business Intelligence and Data Mining

International Journal of Business Intelligence Research (IJBIR)

Websites

businessintelligence.com	Business Intelligence (General Reference)
business-intelligence.ac.uk	Business Intelligence Project for HE (General Reference)

Unit 15: Transport Network Design

Unit code	**T/615/1642**
Unit level	**5**
Credit value	**15**

Introduction

The exponential growth of the World Wide Web has put unprecedented demands on private and public networking infrastructures. The traffic generated by private and commercial networks has become dominated by Voice-over-IP and video on demand. These developments require existing infrastructures to be adapted and that the design of new networks mitigate best-effort delivery issues, avoid low bandwidths and high latency problems and be based on traffic priority. In order for enterprise networks and internet infrastructures to meet expected demands, their design will have to take into consideration principles such as availability, scalability, resiliency, reliability and quality of service (QoS). As a result, network engineers designing and supporting enterprise or Internet Service Provider networks will need the knowledge and skills to support diverse business needs, such as converged network traffics, centralised control and mission-critical applications.

This unit introduces students to the enterprise network design principles, design models, scalable networks and their effectiveness in supporting business requirements. After evaluating the features of scalable networks, such as availability, reliability and hierarchy, the students are expected to apply network design principles in the design and implementation of redundant networks to provide Layer 2 and Layer 3 redundant solutions. The students are also expected to evaluate Wide Area Network (WAN) technologies and make choices based on specific enterprise requirements, and to implement a range of WAN connections and protocols such as Point-to-Point, Frame Relay and VPN with IPSec using network simulators or network lab equipment. In addition, they will also solve network-related issues using network monitoring and troubleshooting methods and techniques.

Among the topics included in this unit are: network design principles, network design modules, features of enterprise IT networks, such as scalability, reliability, availability and hierarchy, LAN redundancy and related issues, spanning tree protocols, router redundancy protocols, link aggregation, in-band and out-of-band network device management, features and characteristics of WAN networks, WAN technologies and protocols, such as PPP, Frame Relay and VPN with IPSec, network monitoring tools, Network Security, network documentation, network troubleshooting methods and LAN and WAN connectivity issues.

On successful completion of this unit students will be able to evaluate LAN design principles and their application in the network design process, implement a network using LAN design principles based on a predefined set of requirements, produce an appropriate WAN solution to a set of organisational requirements and solve a range of network-related problems using appropriate troubleshooting techniques and methods.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Explore LAN design principles and their application in the network design process.

LO2 Implement a network using LAN design principles based on a predefined set of requirements.

LO3 Produce an appropriate WAN solution to a set of organisational requirements.

LO4 Solve a range of network related problems using appropriate troubleshooting techniques and methods.

Essential Content

LO1 Explore LAN design principles and their application in the network design process

Discuss and evaluate LAN design principles based on business needs:

Analysing diverse business needs: support critical applications, support converged network traffic, centralised administrative control.

Network features: bandwidth, delay, load.

Evaluate LAN design models:

Review of OSI and TCP/IP models, three-layer design model, enterprise architecture design model, features of scalable networks (redundancy, hierarchy, scalability, availability, reliability and small failure domains).

Analyse LAN redundancy:

Issues related to redundancy, spanning tree concepts, Spanning Tree Protocols.

Solving bandwidth and load related issues:

Examine link aggregation concepts and operations, configure link aggregation using EtherChannel technology.

Evaluate the need for redundancy at router level:

Default Gateway related issues, router redundancy protocols.

LO2 Implement a network using LAN design principles based on a predefined set of requirements

Application of LAN design principles in network design and configuration:

Selecting network devices to implement a LAN design: use modularity, stackability, port density, switch forwarding, multi-layer switching and router requirements in the selection process.

Configuring LAN devices:

Compare out-of-band and in-band management, evaluate user interfaces, examine operating system management and licencing issues, basic device configuration.

Implementing Layer 2 LAN redundancy:

Configuration of different Spanning Tree Protocols (STP and Rapid STP).

Implementing Layer 3 LAN redundancy for IPv4:

Configuring First Hop Redundancy Protocols (Hot Standby Routing Protocol, Virtual Router Redundancy Protocol and Gateway Load Balancing Protocol).

Implementing Layer 3 LAN redundancy for IPv6:

Configuring the 'new generation' of redundancy routing protocols e.g. OSPFv3, RIPng (RIP New Generation); stateless address auto-configuration.

LO3 **Produce an appropriate WAN solution to a set of organisational requirements**

WAN networks and protocols:

Analyse features and requirements of enterprise networks: analyse WAN enterprise architecture, uptime, bandwidth, ISPs, traffic flows, prioritisation, queuing algorithms, latency, QoS models, teleworking.

WAN Technologies:

Examine WAN operations and services, analyse and compare private and public WAN technologies, select the appropriate WAN protocol and service for a specific network requirement.

WAN serial connections:

Configuring Point-to-Point connections using Point-to-Point Protocol (PPP): explain point-to-point serial WAN serial communication, analyse and configure HDLC, analyse and configure PPP.

Configuring Frame Relay:

Analyse and compare Frame Relay and leased lines benefits and drawbacks, explain Frame Relay protocol Permanent Virtual Circuits (PVC), Link Management Interface (LMI) extensions, Data Link Connection Identifier (DLCI) mappings, configure static Frame Relay, implement advanced Frame Relay configurations.

VPN over a public infrastructure connection:

Explaining Virtual Private Network (VPN) features and benefits, compare VPN types, configure site-to-site secure tunnel connections, configure VPN with IP Security (IPSec) and compare IPSec and SSL VPNs (Secure Socket Layer).

LO4 **Solve a range of network related problems using appropriate troubleshooting techniques and methods**

Network Security considerations:

Network Security issues, their impacts and solutions.

Network monitoring and troubleshooting methods:

Network monitoring tools: analyse, compare and configure Syslog, Network Time Protocol (NTP), NetFlow and Simple Network Management Protocol (SNMP).

Network troubleshooting: establishing network baselines, troubleshooting methods with a systematic approach, gathering information, questioning end users, preparing network documentation, comparing network troubleshooting tools.

Troubleshooting LAN and WAN connectivity issues:

Physical and Data Link layers networking issues and troubleshooting: examine cable faults, device failures, bottlenecks, congestions, attenuation, noise, power issues (redundant power supplies), encapsulation mismatches, STP related issues, etc.

Network layer issues and troubleshooting:

Evaluate divide and conquer method, importance of ipconfig, ping and traceroute commands, subnetting issues, troubleshooting routing protocols, PPP, Frame Relay and VPN configuration issues.

Transport and Application layers networking issues and troubleshooting:

Examine the use of port numbers in Access Control Lists, denying and allowing errors, ACL misconfigurations, NAT, DNS and DHCP related issues.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Explore LAN design principles and their application in the network design process</td><td rowspan="5">LO1 & LO2

D1 Evaluate different implementations of link aggregation using EtherChannel to solve bandwidth and load issues.</td></tr>
<tr><td>P1 Examine the network design models and features of scalable networks based on a given set of business needs.

P2 Discuss LAN redundancy, bandwidth and load related issues and possible solutions with reference to Layer 2 and Layer 3 of the OSI Model.</td><td>M1 Analyse the switch and router redundancy protocols and their effectiveness in supporting scalable networks.</td></tr>
<tr><td colspan="2">LO2 Implement a network using LAN design principles based on a predefined set of requirements</td></tr>
<tr><td>P3 Select LAN devices based on features and requirements, and apply basic configuration commands for network connectivity.

P4 Implement a LAN design with Layer 2 and Layer 3 redundancy using switch and router redundancy protocols.</td><td>M2 Analyse different switch redundancy protocols and their effectiveness in solving redundancy issues.

M3 Analyse Layer 3 redundancy implementations for IPv4 and IPv6.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Produce an appropriate WAN solution to a set of organisational requirements		
P5 Examine WAN technologies and select the appropriate one for a set of enterprise requirements. **P6** Configure WAN protocols as part of an enterprise network solution.	**M4** Analyse the benefits and drawbacks of private and public WAN technologies. **M5** Evaluate features and benefits of different VPN types based on organisational needs.	**LO3 & 4** **D2** Evaluate troubleshooting methods and their effectiveness in solving enterprise-wide networking issues.
LO4 Solve a range of network related problems using appropriate troubleshooting techniques and methods		
P7 Deploy network monitoring tools and troubleshooting methods to establish network baselines and produce network documentation. **P8** Troubleshoot LAN and WAN connectivity issues at different networking layers.	**M6** Develop effective documentation of troubleshooting methods and steps based on a given scenario.	

Recommended Resources

Textbooks

Meyers, M. (2015) *CompTIA Network+ Guide to Managing and Troubleshooting Networks, Fourth Edition*. London, UK: McGraw Hill Professional.

Subramanian, M. (2012) *Network Management: Principles and Practices*. USA: Prentice Hall.

Thomatis, M. (2015) *Network Design Cookbook: Architecting Cisco Networks*. USA: Lulu Press, Inc.

White, R. and Donohue, D. (2014) *The Art of Network Architecture: Business-Driven Design*. USA: Cisco Press.

Unit 16: Cloud Computing

Unit code	**F/615/1644**
Unit level	**5**
Credit value	**15**

Introduction

Cloud Computing has revolutionised the way IT services are delivered and has become an important part of the computing sector. Cloud Computing is internet-hosted computing, which means it uses the internet to deliver data and other IT services such as storage, printing, server facilities and so forth. In other words, the end users or organisations no longer need to have their own extensive network environment on the premises, but can get the same services provided virtually over the internet.

The fundamental difference between traditional networking and Cloud Computing is that the technical details of the system are hidden from the end user. That means the networking infrastructure does not have to be on the premises as it would be hosted off-site in the cloud. However, the end user can use the services without the fear of technical difficulties or disasters as it would be managed by the cloud service provider. Cloud Computing is a natural evolution of networking and is adapting the modern network-oriented technologies such as virtualisation, service-oriented architecture, utility computing and ubiquitous computing among others.

This unit is designed to develop an understanding of the fundamental concept of Cloud Computing, cloud segments, and cloud deployment models, the need for Cloud Computing, an appreciation of issues associated with managing cloud service architecture and to develop a critical awareness of Cloud Computing based projects.

Topics included in the unit are the paradigms of networking, fundamentals of Cloud Computing, Cloud Computing architecture, deployment models, service models, security, technological drivers, and cloud service providers.

On successful completion of this unit, students will understand the concept, architecture, and services of Cloud Computing and will gain hands-on experience of configuring a cloud service from major providers such as ECM, Google, Amazon, Microsoft, IBM etc., and implementing a simple cloud platform using open source software with an appropriate networking platform.

As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures.

LO2. Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use.

LO3. Develop Cloud Computing solutions using service provider's frameworks and open source tools.

LO4. Analyse the technical challenges for cloud applications and assess their risks.

Essential Content

LO1 Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures

Networking Paradigm:

Peer-to-peer computing, client-server computing, distributed computing, cluster computing, high-performance computing, parallel computing, grid computing.

Cloud Computing Fundamentals:

Definition of cloud computing, principles of cloud computing, cloud ecosystem, cloud architecture and infrastructure, virtualisation, network connectivity, managing the cloud, application migration to the cloud.

LO2 Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use

Deployment models:

Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud.

Service models:

IaaS, PaaS, SaaS, AaaS.

Infrastructure as a service (IaaS) is a form of cloud computing that provides virtualized computing resources over the internet. IaaS is one of the three main categories of cloud computing services, alongside software as a service (SaaS) and platform as a service (PaaS)

Software as a service (SaaS) is a cloud computing offering that provides users with access to a vendor's cloud-based software.

Analytics as a service (AaaS) refers to the provision of analytics software and operations through web-delivered technologies.

Technological drivers:

SOA, Virtualisation, Multicore Technology, Memory and Storage Technology, Networking Technology, Web 2.0, & 3.0, Software Process Models for Cloud, Programming Models, Pervasive Computing, Application Environment.

LO3 **Develop Cloud Computing solutions using service provider's frameworks and open source tools**

Cloud Service Providers:

EMC, Google, Amazon Web Services, Microsoft, IBM, VMware.

Open Source:

Open Source Tools for IaaS, Open Source Tools for PaaS, Open Source Tools for SaaS, Distributed Computing Tools: Cassandra, Hadoop, MongoDB, NGrid, Ganglia.

LO4 **Analyse the technical challenges for cloud applications and assess their risks**

Security aspects:

Data Security, Virtualisation, Network Security.

Platform related security:

SaaS Security issues, PaaS Security Issues, IaaS Security Issues, Audit and Compliance.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures</td><td rowspan="5">LO1 & LO2

D1 Justify the tools chosen to realise a Cloud Computing solution.</td></tr>
<tr><td>P1 Analyse the evolution and fundamental concepts of Cloud Computing.

P2 Design an appropriate architectural Cloud Computing framework for a given scenario.</td><td>M1 Discuss why an organisation should migrate to a Cloud Computing solution.</td></tr>
<tr><td colspan="2">LO2 Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use</td></tr>
<tr><td>P3 Define an appropriate deployment model for a given scenario.

P4 Compare the service models for choosing an adequate model for a given scenario.</td><td>M2 Demonstrate these deployment models with real world examples.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Develop Cloud Computing solutions using service provider's frameworks and open source tools		
P5 Configure a Cloud Computing platform with a cloud service provider's framework. **P6** Implement a cloud platform using open source tools.	**M3** Discuss the issues and constraints one can face during the development process.	**D2** Critically discuss how one can overcome these issues and constraints.
LO4 Analyse the technical challenges for cloud applications and assess their risks		
P7 Analyse the most common problems which arise in a Cloud Computing platform and discuss appropriate solutions to these problems. **P8** Assess the most common security issues in cloud environments.	**M4** Discuss how to overcome these security issues when building a secure cloud platform.	**D3** Critically discuss how an organisation should protect their data when they migrate to a cloud solution.

Recommended Resources

Textbooks

Chandrasekaran, K. (2015) *Essentials of Cloud Computing*, CRC Press.

Kapadia, A., Varma, S. and Rajana, K. (2014) *Implementing Cloud Storage with OpenStack*. Packt Publishing.

Patawari, A. (2013) *Getting Started with own Cloud*. Packt Publishing.

Rhoton, J. and De Clercq, J. (2014) *OpenStack Cloud Computing: Architecture*. Recursive Press.

Thomas Eri, T. and Ricardo Puttin, R. (2013) *Cloud Computing: Concept, Technology and Architecture*. Prentice Hall.

Zhu, S-Y. and Hill, R. (2016) *Guide to Security Assurance for Cloud Computing*, Springer.

Links

This unit links to the following related units:

Unit 48: Systems Integration

Unit 17: Network Security

Unit code	**L/615/1646**
Unit level	**5**
Credit value	**15**

Introduction

“Who is accessing my network?" A bank was hacked last week? Did you hear about that? Last night I blocked my neighbours from accessing their internet because they did not have a Wireless Equivalent Protection (WEP) or WPA (Wi-Fi Protected Access) key on their wireless.”

It is estimated that Network Security (NS) breaches occur every second worldwide from small home networks to massive corporate networks. The cost to businesses is in billions, if not trillions. There are several methods, techniques and procedures that need to be implemented on a network in order for it to be ‘secure’. Sometimes basic procedures such as locking your network room, changing your password regularly, as well as putting a password on all your network devices, is all that is needed to achieve some basic network security.

This unit introduces students to the fundamental principles of Network Security practices. As Systems Administration and Management are important tasks in the day-to-day functioning and security of Information Systems, poor or improper practices can lead to loss of data, its integrity, performance reductions, security breaches or total system failure. Special planning and provisions needs to be made for ongoing support of systems and networks, which account for a significant proportion of the IT budget. With the widespread use of computers and the internet for business customers and home consumers, the topic of security continues to be a source for considerable concern.

Among the topics included in this unit are: historical Network Security (NS) principles and associated aspects such as Firewalls, Routers, Switches, MD5, SSL, VPN, AES, SHA-1/2, RSA, DES, 3DES; different types of public and private key cryptography such as Caesar Cipher, IPSec; types of attacks that can be done on a network and methods of preventing such attacks such as Man-In-the-Middle (eavesdropping), Denial of Service (DoS), Distributed Denial of Service (DDoS) (ping); Certificate Authority (CA); ‘The Cloud’ Security aspects and associated counter-measures such Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS), phishing, spoofing, DNS attack, SQL Injection, MAC Address spoofing/control. Firewalls and other Gateways can be used as a tool for Intrusion Detection and Prevention as they can be situated on the perimeter of the Network to provide security.

On successful completion of this unit students will be able to discuss with confidence several types of Network Security measures as well as associated protocols, cryptographic types and configuration settings of Network Security environments. Finally, students will be able to test the security of a given network to identify and fix vulnerabilities.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Examine Network Security principles, protocols and standards.

LO2. Design a secure network for a corporate environment.

LO3. Configure Network Security measures for the corporate environment.

LO4 Undertake the testing of a network using a Test Plan.

Essential Content

LO1 **Examine Network Security principles, protocols and standards**

The history of Network Security.

Formation and role of CERT, common and advanced cyber security threats and techniques e.g. malware, DoS etc, network vulnerabilities, threat actors, threat actor tools.

Network Security devices:

Security frameworks, Authentication, Authorisation, Accounting (AAA), The historical Network Security (NS) principles and associated aspects such as Firewalls, Routers, Switches.

Network Security protocols:

MD5, SSL, VPN, AES, SHA-1/2, RSA, DES, 3DES, IPSec, DNS, DHCP, HTTP, HTTPs, FTP, FTPs, POP3, SMTP, IMAP.

Network Security cryptographic types:

Different types of public and private key cryptography such as Caesar Cipher, Vigenere, Hash.

LO2 **Design a secure network for a corporate environment**

Build a network

Planning a network:

Considerations must be thought through on what the network will be used for (purpose) according to the scenario.

Hardware and software considerations:

What hardware and software will be used on the network?

LO3 **Configure Network Security measures for the corporate environment**

Configure Network Security:

Configure Network Security measures such as Firewalls, Routers, Switches, Gateways, SSL, IPSec, HTTPs, FTPs, passwords and backup devices.

LO4 **Undertake the testing of a network using a Test Plan**

Testing methods:

Different testing methods should be understood in terms of checks on network connection speed, ethernet cards, testing for network vulnerabilities etc.

Create a Test Plan, test the Network Security and make some recommendations.

Create a Test Plan:

Testing data, expected results, actual results.

Comprehensively Test all devices and the whole environment:

Tests should be carried out on all devices (Firewall, Servers, Domain Controllers, Email Servers, Routers, Switches, gateways, passwords).

Make recommendations:

Make recommendations for improving the Network Security for your environment (scenario).

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine Network Security principles, protocols and standards</td><td rowspan="4">LO1 & LO2
D1 Review the importance of network security to an organisation.</td></tr>
<tr><td>P1 Discuss the different types of Network Security devices.
P2 Examine Network Security protocols.</td><td>M1 Compare and contrast at least two major Network Security protocols.</td></tr>
<tr><td colspan="2">LO2 Design a secure network for a corporate environment</td></tr>
<tr><td>P3 Investigate the purpose and requirements of a secure network according to a given scenario.
P4 Determine which network hardware and software to use in this network.</td><td>M2 Create a design of a secure network according to a given scenario.</td></tr>
<tr><td colspan="2">LO3 Configure Network Security measures for the corporate environment</td><td rowspan="2">D2 Review what is meant by Quality of Service (QoS) in relation to Network Security configuration.</td></tr>
<tr><td>P5 Configure Network Security for your network.
P6 Discuss different cryptographic types of Network Security.</td><td>M3 Provide Network Security configuration scripts/files/screenshots with comments.</td></tr>
<tr><td colspan="2">LO4 Undertake the testing of a network using a Test Plan</td><td rowspan="2">D3 Critically evaluate the design, planning, configuration and testing of your network.</td></tr>
<tr><td>P7 Create a Test Plan for your network.
P8 Comprehensively test your network using the devised Test Plan.</td><td>M4 Provide scripts/files/ screenshots of the testing of your network.
M5 Make some improvement recommendations.</td></tr>
</table>

Recommended Resources

Textbooks

Burgess, M. (2003) *Principles of Systems and Network Administration*. Chichester: John Wiley.

Burns, B., Granick, J.S, Manzuik, S., Guersch P., Killion, D., Beauchesne, N., Moret, E., Dhanjani, N., Rios, B. and Hardin, B. (2009) *Hacking: The Next Generation*. O'Reilly.

Cheswick, W. and Bellovin, S. (1994) *Firewalls and Internet Security: Repelling the Wily Hacker*. Wokingham: Addison-Wesley.

Cole, E., Krutz, R.L., Conley, J.W., Reisman, B., Ruebush, M., Gollman, D. and Reese, R. (2008) *Network Security Fundamentals*. John Wiley & Sons, Inc.

Cole, E., Krutz, R.L., Conley, J.W., Reisman, B., Ruebush, M., Gollman, D. and Reese, R. (2008) *Network Security Fundamentals: Project Manual*. John Wiley & Sons, Inc.

Forouzan, B.A. (2008) *Cryptography and Network Security*. New York: McGraw-Hill.

Forouzan, B.A. (2008) *Introduction to Network Security and Cryptography*. London: McGraw-Hill.

Gollmann, D. (2006) *Computer Security*. Chichester: John Wiley.

Harris, S., Harper, A., Eagle, C., Ness, J. and Lester, M. (2004) *Gray Hat Hacking: The Ethical Hacker's Handbook*. McGraw-Hill.

Lammle, T. and Graves, K. (2007) CEH: *Official Certified Ethical Hacker Review Guide*. Sybex.

Lockhart, A. (2007) *Network Security Hacks: Tips & Tools for Protecting your Privacy*, 2nd Ed. O'Reilly.

Manzuik, S., Gold, A. and Gatford, C. (2007) *Network security Assessment: from vulnerability to patch*. Rockland, Ma: Syngress Publishing.

Mather, T., Kumaraswamy, S. and Latif, S. (2009) *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*. O'Reilly.

Oppliger, R. (1998) *Internet and Intranet Security*. London: McGraw-Hill.

Scambray, J. and McClure, S. (2008) *Hacking Exposed Windows: Windows Security, Secrets and Solutions*. London: McGraw-Hill.

Schneier, B. (2000) *Secrets and Lies: Digital Secrets in a Networked World*. Chichester: John Wiley.

Sobrier, J., Lynn, M., Markham, E., Iezzoni, C. and Biondi, P. (2007) *Security Power Tools*, O'Reilly.

Stallings, W. (2005) *Cryptography and Network Security*. Rockland, Ma: Syngress Publishing.

Unit 23: Cryptography

Unit code	**T/615/1656**
Unit level	**5**
Credit value	**15**

Introduction

Although confidentiality in the communication between two parties is very often linked with electronic data transfer, methods for ensuring confidentiality have been used for centuries. That is how cryptography started as a methodology, practice and discipline, ensuring confidential communication in the presence of third parties called 'adversaries'. However, encrypting the message for confidentiality purposes is only one aspect of cryptography. It also provides means of ensuring that the parties involved in communication are 'who they say they are'. Cryptography underpins many aspects of security, and is a crucial component in protecting the confidentiality and integrity of information. It is now a prevalent part of our day-to-day lives despite many people being unaware of its usage or importance. Almost every interaction we make with an electronic device will involve cryptography in some form. Cryptography is an indispensable tool for protecting information in computer systems.

This unit introduces students to the theoretical principles of cryptography and looks at some practical applications, many of which we use on a daily basis. Students are expected to investigate the inner workings of cryptographic systems and how to correctly use them in real-world applications. Students are expected to explore the mathematical algorithms in relation to cryptography and their applications. Students are also expected to analyse the symmetric and asymmetric encryption methods and ciphers, public key cryptography and the security issues related to their implementation. In addition, students are expected to investigate advanced encryption protocols and their applications.

Among the topics included in this unit are: the mathematical algorithms used in cryptography, the mechanisms by which symmetric and asymmetric cryptography work, 3DES and AES block ciphers, the operations of public key cryptography, Public Key Infrastructure (PKI), primality testing and factoring, discreet logarithms, El Gamal encryption, security issues with cryptography, common attacks on cryptographic schemes, and some practical applications of cryptography.

On successful completion of this unit students will be able to examine the symmetric encryption algorithms and ciphers, assess public key encryption protocols and signatures and their uses in the message and key exchanges, analyse the security issues related to symmetric and asymmetric encryption methods and evaluate advanced encryption protocols and their applications in secure message exchanges.

As a result they will develop skills such as critical thinking, analysis, and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Examine the symmetric encryption algorithms and ciphers.

LO2. Assess public key encryption protocols and signatures and their uses in the message and key exchanges.

LO3. Analyse the security issues related to symmetric and asymmetric encryption methods.

LO4 Evaluate advanced encryption protocols and their applications in secure message exchanges.

Essential Content

LO1 Examine the symmetric encryption algorithms and ciphers

Exploring mathematical algorithms:

Examining modular arithmetic, groups, finite fields and probability; random number generation, exploring elliptic curves and projective coordinates.

Examining symmetric encryption and ciphers:

Exploring historical ciphers, Cezar cipher, Enigma machine and information theoretic security (probability and ciphers, entropy and spurious keys); explaining one time pad.

Investigating stream ciphers, the historical Lorenz cipher, modern stream ciphers (linear feedback shift registers and their combinations, RC4).

Examining block ciphers, Feistel cipher and Data Encryption Standard (DES), operation of 3DES, Rijndael cipher and its mode of operation, explaining Advanced Encryption System (AES).

Analysing symmetric key distributions, hash functions and message authentication codes – key management, secret key distribution, designing hash functions, investigating message authentication codes.

LO2 Assess public key encryption protocols and signatures and their uses in the message and key exchanges

Analysing public key cryptography:

Examining public key encryption algorithms, one-way functions, Rivest Shamir Adleman (RSA) algorithm; explaining El Gamal encryption.

Explaining primality testing and factoring and discrete logarithms, prime numbers, factoring algorithms, modern factoring methods; examining Pohlig-Hellman logarithm, logarithmic methods for finite fields, methods for elliptic curves.

Examining key exchange and signature schemes, Diffie-Hellman key exchange, explore digital signatures, using hash functions in signature schemes, digital signature algorithm (DSA), and authenticated key agreement.

Analysing implementation issues and, exponentiation in RSA and DSA, finite field arithmetic.

Obtaining authentic public keys, confidentiality and integrity, digital certificates and Public Key Infrastructure (PKI), analysing examples of PKI.

LO3 **Analyse the security issues related to symmetric and asymmetric encryption methods**

Analysing attacks on public key schemes:

Exploring most common attacks on public key encryption schemes, Wiener's attack on RSA, Lattice-based attacks on RSA, partial key exposure attacks, Meet-in-the-Middle attack, brute force attack and fault analysis.

Analysing different definitions of security:

Examining security of encryption, security of actual encryption algorithms, semantically secure systems, security of signatures.

Analysing provable security, explaining random oracles, security of encryption algorithms and encryption algorithms with random oracles.

Explaining provable security without random oracles, using examples such as strong RSA assumption, signature schemes and encryption schemes.

Analysing hybrid encryption, security of symmetric ciphers, security of hybrid ciphers, explaining the construction of Key Encapsulation Mechanisms (KEMs)

LO4 **Evaluate advanced encryption protocols and their applications in secure message exchanges**

Assessing advanced encryption protocols and their applications:

Evaluating access structures for secret sharing schemes, general secret sharing, Reed-Solomon codes, Shamir sharing scheme.

Applying shared RSA signature generation; explaining commitment schemes and oblivious transfers.

Analysing Zero-Knowledge proofs, demonstrating a Graph Isomorphism in Zero-Knowledge, Sigma protocols, electronic voting systems.

Examining secure multi-party computation, the two-party case, multi-party cases: honest-but-curious adversaries, malicious adversaries.

Evaluating different applications of cryptography, quantum cryptography, digital cash, Bitcoin, Transport Layer Security and IPSec.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine the symmetric encryption algorithms and ciphers</td><td rowspan="5">LO1 & LO2

D1 Evaluate the improvement introduced by AES compared to DES and 3DES encryption standards and public key and private key encryption.</td></tr>
<tr><td>P1 Examine mathematic algorithms and their use in cryptography.

P2 Explain, with the use of examples, the operation of stream cipher and block cipher.</td><td>M1 Compare the operational differences between stream cipher and block cipher.

M2 Analyse issues with symmetric key distribution and how they are solved by hash functions and message authentication codes.</td></tr>
<tr><td colspan="2">LO2 Assess public key encryption protocols and signatures and their uses in the message and key exchanges</td></tr>
<tr><td>P3 Discuss common public key cryptographic methods and their uses.

P4 Explain by the use of examples public key exchange and digital signatures, and their implementation issues.</td><td>M3 Analyse, with examples, the Public Key Infrastructure (PKI).</td></tr>
</table>

Pass	Merit	Distinction
LO3 Analyse the security issues related to symmetric and asymmetric encryption methods		
P5 Discuss the common attacks on public key encryption schemes. **P6** Explain, with examples, provable security in signature schemes and encryption schemes.	**M4** Critically analyse the security of hybrid ciphers and the construction of Key Encapsulation Mechanisms (KEMs).	**D2** Evaluate different definitions of provable security.
LO4 Evaluate advanced encryption protocols and their applications in secure message exchanges		
P7 Examine, by the use of examples, secret sharing schemes. **P8** Evaluate secure multi-party computation using the two-party and multi-party cases.	**M5** Analyse the implementation of public key cryptography in electronic voting systems.	**D3** Critically evaluate the access structures for secret sharing schemes.

Recommended Resources

Textbooks

Martin, K. (2012) *Everyday Cryptography: Fundamental Principles and Applications*. UK: Oxford.

Stallings, W. (2013) *Cryptography and Network Security: Principles and Practice*. UK: Pearson.

Journals

International Association for Cryptologic Research, Online

International Journal of Applied Cryptography, Online

Websites

www.gov.uk/government/publications	Department of Business Innovations and Skills "Guidelines for managing projects – How to organise, plan and control projects." (Report)

Links

This unit links to the following related units:

Unit 5: Security

Unit 19: Data Structures & Algorithms

Unit 24: Forensics

Unit 25: Information Security Management

Unit 24: Forensics

Unit code	**F/615/1658**
Unit level	**5**
Credit value	**15**

Introduction

This unit introduces students to digital forensics involving the use of specialised techniques to investigate the recovery, authentication and analysis of data on electronic data storage devices as well as Network Security breaches and cyberattacks using different tools and techniques.

With the current widespread use of digital devices, digital forensics has become an important part of the detection of crime by being able to identify details of what has been stored on a digital device(s) in the past. Students will have the opportunity to learn about some of the lower level structures of data storage devices, and techniques used to investigate them.

Among the topics included in this unit are: describing the process of carrying out digital forensics; Forensic Investigation legal guidelines and procedures; understanding low level file structures of several Operating Systems (OS); creating a book disk to enable forensic examination of devices; and undertaking a forensic examination of a device(s) and/or Network Security breaches and cyberattacks.

On successful completion of this unit students will be able to carry out digital forensics in accordance with industry and legal guidelines and procedures using different tools as well as understand low-level file structures of several Operating Systems and undertake digital Forensic Investigation of devices.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Examine the processes and procedures for carrying out digital Forensic Investigation.

LO2. Discuss the legal and professional guidelines and procedures for carrying out digital Forensic Investigation.

LO3. Use a tool or tools to conduct digital Forensic Investigation on devices or networks or cyberattacks.

LO4. Develop a Test Plan and make some recommendations for use in digital Forensic Investigation.

Essential Content

LO1 Examine the processes and procedures for carrying out digital Forensic Investigation

The process of carrying out digital Forensic Investigation:

Discuss what is meant by Digital Forensics.

Identity the processes and procedures for carrying out digital Forensic Investigation.

LO2 Discuss the legal and professional guidelines and procedures for carrying out digital Forensic Investigation

Processes and procedures for carrying out digital Forensic Investigation:

Law enforcement:

Give a summary of the APCO guidelines in relation to evidence collection, evidence preservation in a Forensic Investigation case. Discuss the activities of authorities (e.g. MI5/MI6, GCHQ and NSA) in relation to Forensic Investigations.

Legal and ethical considerations:

Discuss the following legal and ethical considerations when conducting a Forensic Investigation; Data Protection Act; Computer Misuse Act and the Freedom of Information Act.

Other stakeholders:

Forensic Science's Society guidelines

British Computer Society

LO3 Use a tool or tools to conduct digital Forensic Investigation on devices or networks or cyberattacks

Tools required to conduct digital Forensic Investigation:

Hardware and software tools.

Conduct digital Forensic Investigation:

Conduct digital Forensic Investigation of devices, networks or cyberattacks.

LO4 **Develop a Test Plan and make some recommendations for use in digital Forensic Investigation**

Develop a Test Plan for digital devices or networks or cyberattacks:

Digital Forensics Test Plan

Recommendations for improving digital Forensic Investigations.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine the processes and procedures for carrying out digital Forensic Investigation</td><td rowspan="2">D1 Investigate the advantages and disadvantages of conducting digital Forensic Investigation.</td></tr>
<tr><td>P1 Discuss what is meant by Digital Forensics with the aid of diagrams/pictures.
P2 Examine the processes and procedures for conducting digital Forensic investigation.</td><td>M1 Discuss the importance of following a process or procedure when conducting digital Forensic Investigation.</td></tr>
<tr><td colspan="2">LO2 Discuss the legal and professional guidelines and procedures for carrying out digital Forensic Investigation</td><td rowspan="2">D2 Discuss why NOT following guidelines might jeopardise a legal case with regards to digital Forensic evidence.</td></tr>
<tr><td>P3 Examine several law enforcement guidelines for conducting digital Forensic Investigations.
P4 Discuss several legal and ethical requirements for conducting digital Forensic Investigations.</td><td>M2 Assess how ethical it is to conduct digital Forensic Investigations on a suspected individual with reference to their legal rights.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Use a tool or tools to conduct digital Forensic Investigation on devices or networks or cyberattacks		
P5 Determine hardware and software tools that can be used to conduct digital Forensic Investigation. **P6** Examine the file system structure of several Operating Systems e.g. MS-DOS, Windows, UNIX, Linux, MacOS, Android, etc.	**M3** Compare two tools that can be used to conduct digital Forensic Investigation. **M4** Conduct a digital Forensic Investigation on a device or network or cyberattack.	**LO3 & 4** **D3** Critically evaluate your work and suggest improvements to the current digital Forensic Investigation guidelines, processes and procedures.
LO4 Develop a Test Plan and make some recommendations for use in digital Forensic Investigation		
P7 Develop a Test Plan for conducting a test on digital devices or networks or cyberattacks. **P8** Suggest recommendations for best practices for conducting digital Forensics.	**M5** Compare the recommendations for best practices for conducting digital Forensics.	

Recommended Resources

Textbooks

Carrier. B. (2005) *File System Forensic Analysis*. Harlow: Addison-Wesley.

Carvey, H. (2004) *Windows Forensics and Incident Recovery*. Harlow: Addison-Wesley.

Farmer, D. and Venema, W. (2005) *Forensic Discovery*. Harlow: Addison-Wesley.

Jones, R. (2005) *Internet Forensics*. Sebastopol, O'Reilly.

Prosise, C. and Mandia, K. (2003) *Incident Response: Computer Forensics*. Osborne/McGraw-Hill.

Sammes, A. and Jenkinson, B. (2007) *Forensic Computing: A Practitioner's Guide*. 2nd Ed. London, Springer.

Journals

British Computer Society Forensics Specialist Group

GCHQ

NSA

Links

This unit links to the following related units:

Unit 5: Security

Unit 23: Cryptography

Unit 25: Information Security Management

Unit 25: Information Security Management

Unit code	**F/615/1661**
Unit level	**5**
Credit value	**15**

Introduction

Organisations of all sizes need to protect their sensitive information from potential attackers, and simply having up-to-date firewalls, anti-virus, and other infrastructure components is not enough to prevent breaches. All physical security devices, the teams who manage them, and the processes surrounding their management need to be constantly monitored and evaluated to ensure the organisation as a whole is protected. This is the concept behind an Information Security Management System (ISMS). An ongoing process to continually assess what the organisation deems its biggest threats, and what its most important assets are.

This unit introduces students to the basic principles of an ISMS and how businesses use them to effectively manage the ongoing protection of sensitive information they hold. There are many reasons for establishing an ISMS for an organisation, but one of the main goals is to enable the organisation to manage information security as a single entity which can be monitored and continually improved upon.

This unit considers information security management in a business context and will allow students to understand how modern organisations manage the ongoing threats to their sensitive assets.

On successful completion of this unit students will be able to describe what an ISMS is, how one is established, maintained and improved, and describe the role international standards play in developing an ISMS. As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Explore the basic principles of information security management.

LO2. Critically assess how an organisation can implement and maintain an Information Security Management System (ISMS).

LO3. Appraise an ISMS and describe any weaknesses it may contain.

LO4. Examine the strengths and weaknesses of implementing ISMS standards.

Essential Content

LO1 Explore the basic principles of information security management

What is an ISMS? Why is an ISMS important? Policies (privacy, acceptable use, information security, separation of duties, least privilege); risk (impact, likelihood, quantitative, qualitative, vulnerabilities, threats); risk treatment (avoid, transfer, accept, mitigate); compliance; stakeholders.

LO2 Critically assess how an organisation can implement and maintain an Information Security Management System (ISMS)

Asset identification; stakeholder requirements; risk assessment; risk treatment planning; policy development; procedure development; senior management buy-in; audit (internal, external); performance monitoring; continual improvement.

LO3 Appraise an ISMS and describe any weaknesses it may contain

Review ISMS documentation for potential weaknesses; examine audit and performance monitoring output; suggest improvements to an ISMS.

LO4 Examine the strengths and weaknesses of implementing ISMS standards

ISO 27001:2013; the organisation and its context; expectations of interested parties; determining ISMS scope; leadership commitment; policy; organisational roles and responsibilities; actions to address risks; information security objectives; resources; competence; awareness; communications; documented information; operational planning; risk assessment; risk treatment; monitoring, measuring, analysis and evaluation; management review; nonconformity and corrective action; continual improvement; external ISMS audit; advantages and disadvantages of ISO 27001:2013 certification; annex A (ISO 27002:2013) controls.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Explore the basic principles of information security management</td><td rowspan="5">LO1 & LO2

D1 Demonstrate through critical analysis the steps required to establish and maintain an ISMS in the context of an example organisation, making reference to the requirements of the ISO 27001:2013 standard.</td></tr>
<tr><td>P1 Examine the key principles of an ISMS and its relevance to the successful operation of an organisation.</td><td>M1 Evaluate the benefits an effective ISMS can have on an organisation.</td></tr>
<tr><td colspan="2">LO2 Critically assess how an organisation can implement and maintain an Information Security Management System (ISMS)</td></tr>
<tr><td>P2 Explore the elements of, and processes behind, establishing and maintaining an ISMS.</td><td>M2 Examine the process of implementing an ISMS in a real-world scenario.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Appraise an ISMS and describe any weaknesses it may contain		**LO3 & LO4** **D2** Critically examine the strengths and weaknesses in the context of an example ISMS and provide potential remedial actions to improve its effectiveness.
P3 Recognise strengths and weaknesses in a given ISMS, based on documentation review and audit output.	**M3** Examine the strengths and weaknesses of an ISMS in the context of an organisation, prioritising issues.	
LO4 Examine the strengths and weaknesses of implementing ISMS standards		
P4 Recognise the purpose of the ISO 27000 series and the key clauses of ISO 27001:2013.	**M4** Evaluate the relationship between ISO 27001:2013 and establishing an effective ISMS within an organisation. **M5** Critically assess the advantages and disadvantages of certification against the standard.	

Recommended Resources

Textbooks

Alexander, D., Finch, A., Sutton, D. and Taylor, A. (2013) *Information Security Management Principles* BCS. 2nd Revised Ed. The Chartered Institute for IT.

Calder, A. and Watkins, S. (2015) *IT Governance: An International Guide to Data Security and ISO27001/ISO27002*. 6th Ed. Kogan Page.

Journals

Information Management & Computer Security

Websites

www.iso.org	International Organisation for Standardisation "ISO/IEC 27001 – Information Security Management" (General Reference)

Electives

Unit 7: Strategic Information Systems

Unit code	**A/615/1626**
Unit type	**Optional**
Unit level	**4**
Credit value	**15**

Introduction

Information is the most valuable resource that an organisation possesses. The effective gathering, protection, analysis, processing and dissemination of information is vital to the success of any organisation. As globalisation and the 24-hour economy develop and increase, organisations must ensure that their information systems are reliable, efficient and able to cope with rapid change.

This unit introduces students to the importance of information to organisations. It will examine how systems can be used to support core business functions and enable organisations to be more productive and competitive within the global marketplace.

Students will be required to analyse the information needs of an organisation at different levels and within different functional areas. It is important that computing professionals are able to understand how an organisation works and how it uses information in order to be able to design, implement, maintain and manage secure information systems to support its operations.

Among the topics included in this unit are understanding organisations in terms of their information needs and the variances within different functional areas. Examination of different information systems at the operational, tactical and strategic levels will be required, in addition to evaluating their effectiveness and role in terms of decision making and gaining competitive advantage.

On successful completion of this unit students will have an insight into the types of systems and technologies available for effective information processing. Critical analysis will also be used to examine the integrated role that each of these play in contributing to the efficiency and competitiveness of organisations.

As a result students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Analyse the information requirements of organisations.

LO2 Discuss the types of information systems that are used within all levels of an organisation.

LO3 Demonstrate the use of an information system to produce management information.

LO4 Evaluate the effectiveness of strategic information systems.

Essential Content

LO1 Analyse the information requirements of organisations

Functional area information requirements:

Finance and accounts for payroll, pensions, supplier payments and invoicing etc., human resources e.g. employee records, personnel data, appraisals, CPD etc., stock control, sales, marketing, research and development, production, distribution, IT, customer service and administration.

Information needs:

How different functional areas use and process data effectively; the integration of data and information within an organisation.

Requirements analysis:

The inputs, outputs and processing activities; information distribution requirements e.g. by location, department, individual/customer.

LO2 Discuss the types of information systems that are used within all levels of an organisation

Information systems types:

Business information systems, decision support systems, management information systems, strategic/executive information systems, office information systems, transaction processing systems, expert systems, global information systems, data warehouse systems, enterprise systems, enterprise resource planning systems, integrated information systems.

Categories of information systems:

Operational, tactical and strategic information systems.

Information and data:

Definition of information and data, sources of information, information requirements and the needs for information at different levels within an organisation; storing information and its importance with regard to security, accuracy and relevance; outputs e.g. payroll, invoicing, ordering, bookings, stock control, personnel records, goods tracking, decision-making, marketing, customer service.

LO3 **Demonstrate the use of an information system to produce management information**

Management information:

Reports e.g. sales report, college enrolment statistics, marketing analysis (brick v click), trends in the market, competition and market share.

Gathering information:

Defining requirements; establishing sources of information; defining other factors to be considered e.g. constraints and access to information.

Selecting information:

Analysis of information in terms of validity, accuracy, currency and relevancy; identifying and rationalising meaningful information from data sets.

Uses:

Proficiency in terms of accessing quality information that can be used for decision-making, problem-solving, predictions, trending and forecasting.

LO4 **Evaluate the effectiveness of strategic information systems**

Models for strategic information systems:

Porters Competitive Advantage and Wiseman's Strategic Planning Process.

Competitive advantage:

How can competitive advantage be measured and attributed to the implementation of a strategic information system?

Gaining competitive advantage:

Delivering a differentiated product or service; delivering a product or service at a lower cost; specific segmentation of the market e.g. targeted marketing to specific target audiences; innovative product or service design and implementation.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Analyse the information requirements of organisations		**D1** Evaluate the inputs, outputs and processing activities of a selected organisation.
P1 Discuss the information needs and requirements for the functional departments of an organisation. **P2** Produce an input/output (I/O) diagram to represent the data and information requirements of a functional department.	**M1** Compare and contrast different processing activities that occur within functional departments within an organisation.	
LO2 Discuss the types of information systems that are used within all levels of an organisation		**D2** Differentiate between the function and purpose of information systems at different levels within an organisation.
P3 Describe the function of different information systems. **P4** Discuss the information needs required at differing levels within an organisation.	**M2** Analyse the effectiveness of information systems at the operational, tactical and strategic levels within an organisation.	

Pass	Merit	Distinction
LO3 Demonstrate the use of an information system to produce management information		
P5 Demonstrate the use of an information system for management reporting purposes. **P6** Discuss the importance of an organisation having data and information that is current, valid and accurate.	**M3** Analyse the constraints that an organisation can face when gathering data and information.	**D3** Critique, with examples, how a given organisation can use information for effective decision-making and forecasting.
LO4 Evaluate the effectiveness of strategic information systems		
P7 Identify different models that can be applied to strategic information systems.	**M4** Justify the ways in which an organisation can obtain competitive advantage within a global market.	**D4** Evaluate how strategic information systems can contribute to the competitiveness of organisations.

Recommended Resources

Textbooks

Peppard, J. (2016) *The Strategic Management of Information Systems: Building a Digital Strategy*. 4th Ed. John Wiley & Sons.

Robson, W. (1997) *Strategic Management and Information Systems: An Integrated Approach*. 2nd Ed. Financial Times / Prentice Hall.

Ward, J. (2002) *Strategic Planning for Information Systems*. 3rd Ed. John Wiley & Sons.

Whitely, D. (2013) *An Introduction to Information Systems*. Palgrave Macmillan.

Journals

The Journal of Strategic Information Systems

Information Systems Journal

Unit 10: Website Design & Development

Unit code	**R/615/1633**
Unit level	**4**
Credit value	**15**

Introduction

Wireless, public hotspots, mobile broadband and unlimited network connections means that accessing and using the internet to request, use and post information has never been so easy, or so important. As public, organisational and business demand increases, so does user expectation. Designers need to successfully use technology to deliver a high quality and consistent User Experiences (UX) through friendly and functional User Interfaces (UI). However, as the software and hardware evolves, so does the challenge of design.

This unit introduces students to the underpinning services required to host, manage and access a secure website before introducing and exploring the methods used by designers and developers to blend back-end technologies (server-side) with front-end technologies (client-side). To help ensure new designers are able to design and deliver a site that offers an outstanding User Experience (UX) supported by an innovative User Interface (UI) this unit also discusses the reasons, requirements, relationships, capabilities and features of the systems they will be using and gives them an opportunity to explore various tools, techniques and technologies with 'good design' principles to plan, design and review a multipage website.

Among the topics included in this unit are: domain structure, domain name systems, web protocols, database servers, development frameworks, website publishing, content management, search engine optimisation, web browsers, HTML standards, CSS and CSS pre-processing (LESS, SASS), presentation models, responsive design, integrated development environments, user requirements, interface design, user experience, branding, navigation, optimisation and validation.

On successful completion of this unit students will be able to explain server technologies and management services associated with the hosting and management of secure websites, categorise website technologies, tools and software used to develop websites, utilise website technologies, tools and techniques with good design principles to create a multipage website and create and use a Test Plan to review the performance and design of a multipage website.

As a result they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Explain server technologies and management services associated with hosting and managing websites.

LO2 Categorise website technologies, tools and software used to develop websites.

LO3 Utilise website technologies, tools and techniques with good design principles to create a multipage website.

LO4 Create and use a Test Plan to review the performance and design of a multipage website.

Essential Content

LO1 **Explain server technologies and management services associated with hosting and managing websites**

Hosting and website management:

Investigate relationships between domain names, DNS services and communication protocols used to access a website.

Overview of publishing and managing secure websites, including search engine indexing and ranking.

Different server technologies:

Differences between web server hardware, software and host operating systems.

Advantages of an integrated database system with regards to expanding website capability.

Common web development technologies and frameworks.

LO2 **Categorise website technologies, tools and software used to develop websites**

Website technologies:

Using front-end technologies, presentation layers and client-side programming to build a User Interface (UI) and effect User Experience (UX).

How back-end technologies, application layers and server-side programming can be used to enable personalisation and deliver dynamic content.

Tools, techniques and software used to develop websites:

Improving User Experience (UX) through Rich Internet Application (RIA) design using JavaScript and CSS frameworks and packages.

Overview of online content management systems including possible advantages and limitations with regards to design.

Using web design and development software to design and build a secure website.

LO3 **Utilise website technologies, tools and techniques with good design principles to create a multipage website**

Establish the client and user requirements:

Differentiate client and user requirements from behaviours.

Consider how audience and purpose could influence the look and feel of a website.

Review accessibility standards and guidelines and their possible impact on design and aesthetics.

Research and create good content combined with good design principles to create a multipage website:

Introduce and use recognised design principles, incorporating accessibility guidelines to implement an appropriately branded, multipage site.

Discuss why and how the quality of content can affect the performance of a website.

LO4 **Create and use a Test Plan to review the performance and design of a multipage website**

Consider factors that influence website performance:

Review how intuitive interfaces and actions, user-friendly designs, appropriate graphics, effective navigation and good quality content can help establish user trust and deliver an improved User Experience (UX).

Consider the effects of good and bad search engine optimisation (SEO) and indexing on the performance of a website.

W3C Validation (HTML and CSS) and how it influences website design and performance.

Establish a Test Plan and use it to assess the performance of a website:

Assess the impact of poorly optimised website graphics.

Research and conduct Quality Assurance (QA) and usability testing on a multipage website.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Explain server technologies and management services associated with hosting and managing websites</td><td rowspan="5">LO1 & LO2
D1 Justify the technologies, management services, tools and software chosen to realise a custom built website.</td></tr>
<tr><td>P1 Identify the purpose and types of DNS, including explanations on how domain names are organised and managed.

P2 Explain the purpose and relationships between communication protocols, server hardware, operating systems and web server software with regards to designing, publishing and accessing a website.</td><td>M1 Evaluate the impact of common web development technologies and frameworks with regards to website design, functionality and management.

M2 Review the influence of search engines on website performance and provide evidence-based support for improving a site’s index value and rank through search engine optimisation.</td></tr>
<tr><td colspan="2">LO2 Categorise website technologies, tools and software used to develop websites</td></tr>
<tr><td>P3 Discuss the capabilities and relationships between front-end and back-end website technologies and explain how these relate to presentation and application layers.

P4 Discuss the differences between online website creation tools and custom built sites with regards to design flexibility, performance, functionality, User Experience (UX) and User Interface (UI).</td><td>M3 Evaluate a range of tools and techniques available to design and develop a custom built website.</td></tr>
</table>

Pass	Merit	Distinction
LO3 Utilise website technologies, tools and techniques with good design principles to create a multipage website		
P5 Create a design document for a branded, multipage website supported with medium fidelity wireframes and a full set of client and user requirements. **P6** Use your design document with appropriate principles, standards and guidelines to produce a branded, multipage website supported with realistic content.	**M4** Compare and contrast the multipage website created to the design document.	**D2** Critically evaluate the design and development process against your design document and analyse any technical challenges.
LO4 Create and use a Test Plan to review the performance and design of a multipage website		
P7 Create a suitable Test Plan identifying key performance areas and use it to review the functionality and performance of your website.	**M5** Evaluate the Quality Assurance (QA) process and review how it was implemented during your design and development stages.	**D3** Critically evaluate the results of your Test Plan and include a review of the overall success of your multipage website; use this evaluation to explain any areas of success and provide justified recommendations for areas that require improvement.

Recommended Resources

Textbooks

Frain, B. (2012) *Responsive Web Design with HTML5 and CSS. UK*: Packt Publishing.

Krug, S. (2013) *Don't Make Me Think: A Common Sense Approach to Web Usability*. USA: New Riders.

Lidwell, W., Holden, K. and Butler, J. (2010) *Universal Principles of Design, Revised and Updated: 115 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions and Teach Through Design*. USA: Rockport Publishers.

Unit 19: Data Structures & Algorithms

Unit code	**D/615/1649**
Unit level	**5**
Credit value	**15**

Introduction

The knowledge to implement algorithms and data structures that solve real problems, and knowing the purpose, complexity and use of algorithms is part of an essential toolkit for software engineers. An algorithm is a sequence of instructions used to manipulate data held in a structured form and together constitute design patterns for solving a diverse range of computer problems, including network analysis, cryptography, data compression and process control.

This unit introduces students to data structures and how they are used in algorithms, enabling them to design and implement data structures. The unit introduces the specification of abstract data types and explores their use in concrete data structures. Based on this knowledge, students should be able to develop solutions by specifying, designing and implementing data structures and algorithms in a variety of programming paradigms for an identified need.

Among the topics included in this unit are abstract data types specification, formal data notations, data encapsulation, complex data structures, programming language implementations using handles, pointers, classes and methods, algorithm types, data structure libraries, algorithm complexity, asymptotic testing and benchmarking.

On completion of this unit the student should be able to identify program data requirements, specify abstract data types using a formal notation, translate into concrete data structures and be able to develop, using a programming paradigm, different sorting, searching and navigational algorithms that implement complex data structures and evaluate their effectiveness.

As a result of studying this unit students will develop skills such as communication literacy, critical thinking, analysis, synthesis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of the unit students will be able to:

LO1. Examine abstract data types, concrete data structures and algorithms.

LO2. Specify abstract data types and algorithms in a formal notation.

LO3. Implement complex data structures and algorithms.

LO4. Assess the effectiveness of data structures and algorithms.

Essential Content

LO1 Examine abstract data types, concrete data structures and algorithms

Abstract Data Types (ADTs):

Specification of ADTs with formal notation.

Data structures:

Array; set; stack; queue; list; tree; types e.g. active, passive, recursive.

Algorithm types:

Recursive, backtracking, dynamic, divide & conquer, branch & bound, greedy, randomised, brute force.

Algorithms:

Sort; insertion, quick, merge, heap, bucket, selection; search linear, binary, binary search tree, recursive e.g. binary tree traversals; find path; travelling salesman.

LO2 Specify abstract data types and algorithms in a formal notation

Design specification:

Specify ADTs using formal notation e.g. ASN.1; use non-executable program specification language e.g. SDL, VDM; issues e.g. complexity in software development; design patterns, parallelism; interfaces; encapsulation, information hiding, efficiency.

Creation:

Pre-conditions, post-conditions, error-conditions.

LO3 Implement complex data structures and algorithms

Implementation:

Data structures; multidimensional arrays, linked lists, stacks, queues, trees, hash table, heap, graph Algorithms; sorting, searching, tree traversal, list traversal, hash functions, string manipulation, scheduling and recursive algorithms; using handle, pointer, class, methods; using an executable programming language.

LO4 **Assess the effectiveness of data structures and algorithms**

Use of data structure libraries (DSL):

Limitations of DSL; manual selection of data structures; theoretical analysis; asymptotic analysis; size of N, Big O notation.

Algorithm effectiveness:

Run time benchmark, compiler/interpreter dependencies, resource usage, degree of parallelism, time, space, power performance, efficiency of garbage collection.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine abstract data types, concrete data structures and algorithms		
P1 Create a design specification for data structures explaining the valid operations that can be carried out on the structures. **P2** Determine the operations of a memory stack and how it is used to implement function calls in a computer.	**M1** Illustrate, with an example, a concrete data structure for a First In First out (FIFO) queue. **M2** Compare the performance of two sorting algorithms.	**D1** Analyse the operation, using illustrations, of two network shortest path algorithms, providing an example of each.
LO2 Specify abstract data types and algorithms in a formal notation		
P3 Using an imperative definition, specify the abstract data type for a software stack.	**M3** Examine the advantages of encapsulation and information hiding when using an ADT.	**D2** Discuss the view that imperative ADTs are a basis for object orientation and, with justification, state whether you agree.

Pass	Merit	Distinction
LO3 Implement complex data structures and algorithms		
P4 Implement a complex ADT and algorithm in an executable programming language to solve a well-defined problem. **P5** Implement error handling and report test results.	**M4** Demonstrate how the implementation of an ADT/algorithm solves a well-defined problem.	**D3** Critically evaluate the complexity of an implemented ADT/algorithm.
LO4 Assess the effectiveness of data structures and algorithms		
P6 Discuss how asymptotic analysis can be used to assess the effectiveness of an algorithm. **P7** Determine two ways in which the efficiency of an algorithm can be measured, illustrating your answer with an example.	**M5** Interpret what a trade-off is when specifying an ADT using an example to support your answer.	**D4** Evaluate three benefits of using implementation independent data structures.

Recommended Resources

Textbooks

Cormen, T. (1990) *Introduction to Algorithms*. MIT Labs.

Cormen, T. (2002) *Instructors Manual: Introduction to Algorithms*. MIT Labs.

Heineman, G. (2009) *Algorithms in a Nutshell*. O'Reilly Publishing.

Larmouth, J. (1999) *ASN.1 Complete*. Kaufman Publishing.

Leiss, E. (2007) *A Programmer's Companion to Algorithm Analysis*. Chapman & Hall.

Sedgewick, R. (1983) *Algorithms*. Addison-Wesley.

Wirth, N. (2004) *Algorithms and Data Structures*. Oberon.

Unit 43: Internet of Things

Unit code	**T/615/1690**
Unit level	**5**
Credit value	**15**

Introduction

The Internet of Things (IoT) is a network of physical objects – devices, vehicles, drones and other objects embedded with electronics, software, sensors and network connectivity that enables these objects to collect and exchange data. The objective of the IoT is to enable almost any object to become smart, accessible and data capable, thereby benefitting from advances in communications, computation and interconnectivity. IoT explores the mixture of hardware, software, data, platforms and services that can be combined to create innovative opportunities for more direct integration of the physical world and objects into computer-based systems, resulting in improved efficiency, accuracy, social and economic benefit to people.

This unit introduces students to the role, basic concepts and benefits of IoT in the design and development process of computer applications. The aim of the unit is to enhance the student's understanding of the methodology, terminology and benefits of IoT in the design and development of software applications.

Among the topics included in this unit are: classification and terminology of IoT, the hardware, software, data, platforms and services used to enable IoT, common architecture, frameworks, tools, hardware and APIs that can be utilised to design IoT-enabled objects, problems and solutions resulting from widespread deployment and adoption of IoT, software application methodology for IoT specific software application design and development, data models, network complexity, security, privacy, enabling technologies and how to simulate and test an IoT concept.

On successful completion of this unit students will be able to explain the basic concepts of IoT; design, build and simulate an IoT application using any combination of hardware, software, data, platforms and services; be able to discuss the problem IoT applications solves; the potential impact on society, business and the end user and the problems encountered when integrating into the wider IoT ecosystem.

As a result they will develop skills such as communication literacy, design thinking, team working, critical thinking, analysis, reasoning and interpretation, computer software literacy, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Analyse what aspects of IoT are necessary and appropriate when designing software applications.

LO2. Outline a plan for an appropriate IoT application using common architecture, frameworks, tools, hardware and APIs.

LO3. Develop an IoT application using any combination of hardware, software, data, platforms and services.

LO4. Evaluate your IoT application and the problems it might encounter when integrating into the wider IoT ecosystem.

Essential Content

LO1 Analyse what aspects of IoT are necessary and appropriate when designing software applications

Identify role, formats and characteristics of IoT:

Present an overview of IoT and its appropriate use in software development.

Investigate what IoT is by researching its role, purpose, terminology and methodology.

Recognise the various forms of IoT by researching its history, current trends and use in relation to, and conjunction with, traditional computer-based systems and networks.

Define the characteristics of IoT by investigating how it can be used and how it can interact with existing computer-based networks and the physical world.

Recognise the use of appropriate IoT applications to solve specific problems.

Research specific forms of IoT functionality:

Explore various forms of IoT functionality.

Research, debate and agree current functionality, technology and trends for IoT.

Investigate the advantages and disadvantages of using IoT.

Define standard architecture, frameworks, tools, hardware and APIs available for use in IoT application development:

Review architecture, frameworks, tools, hardware and APIs available to develop IoT applications.

The advantages and disadvantages of IoT architecture, frameworks, tools, hardware and APIs.

How various architecture, frameworks, tools, hardware and APIs can be used to create IoT applications.

Appropriateness of various architecture, frameworks, tools, hardware and APIs for different problem-solving requirements.

LO2 **Outline a plan for an appropriate IoT application using common architecture, frameworks, tools, hardware and APIs**

Identify a problem to be solved and select appropriate IoT techniques to solve this problem:

Choose a specific problem to solve using IoT.

Evaluate the benefits, features, advantages and disadvantages of IoT to solve this problem.

Review different architecture, frameworks, tools, hardware and API techniques you could apply to solve this problem.

Select the most appropriate IoT architecture, frameworks, tools, hardware and API techniques to include in an application to solve this problem.

Describe a plan for an IoT application to solve this problem:

Outline the problem you intend to solve and how IoT and your application addresses this problem.

Select an appropriate IoT application to achieve desired results.

Apply IoT architecture, frameworks, tools, hardware and API techniques to solve this problem.

Use your selected techniques to create an IoT application development plan.

LO3 **Develop an IoT application using any combination of hardware, software, data, platforms and services**

Utilise appropriate tools and techniques to develop an IoT application:

Employ an appropriate set of tools to develop your plan into an IoT application.

Run end user experiments and examine feedback.

Reconcile and evaluate end user feedback and determine advantages and disadvantages of your chosen IoT techniques.

LO4 **Evaluate your IoT application and the problems it might encounter when integrating into the wider IoT ecosystem**

Assess the success of your IoT application:

Assemble and appraise end use feedback from your IoT application.

Undertake a critical review and compare your final application with the original plan.

Evaluate the advantages, disadvantages, strengths and weaknesses of your IoT techniques.

Critique the overall success of your application. Did it solve your problem? What is the potential impact on people, business, society and the end user? What problems might it encounter when integrating into the wider IoT ecosystem?

Discusses your insight using IoT.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Analyse what aspects of IoT are necessary and appropriate when designing software applications</td><td rowspan="2">D1 Evaluate specific forms of IoT architecture and justify their use when designing software applications.</td></tr>
<tr><td>P1 Explore various forms of IoT functionality.

P2 Review standard architecture, frameworks, tools, hardware and APIs available for use in IoT development.</td><td>M1 Analyse the impact of common IoT architecture, frameworks, tools, hardware and APIs in the software development life cycle.

M2 Review specific forms of IoT architecture, frameworks, tools, hardware and APIs for different problem-solving requirements.</td></tr>
<tr><td colspan="2">LO2 Outline a plan for an appropriate IoT application using common architecture, frameworks, tools, hardware and APIs</td><td rowspan="4">LO2 & LO3

D2 Make multiple iterations of your IoT application and modify each iteration with enhancements gathered from user feedback and experimentation.</td></tr>
<tr><td>P3 Investigate architecture, frameworks, tools, hardware and API techniques available to develop IoT applications.

P4 Determine a specific problem to solve using IoT.</td><td>M3 Select the most appropriate IoT architecture, frameworks, tools, hardware and API techniques to include in an application to solve this problem.

M4 Apply your selected techniques to create an IoT application development plan.</td></tr>
<tr><td colspan="2">LO3 Develop an IoT application using any combination of hardware, software, data, platforms and services.</td></tr>
<tr><td>P5 Employ an appropriate set of tools to develop your plan into an IoT application.

P6 Run end user experiments and examine feedback.</td><td>M5 Reconcile and evaluate end user feedback and determine advantages and disadvantages of your chosen IoT techniques.</td></tr>
</table>

Pass	Merit	Distinction
LO4 Evaluate your IoT application and the problems it might encounter when integrating into the wider IoT ecosystem		
P7 Review your IoT application detailing the problems it solves. **P8** Assess the potential impacts of your IoT application on people, business and society and the end user. **P9** Investigate the potential problems your IoT application might encounter when integrating into the wider system.	**M6** Undertake a critical review and compare your final application with the original plan.	**D3** Critically evaluate the overall success of your application.

Recommended Resources

Textbooks

Arshdeep, B. (2014) *Internet of Things: A Hands on Approach*. 1st Ed. VPT.

McEwen, A. (2013) *Designing the Internet of Things*. 1st Ed. John Wiley and Sons.