**Higher National Diploma**

**Computing & Systems Development**

# 

Year 1

**Course Code: 12000Y1**

**Module Specifications**

**2022 – 2023**

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Module Details

Unit 1: Programming **Unit code H/618/7388**

**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:*

Develop simple applications that implement basic algorithms, including the

features of a suitable language and IDE.

Create logical and maintainable codes.

Consideration of security concerns and how they could be solved.

Build, manage and deploy code to the relevant environment to solve the

identified problems

###### 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.

Use of debugging the process to help developers fix vulnerabilities, defects and

bugs in code.

Apply structured techniques to problem solving, debugging code and consider

structure of programmes to identify and resolve issues.

Understand coding standards and their benefits when writing code

### Learning Outcomes and Assessment Criteria

|  |  |  |
| --- | --- | --- |
| **Pass** | **Merit** | **Distinction** |
| **LO1** Define basic algorithms to carry out an operation and outline the process of programming an application | |  |
| **P1** Define an algorithm and outline the process in building an application.  **P2** Determine the steps taken from writing code to execution. | **M1** Analyse the process of writing code, including the potential challenges faced. | **D1** Evaluate the implementation of an algorithm in a suitable language and the relationship between the written algorithm and the code variant. |
| **LO2** Explain the characteristics of procedural, object- | |  |
| orientated and event-driven programming | |  |
| **P3** Discuss what | **M2** Compare the procedural, | **D2** Critically evaluate the |
| procedural, object- | object-orientated and event- | source code of an application |
| orientated and event- | driven paradigms used in | that implements the |
| driven paradigms are; | given source code of an | procedural, object-orientated |
| their characteristics and | application. | and event-driven paradigms, |
| the relationship between |  | in terms of the code structure |
| them. |  | and characteristics. |
| **LO3** Implement basic algorithms in code using an IDE | |  |
| **P4** Write a program that | **M3** Enhance the algorithm | **D3** Evaluate the use of an IDE |
| implements an algorithm | written, using the features of | for development of |
| using an IDE. | the IDE to manage the | applications contrasted with |
|  | development process. | not using an IDE. |
| **LO4** Determine the debugging process and explain the importance of a coding standard | |  |
| **P5** Explain the debugging process and the debugging facilities available in the IDE.  **P6** Explain the coding standard you have used in your code. | **M4** Examine how the debugging process can be used to help develop more secure, robust applications. | **D4** Evaluate the role and purpose of a coding standard and why it is necessary in a team as well as for the individual. |

**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.

##### Links

This unit links to the following related units:

*Unit 19: Data Structures & Algorithms   
Unit 20: Advanced Programming*

*Unit 54: Prototyping*

Unit 2: Networking **Unit code M/618/7393**

**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.

Students will also explore the protocol methodologies related to IP data networks.

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**

*Role of networks:*

Purpose, benefits, resource implications, communications, 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.

*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.

*Wireless networks:*

Explore the use and evolution and industry developments in mobile/cellular networks, including key technologies; standards for communications (3G, 4G, 5G); process of accessing and connecting to NB-IoT, GPRS and Wi-Fi networks.

Distinguish between NB-IoT and Wi-Fi AT command sets.

###### LO2 **Explain networking devices and operations**

*Networking devices:*

Server; hub, routers; switches; multilayer switch, firewall, HIDS, repeaters; bridges; wireless devices; access point (wireless/wired), content filter, Load balancer, Modem, Packet shaper, VPN concentrator.

Explore the basic concepts, features and key technologies of IoT gateways, including IoT gateway solutions, industrial IoT gateway positioning, edge computing, network topologies, RF mesh, Smart Home networks, acceleration, Wi-Fi coverage and intelligent services and serial data transmission (binary data).

*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.  
System bus and local-system architecture, e.g. memory, processor, I/O devices.   
Permissions

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, static and dynamic routing between multiple subnets.

Calculate IP subnet address ranges in dotted decimal and binary.

Calculate subnet masks

*Communications:*Ensuring communications are suited to devices, suited to users, supportive of lifestyle desires, supportive of commercial requirements, security requirements, quality of service needs.

*Scalability:*

Ability to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend changes, protocol utilisation, addressing, multiple subnets, dynamic, static routing protocols.

*Selection of components:*

Supporting infrastructure needs; supporting connectivity requirements.  
  
*Security:*

The concept of ‘secure by design’ and its application to infrastructure.

Security considerations when designing a network for an identified scenario, e.g. shared data, network access, remote workers, public facing systems, internal policy.

###### 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.

Evidence the system meets design requirements, including security controls as required by the scenario, have been implemented.

*System monitoring:*

Utilisation, bandwidth needs, monitoring user productivity and security of the system. Factors affecting network performance.

Identify typical failure modes in protocols and approaches to error control.

Review network monitoring data to optimise performance and undertake root cause analysis of events and make recommendations to reduce false positives and false negatives.  
 *Network automation:*

Process of setting up software to automatically manage, configure, test, deploy, and operate network devices (physical or virtual).

*Maintenance schedule:*

Backups, upgrades, security, auditing.

*Diagnose and resolve layer 1 problems:*

Explore the E2E integrated development and testing process.

Framing, CRC, runts, giants, dropped packets, late collisions, input/output errors.

*Policy review:*

Bandwidth, resource availability.

*Service level agreements (SLAs):*

Conditions of service availability, time window for each level of service (prime time and non-prime time), responsibilities of each party, escalation procedures, and cost/service trade-offs.

### Learning Outcomes and Assessment Criteria

|  |  |  |
| --- | --- | --- |
| **Pass** | **Merit** | **Distinction** |
| **LO1** Examine networking principles and their protocols | |  |
| **P1** Discuss the benefits and constraints of different network types and standards.  **P2** Explain the impact of network topology, communication and bandwidth requirements. | **M1** Assess common networking principles and how protocols enable the effectiveness of networked systems. | **D1** Evaluate the topology protocol selected for a given scenario and how it demonstrates the efficient utilisation of a networking system. |
| **LO2** Explain networking devices and operations | |  |
| **P3** Discuss the operating principles of networking devices and server types.  **P4** Discuss the interdependence of workstation hardware and relevant networking software. | **M2** Explore a range of server types and justify the selection of a server for a given scenario, regarding cost and performance optimisation. |  |
| **LO3** Design efficient networked systems | |  |
| **P5** Design a networked system to meet a given specification.  **P6** Design a maintenance schedule to support the networked system. | **M3** Analyse user feedback on your designs with the aim of optimising your design and improving efficiency. | **D2** Critically reflect on the implemented network, including the design and decisions made to enhance the system. |
| **LO4** Implement and diagnose networked systems | |  |
| **P7** Implement a networked system based on a prepared design. | **M4** Recommend potential enhancements for the networked systems. |  |
| **P8** Document and analyse test results against expected results. |  |  |

**Recommended Resources**

##### Textbooks

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

Donahue, G. A. (2011) *Network Warrior* 2nd Ed. O'Reilly Media.

Goransson, P. Black, C. et al (2016) *Software Defined Networks: A Comprehensive Approach* 2nd Ed. Morgan Kaufmann.

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

##### Links

This unit links to the following related units:s

*Unit 9: Computer Systems Architecture Unit 27: Transport Network Design Unit 29: Network Security*

*Unit 39: Network Management*

*Unit 40: Client/Server Computing Systems.*

Unit 3: Professional Practice **Unit code L/618/7398**

**Unit type Core Unit level 4 Credit value 15**

**Introduction**

In the workplace, it is essential to be effective as a communicator, critical thinker, analyser, team worker and team leader. These skills are needed on a daily basis in order to carry out designated tasks as part of a job role. The development of academic competence and the continuation of lifelong learning and continuing professional development (CPD) are 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 skills that enable tasks to be completed successfully and facilitate effective decision making. Working with others in a group environment such as an academic setting or in 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, reflective practice and working towards various goals are encouraged in the workplace through an appraisal framework. Professional development includes at higher levels of learning and the ability to demonstrate effective research skills and academic reporting skills.

This unit covers the development of communication skills and communication literacy and the use of qualitative and quantitative data to demonstrate analysis, reasoning and critical thinking. Students will carry out tasks that require working with others in a team-based scenario and planning and problem solving.

On successful completion of the unit, students will be able to demonstrate leadership skills through the dynamics of team working. Through reflective practice, they will be able to evaluate the contributions they make as an individual and those of others.

**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.

Understanding of the reasons for communicating with internal and external stakeholders, e.g. responding to queries, technical support, providing instructions, raising awareness of issues.

Considerations when communicating with internal and external stakeholders, e.g. maintaining privacy and security, tone of voice, use of technical vocabulary or jargon, company image.

Consideration of issues relating to inclusion and diversity when communicating and interacting with others.

*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.  
Demonstrate resourcefulness and creativity when solving problems.

*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.

Individual responsibility when working as part of a team.

Working effectively on individual and collaborative tasks regardless of levels of supervision.

Allocation and management of tasks between members of the team, identifying team members’ strengths, communicating requirements and expectations effectively.

*Teams and team building:*

Selecting team members e.g. specialist roles, skill and style/approach mixes. Identification of team and work group roles.

Stages in team development, including team building, identity, loyalty, commitment to shared beliefs, professionalism.

Team health evaluation, including promoting and maintaining a safe and secure working environment, 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 responsibilities, including employment legislation, ethics, employment rights and responsibilities.

Maintaining a productive, professional and secure working environment.

*Performance objectives:*

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

CPD, including 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, including 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:*

Plan to include current performance, future needs, opportunities and threats to career progression, aims and objectives, achievement dates, review dates, learning programme or activities, action plans, personal development plans, ongoing commitment to CPD.

**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 used in the design and delivery of a training event. |
| **P1** Demonstrate effective design and delivery of a training event for a given target audience, using different communication styles and formats  **P2** Demonstrate 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** Evaluate the overall success of the event delivered, in terms of how well critical reasoning and thinking were applied to achieve the end goal. |
| **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 the design and delivery of the event. | **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 methodologies in the design and delivery of an event. |

|  |  |  |
| --- | --- | --- |
| **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 in a team to achieve a defined goal. | **M4** Analyse team dynamics, in terms of the roles that group members play in a team and the effectiveness in terms of achieving shared goals. | **D3** Critically evaluate 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 and motivation. | **M5** Justify the role of CPD and development planning in building motivation. | **D4** Evaluate a range of evidence criteria that is  used as a measure for effective CPD. |
| **P8** Review different motivational theories and the impact they can have on performance in the  workplace. |  |  |
| **P9** Produce a development plan that outlines responsibilities, performance objectives and required skills for future goals. |  |  |

**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 - Japan Institute for Group Dynamics*

*Professional Development in Education - Taylor and Francis Online*

**Websites**

[www.thinkwatson.com](http://www.thinkwatson.com/) Critical Thinking Resources

“Critical Thinking Correlation Studies” (Research)

ipda.org.uk International Professional Development Association

(General Reference)

**Links**

This unit links to the following related units:

*Unit 6: Managing a Successful Computing Project Unit 13: Computing Research Project*

**Unit 4: Database Design & Development**

**Unit code A/618/7400**

**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.

As applications get increasingly more sophisticated, database systems continue to demand more complex data structures and interfaces. 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 is 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, it will also provide the practical skills to translate that understanding into the design and creation of complex databases.

Topics covered in this unit are: examination of different design tools and techniques; examination of different development software options; consideration of 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. 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. 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**

Principles and uses of relational and non-relational databases.

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

Determining user and system requirements.

Design tools and techniques for a relational database system.

Logical design for relational databases, including structured data in tables, data elements, data types, indexes, primary and 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 and linking code to data sets.

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.

Consideration of user interface requirements looking at functionality, reliability, consistency, performance and accessibility for a range of different users.

Develop effective user interfaces linked 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.

Implementation of security elements in a database, including consideration of permissions, access rights, network vulnerabilities, physical location of data, multi-tenancy and data separation, encryption.

Consideration of GDPR issues, including data crossing borders and other nations’ data protection regulations.

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.

Technical documentation to include diagrams showing movement of data through the system and flowcharts describing how the system works.

User documentation, including how to use the system, outputs produced by the system, menu operations and other functions.

**Learning Outcomes and Assessment Criteria**

|  |  |  |
| --- | --- | --- |
| **Pass** | **Merit** | **Distinction** |
| **LO1** Use an appropriate design tool to design a | |  |
| relational database system for a substantial problem | |  |
| **P1** Design a relational | **M1** Produce a | **D1** Evaluate the effectiveness |
| database system using | comprehensive design for | of the design in relation to |
| appropriate design tools | a fully-functional system, | user and system |
| and techniques, | which includes interface | requirements. |
| containing at least four | and output designs, data |  |
| interrelated tables, with | validations and data |  |
| clear statements of user | normalisation. |  |
| and system |  |  |
| requirements. |  |  |
| **LO2** Develop a fully-functional relational database system, based on an existing system design | |  |
| **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. | **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. | **D2** Evaluate the effectiveness of the database solution in relation to user and system requirements and suggest improvements. |
| **LO3** Test the system against user and system requirements | |  |
| **P4** Test the system against user and system requirements. | **M4** Assess the effectiveness of the testing, including an explanation of the choice of test data used. |  |

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| **Pass** | **Merit** | **Distinction** |
| **LO4** Produce technical and user documentation | | **D3** Evaluate the database in terms of improvements needed to ensure the continued effectiveness of the system. |
| **P5** Produce technical and user documentation. | **M5** Produce technical and user documentation for a fully-functional system, including data flow diagrams and flowcharts, describing how the system works. |

**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.

Flejoles, R. P. (2018) *Database Theory and Application*. Arcler Press.

Karwin, B. (2017) *SQL Antipatterns: Avoiding the Pitfalls of Database Programming*

Pragmatic Programmers, LLC, The.

Kroemke, D. and Auer, D. (2012) *Database Concepts: International Edition.*

6th Ed. Pearson.

**Journals**

*The Computer Journal - Oxford Academic*

*International Journal of Database Management (IJDMS)*

*Journal of Emerging Trends in Computing and Information Sciences Journal of Systems   
Analysis and Software Engineering*

*Systems Journal of Database Management*

**Websites**

[www.lynda.com](http://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)

**Links**

This unit links to the following related units:

*Unit 11: Strategic Information Systems Unit 41: Database Management Systems*

**Unit 5: Security Unit code D/618/7406**

**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. They will implement contingency plans and devise security policies and procedures. The unit also introduces students to detection of threats and vulnerabilities in physical and IT security, and how to manage risks relating to organisational security.

This unit includes 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. 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 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 of unauthorised use of a system, including 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, internal and external sources of risk.*

*Legal restrictions on the access to data, including UK and international data laws (walled garden laws), e.g. General Data Protection Regulation (UK) (GDPR).*

*Organisational security, including business continuance, backup/restoration of data, audits, areas of systems to be secured, e.g. data, network, systems (hardware and software), WANs, intranets, wireless access systems, security culture and the approaches to security in the work place, operational impact of security breaches.*

*The concepts, main functions and features of a range of Operating Systems (OS) and their security functions and associated security features.*

LO2 **Describe IT security solutions**

*IT security solution evaluation:*

Network security infrastructure, including evaluation of network address translation (NAT), demilitarized zone (DMZ), static and dynamic IP addresses.

Network performance: redundant array of inexpensive disks (RAID), Main/Standby, Dual LAN, web server balancing.

Data security, including asset management, image differential/incremental backups, storage area network (SAN) servers, encryption.

Data centre, including replica data centres, virtualisation, secure transport protocol, secure MPLS routing, segment routing and remote access methods/procedures for third-party access, physical mechanisms, e.g. air flow and cooling to prevent overheating.

Security vulnerability, including logs, traces, honeypots, data mining algorithms, vulnerability testing, zero-day exploits.

Educating staff and customers on IT security issues and prevention methods.

Understand how cyber security technology components are typically deployed in digital systems to provide security and functionality, including hardware and software to implement security controls.

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.*

*Legal mechanisms, both UK and international, including Data Protection Act 2018, Computer Misuse Act 1990 and amendments, ISO 31000 Risk Management standards.*

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

*Awareness of common security architectures and methodologies that incorporate hardware and software components, and sources of architecture patterns and guidance.*

*Assess the security culture within an organisation (the approach to security, including how user actions impact on security).*

*Ensure system defences are informed by the most up-to-date legislation and guidance on best practice from professional bodies.*

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, third-party access, business continuity, responsibility matrix.*

*Reviewing and monitoring of security risk assessments and ensuring stakeholder compliance with security procedures and standards.*

*Collect information from various sources (e.g. log files, system monitoring tools, Secure Information and Event Management (SIEM) tools, access control systems, physical security systems) and compare to known threat and vulnerability data to determine a digital system security breach.*

*Using enterprise risk management (as part of system management and lifecycle) for identifying, evaluating, implementing and follow up of security risks according to ISO 31000 standards.*

*Understand appropriate security tools and methods, 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 and penetration testing.*

*Investigate organisation policy on ethical hacking and bug bounties.*

*Gathering and recording information on security and initiating suitable actions for remediation*

**Learning Outcomes and Assessment Criteria**

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| --- | --- | --- |
| **Pass** | **Merit** | **Distinction** |
| **LO1** Assess risks to IT security | | **D1** Evaluate a range of physical and virtual security measures that can be employed to ensure the integrity of organisational IT security. |
| **P1** Discuss types of security risks to organisations.  **P2** Assess organisational security procedures. | **M1** Analyse the benefits of implementing network monitoring systems with supporting reasons. |
| **LO2** Describe IT security solutions | |
| **P3** Discuss the potential impact to IT security of incorrect configuration of firewall policies and third-  party VPNs. | **M2** Propose a method to assess and treat IT security risks. |
| **P4** Discuss, using an example for each, how implementing a DMZ, static IP and NAT in a network can improve network security. |
| **LO3** Review mechanisms to control organisational IT security | | **D2** Recommend how IT security can be aligned with an organisational policy, detailing the security impact of any misalignment. |
| **P5** Review risk assessment procedures in an organisation.  **P6** Explain data protection processes and regulations as applicable to an organisation. | **M3** Summarise an appropriate risk- management approach or ISO standard and its application in IT security.  **M4** Analyse possible impacts to organisational security resulting from an IT security audit. |

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| **Pass** | **Merit** | **Distinction** |
| **LO4** Manage organisational security | |  |
| **P7** Design a suitable security policy for an organisation, including the main components of an  organisational disaster recovery plan. | **M5** Justify the security plan developed giving reasons for the elements selected**.** | **D3** Evaluate the suitability of the tools used in the organisational policy to meet business needs. |
| **P8** Discuss the roles of stakeholders in the organisation in implementing security audits. |  |  |

**Recommended Resources**

**Textbooks**

Alexander, D. et al. (2020) *Information Security Management Principles.* BSC. Collins, R. (2017) *Network Security Monitoring: Basics for Beginners. A Practical Guide*

CreateSpace Independent Publishing Platform.

Sanders, C. Smith, J. (2013) *Applied Network Security Monitoring: Collection, Detection, and Analysis.* Syngress.

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 Publications.

**Websites**

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

**Links**

This unit links to the following related units:

*Unit 17: Network Security Unit 23: Cryptography*

*Unit 24: Forensics*

*Unit 25: Information Security Management*

**Unit 6: Planning a Computing Project (Pearson Set)**

**Unit code H/618/7407**

**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.

As computing systems and technologies continually develop so do the ways in which businesses utilise technologies to support their operations and remain competitive. As a computing professional it is important to understand the ways in which technology evolves and how it can be utilised in different sectors.

The aim of this unit is to give students an opportunity to demonstrate the research skills required for developing a deeper understanding of a subject and the ability to use evidence to inform decisions. Students will undertake independent research, and investigation of a theme set by Pearson. Students will also investigate and research an industry sector as outlined in the centre-set project brief. Students will use the outcomes of their research to help them plan a computer-based project and to support recommendations for how the identified business could utilise the tools and technologies identified as part of their research.

On successful completion of this unit, students will have the confidence to engage in decision making, problem solving, research activities and project planning tasks They will have the fundamental knowledge and skills that will enable them to investigate and examine relevant computing concepts in 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 Conduct small-scale research, information gathering and data collection to generate knowledge on an identified subject

LO2 Explore the features and business requirements of organisations in an identified sector.

LO3 Produce project plans based on research of the chosen theme for an identified organisation

LO4 Present your project recommendations and justifications of decisions made, based on research of the identified theme and sector.

**Essential Content**

LO1 **Conduct small-scale research, information gathering and data collection to generate knowledge on an identified subject**

*Project execution phase:*

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

The distinct phases that 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) used to gather data (qualitative or quantitative).

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

*Analysing information and data:*

Using data collection tools, such as interviews and questionnaires, and their advantages and disadvantages.

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

Sources of, and access to, data, including open and public data, administrative and sensitive data, research data.

The principles of data to govern data, including data has value, data should be reusable, data is managed according to its value, data should be fit for purpose.

*Ethics, reliability and validity:*

Ensure that all research is conducted, data stored, processed and used in an ethical way.

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

Ensure validity and reliability of secondary data and information used, including consideration of who wrote or collected the information or data, age of data collected, original purpose of the data collection, potential errors or variability in the data, potential bias, e.g. sample size, sample participants, questions used, interpretation of results.

LO2 **Explore the features and business requirements of organisations in an identified sector**

*Features of businesses:*

Types of business, their ownership and liability.

Private, e.g. sole trader, private limited company, public limited company. Public, e.g. government department, not-for-profit, e.g. charity, voluntary. Industry sectors, including primary, secondary, tertiary, quaternary.

How an organisation may provide a specific product(s) or service within a sector. How some organisations provide both products and services.

The concept of diversification to aid business success.

*Operational areas of businesses:*

The operational areas of a business (‘business functions’) and how they support the organisation’s purpose, e.g. human resources, research and development, sales, marketing, purchasing, production and quality, finance, customer service, IT, administration.

*Stakeholders:*

Internal stakeholders, e.g. management, employees, shareholders.

External stakeholders, e.g. suppliers, customers, government agencies, communities.

How stakeholders influence business processes and decisions. The impact of stakeholders on an organisation’s success.

*Challenges to the success of a business:*

Legislation and industry standards relevant to the organisation and sector.

Change management, including planned change, e.g. expansion, diversification, changes in legislation, system upgrades.

Unplanned change, e.g. response to a security breach, disaster response and recovery.

Communication of need for change to stakeholders.

Management of stakeholders before during and after change, e.g. training, target setting, support

Method of implementation of change, e.g. parallel running, direct change over, phased changeover.

Documenting the change process, testing changes to the system and business. Security and privacy concerns relevant to the organisation and sector.

LO3 **Produce project plans based on research of the chosen theme for an identified organisation**

*Project planning and initiation:*

The role of a business or systems analyst and the activities they undertake as part of initiation of a project.

Analysing the features and requirements of an identified organisation to establish their requirements.

Recommend potential solutions to identified business needs, including carrying out a cost/benefit analysis, defining business objectives, scope and purpose of the project.

Comprehensive project plans, including defining functional and non-functional requirements of the system, stakeholder requirements and expectations, carrying out impact analysis, prioritising requirements, describing the deliverables to be produced, timescales and time management, costs, change management planning, risk and challenges analysis.

Success criteria to be used, e.g. Key Performance Indicators (KPIs), performance metrics, quality metrics, and business targets.

Use of an identified project management methodology, e.g. Waterfall, Agile, Rapid Application Development (RAD).

Consider approaches to continuous integration, version and source control.

*Tools:*

Tools for effective project planning, resource planning and allocation, and work breakdown structure, including Project Initiation Documents (PID), bar and Gantt charts, Critical Path Analysis (CPA), risk matrix.

LO4 **Present your project recommendations and justifications of decisions made based on research of the identified theme and sector**

*Presenting and communicating project recommendations:*

Presenting to different technical and non-technical stakeholders, e.g. emphasis on operational or strategic information, technical terminology used, levels of detail given and simplifying concepts.

Consider the methods and mediums to be used, including written or verbal, report, online or presentation.

Understand how project research and intended audience will influence on method and medium.

*Justification of decisions made:*

Justification of recommendations, including use of key points from cost/benefit analysis, deliverables, success criteria, impact analysis.

Justifications of planning, including chosen development methodology, work and resource allocation, key deadlines and timescales.

Rationale for decisions made in the recommended solution and project plan, including use of research and data for the identified technology and business sector, analysis of evidence and business requirements, contextual factors specific to the identified organisation.

*Reflection on the quality of research:*

Quality of secondary and primary data used to inform planning and make decisions.

Awareness that some studies may result in generalised findings and how this can impact on the quality of decisions and the accuracy of conclusions made.

Evaluate the quality of the data and information used to inform project initiation plans, e.g. sample size, sample characteristics, user experience during collection, domain context.

Reach conclusions as to the likely accuracy and reliability of assertions made.

**Learning Outcomes and Assessment Criteria**

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| **Pass** | **Merit** | **Distinction** |
| **LO1** Conduct small-scale research, information gathering and data collection to generate knowledge on an identified subject | |  |
| **P1** Demonstrate qualitative and quantitative research methods to generate relevant primary data for an identified theme.  **P2** Examine secondary sources to collect relevant secondary data and information for an identified theme. | **M1** Analyse data and information from primary and secondary sources to generate knowledge on an identified theme. | **D1** Interpret findings to generate knowledge on how the research theme supports business requirements in the identified sector. |
| **LO2** Explore the features and business requirements of organisations in an identified sector | |  |
| **P3** Discuss the features and operational areas of a businesses in an identified  sector. | **M2** Analyse the challenges to the success of a business in an identified  sector. |  |
| **P4** Discuss the role of stakeholders and their impact on the success of a business. |  |  |

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| **Pass** | **Merit** | **Distinction** |
| **LO3** Produce project plans based on research of the chosen theme for an identified organisation | |  |
| **P5** Devise comprehensive project plans for a chosen scenario, including a work and resource allocation breakdown using appropriate tools. | **M3** Produce comprehensive project plans that effectively consider aims, objectives and risks/benefits for an identified organization. | **D2** Evaluate the project planning recommendations made in relation to the needs of the identified organisation and the accuracy and reliability of the research carried out. |
| **LO4** Present your project recommendations and justifications of decisions made, based on research of the identified theme and sector | |
| **P6** Communicate appropriate project recommendations for technical and non- technical audiences.  **P7** Present arguments for the planning decisions made when developing  the project plans. | **M4** Assess the extent to which the project recommendations meet the needs of the identified organisation, including fully- supported rationales for planning decisions made. |  |
| **P8** Discuss accuracy and reliability of the different research methods applied. |  |  |

**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.apm.org.uk](http://www.apm.org.uk/) Association for Project Management [www.gov.uk/government/publications](http://www.gov.uk/government/publications) Department of Business Innovations and

Skills, *Guidelines for managing projects – How to organise, plan and control projects*. (Report)

[www.hesa.ac.uk](http://www.hesa.ac.uk/) Higher Education Statistics Agency (HESA) – data collection and analysis for higher education

[www.ons.gov.uk](http://www.ons.gov.uk/) Office for National Statistics(ONS)

[www.pmi.org.uk](http://www.pmi.org.uk/) Project Management Institute UK

**Links**

This unit links to the following related units:

*Unit 3: Professional Practice*

*Unit 16: Computing Research Project Unit 17: Business Process Support*

*Unit 35: Systems Analysis & Design*

# Unit 7: Software Development Lifecycles

**Unit code** **K/618/7408**

**Unit level 4 Credit value 15**

**Introduction**

The software development lifecycle is an integrated process that promotes building good quality, secure software throughout the entire development process. The aim of this unit is to provide students with the knowledge and skills needed to understand software development lifecycles and to demonstrate their knowledge by implementing a software development lifecycle with a suitable methodology.

This unit introduces students to lifecycle decision-making at different stages of the software development process. They will examine various lifecycle models and learn to appreciate their particular characteristics to understand for which project environments they are most appropriate for. Theoretical understanding will be translated into practical skills through an actual software development lifecycle project. students will become confident in the use of particular tools and techniques relevant to a chosen methodology.

Among the topics included in this unit are iterative and sequential models of software development lifecycles and reference frameworks for initially capturing conceptual data and information through a feasibility study and requirement gathering techniques through to analysis, design and software implementation activities.

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 Describe different software development lifecycles.   
LO2 Explain the importance of a feasibility study.

LO3 Undertake a software development lifecycle.

LO4 Discuss the suitability of software behavioural design techniques.

### Essential Content

###### LO1 **Describe different software development lifecycles**

*Software development lifecycles:*

Describe different software development lifecycles.

Understand and use different lifecycle models, including predictive (Waterfall, Prototyping, RAD), adaptive (Spiral, Agile, DSDM), sequential and iterative software development models.

Lifecycle stage and connectivity, including feasibility study, analysis, design, implementation, testing, review or analysis, design, implementation, maintenance, planning, requirements traceability.

Testing and integration, including relationship between test activities and software development activities, levels of testing, building test environments, developing test harnesses, black box and white box testing, incremental testing, system testing, acceptance test and integration approaches, changeover strategies, trials and Go-Live prerequisites.

*Understand the role and utilisation of analysis artefacts:*

The creation of analysis artefacts in a software development project, e.g. software requirements specification, use case or user stories, user profiles, workflow model, wireframes, logical data model, data dictionary etc.

The purpose and activities of the gap analysis process.

*Roles and responsibilities in a large-scale software project development lifecycle:*

Identify the different individuals in a project, e.g. project manager, business analyst, systems analyst, programmer, DevOps engineer, testing engineer etc.

Contributions, including quality assurance, common core skills, tools and behaviours.

Explore how the psychology and mindset of testing differs to that development mindset and their possible influence on the overall success of a software project.

###### LO2 **Explain the importance of a feasibility study**

*Requirement gathering:*

Requirement gathering techniques, including how to categorise, validate and prioritise, e.g. MosCow method, functional requirements, non-functional requirements, users and constraints.

Interviews, observation, investigation.

*Importance of feasibility study:*

Feasibility criteria considerations, e.g. legal, social, economic, technical, timescales, organisational constraints.

Components of feasibility study, including purpose, structure, intended audience, outcomes.

The purpose of process modelling and the importance of an organisational view of business processes.

Key drivers for change, including performance and efficiency, legacy systems upgrade, automation, elimination of human error.

###### LO3 **Undertake a software development lifecycle**

*Carry out software development lifecycle:*

Follow company, team or client approaches to continuous integration, version and source control.

Apply an appropriate software development approach according to the relevant paradigm, e.g. object oriented, event driven or procedural.

Identify stakeholder requirements.

Scope of project, including inputs, outputs, processes and process descriptors, consideration of alternate solutions and security considerations, required quality assurance and testing.

Constraints specific to activity, e.g. costs, organisational policies, legacy systems, hardware requirements.

Create simple software designs to effectively communicate understanding of the program.

Follow agreed software designs and technical and functional specifications.

Follow organisational policies and procedures relating to the tasks being undertaken, e.g. the storage and treatment of GDPR sensitive data  
  
Report documentation, including structure, e.g. background information, problem statements, data collection process and summary, recommendations and appendices.

Use of appropriate systems analysis terminology and tools, including data stores and entities, data flows, process representation techniques relationships (1:1, 1:M and M:M).

Investigation, e.g. upgrading computer systems, designing new systems.

Techniques and documents for documenting business requirements and processes relevant to selected methodology, e.g. Context Diagrams, Data Flow Diagrams (DFDs), Entity Relationship Diagrams (ERDs), Business Systems Options (BSOs), Technical Systems Options (TSOs) and requirements traceability.

Analyse documented requirements to remove duplication, conflict and overlap. Quality considerations, e.g. Total Quality Management (TQM).

###### LO4 **Discuss the suitability of software behavioural design techniques**

*Evaluate suitability of software behavioural design techniques:*

Flowcharts, pseudocode, formal specification methods, event/state/data driven, finite state machines extended-FSM/FSP.

Problem of e-FSM state explosion, reachability analysis, safety, liveness properties.

Automatic analysis and animation tools.

Understand the characteristics of software architecture that impact on software testing in the development lifecycle.

### Learning Outcomes and Assessment Criteria

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| **Pass** | **Merit** | **Distinction** |
| **LO1** Describe different software development lifecycles | | **D1** Assess the merits of applying the Waterfall lifecycle model to a large software development project. |
| **P1** Describe two iterative and two sequential software lifecycle models.  **P2** Explain how risk is managed in software lifecycle models. | **M1** Discuss using an example, why a particular lifecycle model is selected for a development environment. |
| **LO2** Explain the importance of a feasibility study | | **D2** Assess the impact of different feasibility criteria on a software investigation. |
| **P3** Explain the purpose of a feasibility report.  **P4** Describe how technical solutions can be compared. | **M2** Discuss the components of a feasibility report. |
| **LO3** Undertake a software development lifecycle | | **D3** Evaluate the process of undertaking a systems investigation with regard to its effectiveness in improving a software quality. |
| **P5** Undertake a software investigation to meet a business need.  **P6** Use appropriate software analysis tools/techniques to carry out a software investigation and create supporting documentation. | **M3** Analyse how software requirements can be traced throughout the software lifecycle.  **M4** Discuss two approaches to improving software quality. |
| **LO4** Discuss the suitability of software behavioural design techniques | | **D4** Present justifications of how data-driven software can improve the reliability and effectiveness of software. |
| **P7** Discuss, using examples, the suitability of software behavioural design techniques. | **M5** Analyse a range of software behavioural tools and techniques.  **M6** Differentiate between a finite state machine (FSM) and an extended FSM, providing an application of use for both. |

**Recommended Resources**

##### Textbooks

Dennis, A. and Haley, W. (2009) *Systems Analysis and Design*. John Wiley & Sons Ltd.

Lejk, M. and Deeks, D. (2002) *An Introduction to System Analysis Techniques*. 2nd Ed. Addison-Wesley.

Murch, R. (2012) *The Software Development Lifecycle: A Complete Guide*. Kindle.

Smart, J. F. (2014) *BDD in Action: Behavior-driven development for the whole software lifecycle*. Manning.

##### Websites

[www.freetutes.com](http://www.freetutes.com/) FreeTutes

“Systems Analysis and Design – Complete Introductory Tutorial for Software Engineering” (Tutorial)

[www.ijcsi.org](http://www.ijcsi.org/) IJCSI International Journal of Computer Science

Vol. 7, Issue 5, September 2010

“A Comparison Between Five Models Of Software Engineering” (Research)

[www.ijcsi.org](http://www.ijcsi.org/) IJCSI International Journal of Computer Science Vol. 6, Issue 1, 2015

“Software Development Life Cycle Models – Comparison, Consequences” (Research)

##### Links

This unit links to the following related units:

*Unit 6: Planning a Computing Project   
Unit 16: Computing Research Project   
Unit 22: Application Development   
Unit 35: Systems Analysis & Design   
Unit 42: Game Design Theory*

*Unit 43: Games Development*

*Unit 54: Prototyping.*

# Unit 13: Website Design & Development Unit code Y/618/7419 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. This 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, e.g. integrated development environments, code repositories, low code environments, front- end and back-end processing.

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 and inclusivity standards and guidelines, e.g. W3C, Equality Act 2010 and other relevant legislation, 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 and inclusivity guidelines to implement an appropriately branded, multipage site.

Guidelines and recommended good practice to ensure the website and associated data is ‘secure by design’.

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

|  |  |  |
| --- | --- | --- |
| **Pass** | **Merit** | **Distinction** |
| **LO1** Explain server technologies and management services associated with hosting and managing websites | | **D1** Justify the technologies, management services, tools and software chosen to realise a custom-built website. |
| **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 regard to designing, publishing and accessing a website. | **M1** Analyse the impact of common web development technologies and frameworks with regard 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. |
| **LO2** Categorise website technologies, tools and software used to develop websites | |
| **P3** Discuss the capabilities and relationships between front-end and back-end website technologies and explain how they relate to presentation and  application layers. | **M3** Analyse a range of tools and techniques available to design and develop a custom-built website. |
| **P4** Discuss the differences between online website creation tools and custom-built sites with regard to design flexibility, performance, functionality, User Experience (UX) and User Interface (UI). |

|  |  |  |
| --- | --- | --- |
| **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. | **M4** Justify the multipage website implementation decisions against the design document. | **D2** Evaluate the design and development process of the multipage website against the design document including any technical challenges faced. |
| **P6** Use the design document with appropriate principles, standards and guidelines to produce a branded, multipage website supported with realistic content. |  |  |
| **LO4** Create and use a Test Plan to review the | |  |
| performance and design of a multipage website | |  |
| **P7** Create a suitable test | **M5** Analyse the Quality | **D3** Evaluate the results of the |
| plan, identifying key | Assurance (QA) process | Test Plan and the overall |
| performance areas to | and review how it was | success of the multipage |
| review the functionality | implemented during the | website with |
| and performance of the | multipage website design | recommendations for |
| multipage website | and development stages. | improvement. |
| developed |  |  |

**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.

##### **Web Links**

developers.google.com/web/tools Google web development tools

(General reference)

getbootstrap.com Open source web development tool kit (General reference)

[www.w3.org](http://www.w3.org) World Wide Web Consortium (General reference)

##### Links

This unit links to the following related units:

*Unit 36: User Experience & Interface Design*