

# ETC Course content

## Computing

### Year 1 Computing units

- Computer Programming
- Information Systems Development
- The Global Web
- Computer Systems, Operating Systems and Architecture \*
- Networking \*
- Mathematics and Business Management
- Database Design and Implementation
- Introduction to ICT

### Year 2 Computing units

- Software and Security Management
- Object Oriented Design
- Object Oriented Development
- Interactive Systems Design and Evaluation
- Multimedia Development
- Project Management and Team Development (Scrum)
- Business Intelligence
- Introduction to Research

\* Students will have the opportunity to sit exams from EC Council or CompTIA to obtain the industry certifications. Please see details in introduction section of the relevant units.

## Computer Programming

### Introduction

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, visual development and GUI development, the integrated development environment and the debugging process. Programming languages typically provide the representation of both the data and the process; they provide control constructs and data types. Students will learn important algorithms and data structures which they will use and improve, even enhance, to be more efficient and improve user experience on top of creating a useful solution.

### Learning Outcomes

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

LO2 Explain the characteristics of procedural and event-driven programming, conduct an analysis of a suitable IDE.

LO3 Implement basic algorithms in C using an IDE.

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

**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 and event-driven programming, conduct an analysis of a suitable IDE.**

*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.

**LO3 Implement basic algorithms in C using an IDE.**

*Implementation* Developing simple applications which implements basic algorithms covered in LO1, using the features of C and an IDE.

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

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

## **Mathematics and Business Management**

### **Introduction**

This unit introduces students to the mathematical principles and theory that underpin the computing curriculum. Through a series of case studies, scenarios and task-based assessments students will explore number theory within a variety of scenarios; use applicable probability theory; apply geometrical and vector methodology; and finally evaluate problems concerning differential and integral calculus.

Among the topics included in this unit are: prime number theory, sequences and series, probability theory, geometry, differential calculus and integral calculus.

### **Learning Outcomes**

LO1 Use applied number theory in practical scenarios.

LO2 Analyse events using probability theory and probability distributions.

LO3 Determine solutions of graphical examples using geometry and vector methods.

LO4 Evaluate problems concerning differential and integral calculus.

LO5 Explain Management and Operations as cross-organisation activities. Understand Inventory control and costing management. Explain the use of business intelligence tools and technologies.

#### **LO1 Use applied number theory in practical computing scenarios**

##### *Number theory:*

Converting between number bases (Denary, Binary, Octal, Duodecimal and Hexadecimal).

Prime numbers, Pythagorean triples and Mersenne primes.

Greatest common divisors and least common multiples.

Modular arithmetic operations.

##### *Sequences and series:*

Expressing a sequence recursively.

Arithmetic and geometric progression theory and application.

Summation of series and the sum to infinity.

#### **LO2 Analyse events using probability theory and probability distributions**

##### *Probability theory:*

Calculating conditional probability from independent trials.

Random variables and the expectation of events.

Applying probability calculations to hashing and load balancing.

##### *Probability distributions:*

Discrete probability distribution of the binomial distribution.

Continuous probability distribution of the normal (Gaussian) distribution.

#### **LO3 Determine solutions of graphical examples using geometry and vector methods**

##### *Geometry:*

Cartesian co-ordinate systems in two dimensions.

Representing lines and simple shapes using co-ordinates.

The co-ordinate system used in programming output device.

##### *Vectors:*

Introducing vector concepts.

Cartesian and polar representations of a vector.  
Scaling shapes described by vector co-ordinates.

#### **LO4 Evaluate problems concerning differential and integral calculus**

##### *Differential calculus:*

Introduction to methods for differentiating mathematical functions.

The use of stationary points to determine maxima and minima.

Using differentiation to assess rate of change in a quantity.

##### *Integral calculus:*

Introducing definite and indefinite integration for known functions.

Using integration to determine the area under a curve.

Formulating models of exponential growth and decay using integration methods.

#### **LO5 Explain Management and Operations as cross-organisation activities. Understand Inventory control and costing management. Explain the use of business intelligence tools and technologies.**

Operations as a concept and as a function vs management as strategic oversight  
Operations as a concept  
Overseeing the design, implementation and effectiveness of an operations function. Utilising control systems and contingencies to ensure efficiency. The use of Six Sigma and Lean principles to improve efficiency and effectiveness. Policies and processes including cost reduction and quality improvement. Continuous improvement as a philosophy and approach using the application of Lean principles within a cycle of continuous improvement.

##### Business Intelligence 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.

## Information Systems Development

### Introduction

This unit introduces students to lifecycle decision-making at different stages of the software development process. Students will examine various lifecycle models and appreciate their particular characteristics to understand which project environments they are most appropriate for. Theoretical understanding will be translated into practical skills through an actual software development lifecycle project and 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.

### Learning Outcomes

LO1 Describe different software development lifecycles.

LO2 Explain the importance of a feasibility study when designing an information system.

LO3 Understand a software development lifecycle, the development process and production of a system which meets client's requirements.

LO4 Discuss the suitability of software behavioural design techniques.

#### LO1 Describe different software development lifecycles

*Software development lifecycles:*

Lifecycle models: understanding and use of predictive (Waterfall, Prototyping, RAD) and adaptive (Spiral, Agile, DSDM) software development models.

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

Test and integration: building test environments; developing test harnesses; black box/white box testing; incremental testing; acceptance test and integration approaches; changeover strategies, trials and Go-Live prerequisites.

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

*Importance of feasibility study:*

Requirement gathering techniques: e.g., interviews, observation, investigation

Key drivers: performance and efficiency; legacy systems upgrade; automation; elimination of human error.

Feasibility criteria: issues e.g. legal, social, economic, technical, timescales; organisational constraints.

Components: purpose; structure; intended audience; outcomes.

Requirements: MosCow; Functional; non-functional; user; constraints.

#### LO3 Undertake a software development lifecycle

*Carry out software development lifecycle:*

Identify requirements: stakeholders; requirements identification; requirements specification e.g. scope, inputs, outputs, processes and process descriptors;

consideration of alternate solutions and security considerations; quality assurance required.

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

hardware requirements.

Report documentation: structure e.g. background information, problem statements, data collection process and summary, recommendations, appendices.

Systems analysis terminology and tools: data stores and entities; data flows; process representation techniques relationships – 1:1, 1:Many (1:M) and Many:Many (M:M).

Investigation: e.g. upgrading computer systems, designing new systems. Techniques: examples relevant to methodology chosen e.g. Context Diagrams, Data Flow Diagrams (DFDs), Entity Relationship Diagrams (ERDs); Business Systems Options (BSOs); Technical Systems Options (TSOs); quality considerations e.g. Total Quality Management (TQM).

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

*Evaluate suitability of software behavioural design techniques:*

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.

## Introduction to ICT

### Introduction

In this unit students will start by analysing 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 systems to support its operation.

On completion of this unit, students will understand the importance of effective information systems to an organisation. They will be aware of the variety of options available for information processing and know that these will inevitably change over time. They will also use an information system to produce management information.

The final topic of this unit will be about the IoE, or IoT. The Internet of Everything is always evolving; we are using the internet to communicate with multiple distributed devices and we need to learn how to connect devices safely and efficiently to ensure it will make our lives easier.

### Learning Outcomes

LO1 Understand and analyse information needs within different functional areas of various organisations.

LO2 Compare and contrast information systems.

LO3 Use information systems to produce management information.

LO4 Evaluate the role, basic concepts and benefits of IoT in the design process of computer applications.

#### **LO1 Understand information needs within different functional areas of various organisations.**

Functional areas of an organisation: typical areas e.g. finance, accounts, human resources, stock control, sales, marketing, research and development, production, distribution, customer service, administration  
Information needs: requirements analysis e.g. strategic, tactical, operational; data requirements e.g. inputs, outputs, processing activities; information distribution requirements e.g. location, department, individual

#### **LO2 Compare information systems.**

Information systems: types e.g. business information systems, decision support systems, management information systems, 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

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 Use information systems to produce management information.**

Management information: reports e.g. sales report, college enrolment statistics, marketing analysis (brick v click)

Gathering information: defining requirements; establishing sources of information; defining other factors to be considered e.g. constraints

Selecting information: analysis of e.g. validity, accuracy, currency, relevance; identifying alternatives

**LO4 Evaluate the role, basic concepts and benefits of IoT in the design process of computer applications.**

You will be introduced to the social, political, economic and legal context of ICT.

What is the IoE? People, process, data and things, The value of the IoE, Devices of the IoE, Building blocks and application of the IoE. Connecting various devices. Security Issues.

## **Computer Systems, OS and Architecture \***

### **Introduction**

This unit introduces students to the foundations of computer systems architecture together with the integrated hardware and software components and subsystems that enable and allow data to be input, processed and output. The unit further explores the concepts of operating systems, hardware management and computer networks together with the practical skills needed to diagnose, troubleshoot and maintain computer systems taking the security of these systems into consideration.

Among the topics included in this unit are: CPUs, memory, input & output devices, ALU operations, program execution, operating systems (including kernel, file systems, API and system calls), hardware management, installation, firmware, device drivers, networking (including OSI and TCP/IP models), error and information gathering, fault diagnostics, security and problem resolution.

**Students will have the opportunity to sit an exam to obtain the A+ certification from CompTIA.**

### **Learning Outcomes**

LO1 Understand the relationships between hardware components and the subsystems used in a computer system.

LO2 Explain the key features and services provided by different computer operating systems and hardware.

LO3 Understand basic shell-scripts and security risks in computer configurations.

LO4 Demonstrate diagnostic and troubleshooting skills to solve hardware, software and networking related issues.

#### **LO1 Explain the relationships between hardware components and the subsystems used in a computer system**

*Hardware components and subsystems:*

Computers consist of four main subsystems (Von Neumann Architecture, Memory, CPU (Arithmetical & Logic Unit (ALU) and Control Unit), Input and output Systems).

Review Memory subsystems regarding programs and data (variable) storage (ROM, RAM, size, speed, operation and structure).

Explore Input/output systems and structure (communicating with other devices (screen, keyboard, printers, etc.), storage (Hard Disk Drives (HDD), DVD's, etc.), IO controllers & data transfer (speed, buffers, interrupts, etc.).

Discuss ALU subsystems (mathematical & logical operations, registers, bus, etc.).

Investigate how the Control Unit works (program code & language, fetch, decode, execute, halt) including an introduction to machine language instructions (reduced instruction and complex instruction sets: arithmetic, compare, branch, control, Program Counter (PC), Instruction Register (IR) and Instruction decoder.

#### **LO2 Categorise the key features and services provided by different computer operating systems and hardware**

*Operating system types and hardware:*

Introduce different operating systems and types (desktop & server/network, mobile, embedded systems (e.g. Windows 10, Windows Server 2012/2016, Linux, Unix, MacOS, IOS, Android, etc.).

Hardware management and connections including the hardware abstraction

layer, firmware and device drivers (network cards, video cards, optical drives, magnetic disks, solid state drives, RAID, etc.).

Installing and configuring common peripheral devices (mouse, keyboard, scanners, biometrics, webcams, smartcards, motion sensor, printers, speakers, display devices, etc.).

*Features and services:*

Introduce Operating Systems Architecture (Kernel, File Systems, API).

Review how operating systems function and provide services (user interface, memory management (Direct Memory Access), file management).

### **LO3 Use network communication technology and the associated services to connect computer systems**

*Networking technology and services:*

Introduction to network protocols (HTTP, SMTP, TCP, UDP, etc.) including the OSI and TCP/IP models.

Students should have an understanding about the five layers for the TCP/IP model to include the application layer, transport layer, network layer, data link layer and physical layer in terms of functionality and links to the OSI model and layers.

OSI understand that it is a conceptual model, dividing network architecture into seven progressive layers.

Hardware and network addresses (physical/MAC addresses, logical/IP addresses).

Network devices and components (network interface cards (NIC), network cables, switches, wireless access points, routers, network services).

*Connecting computer systems to a network:*

Introduce topologies including physical and logical: bus, star (extended star), ring and mesh.

Establishing network connections including wired/wireless client configuration.

Security of networking systems and the importance of this.

### **LO4 Demonstrate diagnostic and troubleshooting skills to solve hardware, software and networking related issues.**

*Hardware, software & networking issues and maintenance:*

Different hardware and software related problems and the implication of choices with regards to system administration, impact on users and business operations.

*Explore methods of maintenance with regard to hardware and software. Diagnostic and troubleshooting skills:*

Discuss information gathering methods and techniques (such as: system documents, user information, error codes, error messages, failure domain, problem history, etc.).

Consider solutions to security problems.

Analyse evidence and establish possible problem domains, complexity, priority and impact; introduce 'Research, Determine, Implement, Review, Document (and Repeat)'.  
Creating and updating system documentation.

## **The Global Web**

### **Introduction**

The aim of this unit is to introduce students to various protocols and models to be able to interrogate, understand and explain global communications.

### **Learning Outcomes**

LO1 Describe the features, operation, and use of TCP/IP application layer services and Protocols.

LO2 Define the application layer as the source and destination of data for communication across networks.

LO3 Understand and apply HTML and CSS to meet a client's requirements.

LO4 Discuss security risks and legal issues

### **Essential Content**

Describe how networks impact our daily lives.

Describe the role of data networking in the human network.

Identify the key components of any data network.

Identify the opportunities and challenges posed by converged networks.

Describe the characteristics of network architectures: fault tolerance, scalability, quality of service and security.

Describe the structure of a network, including the devices and media that are necessary for successful communications.

Explain the function of protocols in network communications.

Explain the advantages of using a layered model to describe network functionality.

Describe the role of each layer in two recognized network models: The TCP/IP model and the OSI model.

Describe the importance of addressing and naming schemes in network communications.

Define the application layer as the source and destination of data for communication across networks.

Explain the role of protocols in supporting communication between server and client processes.

Describe the features, operation, and use of well-known TCP/IP application layer services (HTTP, DNS, SMTP).

Explain the role of Transport Layer protocols and services in supporting communications across data networks

Analyze the application and operation of TCP mechanisms that support reliability

Analyze the application and operation of TCP mechanisms that support reassembly and manage data loss.

Analyze the operation of UDP to support communicate between two processes on end devices

Software that drives the internet:

Application layer: browsers.

Router and switch 'software' – Computer operating systems and their "Web"-software.

HTML and CSS - Introduction, Basics,

SQL injection attack

Legal aspects of protection of security, copyright, patents, various case studies.

Information and The Law

Privacy laws, Hacking Laws,

Specific Laws in the UK

## **Computer Networks \***

### **Introduction**

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 largescale networks and the protocol methodologies related to IP data networks will be explored.

**All students will have the opportunity to sit an exam to obtain the Network+ certification from CompTIA.**

### Learning Outcomes

LO1 Explain networking principles and their protocols.

LO2 Explain and understand networking devices and operations.

LO3 Design efficient networked systems.

LO4 Implement and diagnose networked systems.

#### **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:

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

Protocols:

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

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

*Networking devices:*

Servers; hub, routers; switches; multilayer switch, 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.

## Database Design and Implementation

### Introduction

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.

### Learning Outcomes

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.

#### **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.

## **Year 2 Computing units**

- Software and Security Management
- Object Oriented Design
- Object Oriented Development
- Interactive Systems Design and Evaluation
- Multimedia Development
- Project Management and Team Development (Scrum)
- Business Intelligence
- Introduction to Research

## Software and Security Management

### Introduction

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

### Learning Outcomes

- LO1 Describe different software development lifecycles.
- LO2 Explain the importance of a feasibility study.
- LO3 Explore the basic principles of information security management.
- LO4 Critically assess how an organisation can implement and maintain an Information Security Management System (ISMS).

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

*Software development lifecycles:*

Lifecycle models: understanding and use of predictive (Waterfall, Prototyping, RAD) and adaptive (Spiral, Agile, DSDM) software development models. Lifecycle stage and connectivity: feasibility study, analysis, design, implementation, testing, review or analysis, design, implementation, maintenance, planning; requirements traceability. Test and integration: building test environments; developing test harnesses; black box/white box testing; incremental testing; acceptance test and integration approaches; changeover strategies, trials and Go-Live prerequisites.

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

*Importance of feasibility study:*

Requirement gathering techniques: e.g., interviews, observation, investigation  
Key drivers: performance and efficiency; legacy systems upgrade; automation; elimination of human error. Feasibility criteria: issues e.g. legal, social, economic, technical, timescales; organisational constraints. Components: purpose; structure; intended audience; outcomes.  
Requirements: MosCow; Functional; non-functional; user; constraints.

#### **LO3 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.

#### **LO4 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 buying; audit (internal, external); performance monitoring; continual improvement.

## Object Oriented Design

### Introduction

Features of programming languages that are considered advanced are used to develop software that is efficient; it can affect the performance of an application as well as the readability and extensibility of the code, improving productivity and therefore reducing cost. Many commercial applications available today, whether for productivity or entertainment, will have used one or more design pattern in their development. A design pattern is a description of how to solve a problem that can be used in many different situations and can help deepen the understanding of object-orientated programming in Java (and be exposed to C++) and help improve software design and reusability.

The aim of this unit is to familiarise students with these features and their best practices to ensure that their code is in line with industry standards. Among the topics included in this unit are: object-orientated programming; polymorphism, encapsulation, class aggregation/association, constructors/destructors, inheritance, abstract classes, interfaces, containers, generics, introduction to design patterns and Unified Modelling Language (UML).

### Learning Outcomes

LO1 Design an object-oriented software system, using UML.

LO2 Design and plan reusable libraries.

LO3 Implement an object-oriented solution and include reusable libraries, in Java

### Unit content

*Outline the object-orientated paradigm characteristics:*

Encapsulation, polymorphism, constructors/destructors, sub objects, abstract/concrete, interface, method redefinition, generics/templates, containers.

*Object-orientated class relationships:*

Generalisation/inheritance, realisation, dependency, aggregation, composition.

*Design patterns:*

*Libraries:*

Design, test and implement

Creational, structural and behavioural.

*UML class design:*

Analyse a code scenario and utilise a suitable UML tool to develop class diagrams.

*Design and Implementation:*

Using an appropriate language & IDE to develop code that implements design patterns and utilises techniques to produce secure code.

## Object Oriented Development

### Introduction

In this module students will build on Object Oriented Design and will focus on Object-Oriented (OO) application development. Students will be exposed to using the extensive library packages provided by the Java Software Development Kit. Among the topics included in this unit are: object-orientated programming; polymorphism, encapsulation, class aggregation/association, constructors/destructors, inheritance, abstract classes, interfaces, containers, generics, introduction to design patterns and Unified Modelling Language (UML).

### Learning Outcomes

LO1 Develop extensive library packages using Java.

LO2 Explain key characteristics of encapsulation and inheritance.

LO3 Implement an object-oriented solution to include encapsulation and inheritance

### Unit content

#### *Implement and investigate:*

Encapsulation, polymorphism, constructors/destructors, sub objects, abstract/concrete, interface, method redefinition, generics/templates, containers

Use library packages in Java, to aid OO design.

Design extensive library packages using Java.

Explain encapsulation and inheritance using examples.

Access Modifiers: No modifier, Private, Protected and Public

#### *Object-orientated class relationships:*

Generalisation/inheritance, realisation, dependency, aggregation, composition.

Composition and Abstraction

Mutator explained

Coding an OOP solution using libraries to include inheritance and encapsulation.

## Project Management and Team Development (Scrum)

### Introduction

In this module students collaborate on a project where they get an opportunity to engage in a constrained work-place simulation based on Scrum software development. Students working in teams will initially identify a system of a sufficient size to be distributed equally among all members and then allocate work amongst themselves. They will be monitored under the guidance of their tutor whilst completing their projects. The notion of team entails shared accountability: good or bad, the outcomes should be attributed to the entire team rather than to any individual. On successful completion of this unit students will have developed sufficient knowledge and understanding of operations and project management to make an effective and immediate contribution to the way in which an organisation conducts its business. Students will also be in a strong position to contribute to, as well as lead, small-scale projects.

### Learning Outcomes

LO1 Plan and design a software project for a specific scenario.

LO2 Implement the planned design for the project.

LO3 Test and report on the implemented project and CRUD functionality.

LO4 Evaluate success of implemented project and your own contribution to the project.

### Unit content

Scrum definitions and Glossary compared to Agile teams and definitions, Agile Teams are Cross-Functional

*SAFe Teams Typically Blend Agile Methods*

Responsibilities vary based on team type

Collaboration and Culture

*Agile Teams Are on the 'Train' vs The Scrum Framework*

Plan together, demo together, learn together,

Explore, Integrate, Deploy, and Release Independently

Join the Value Stream

*Specialize principles and practices:*

Agile Team Roles compared to Scrum Team roles

Agile Team Structures: Generalist Agile Team, Specialist Agile Team, Transitioning Agile Team, Parallel

Scrum events and Artifacts, i.e. Backlog, sprint, etc.

Agile Team and Agile Product Sub-Team.

Common pitfalls in all projects and pitfalls in any project management methodology.

Project Management and the cycle:

The phases and activities of the PLC: initiation, planning, execution and closure.

Developing the business case for a project and undertaking feasibility study.

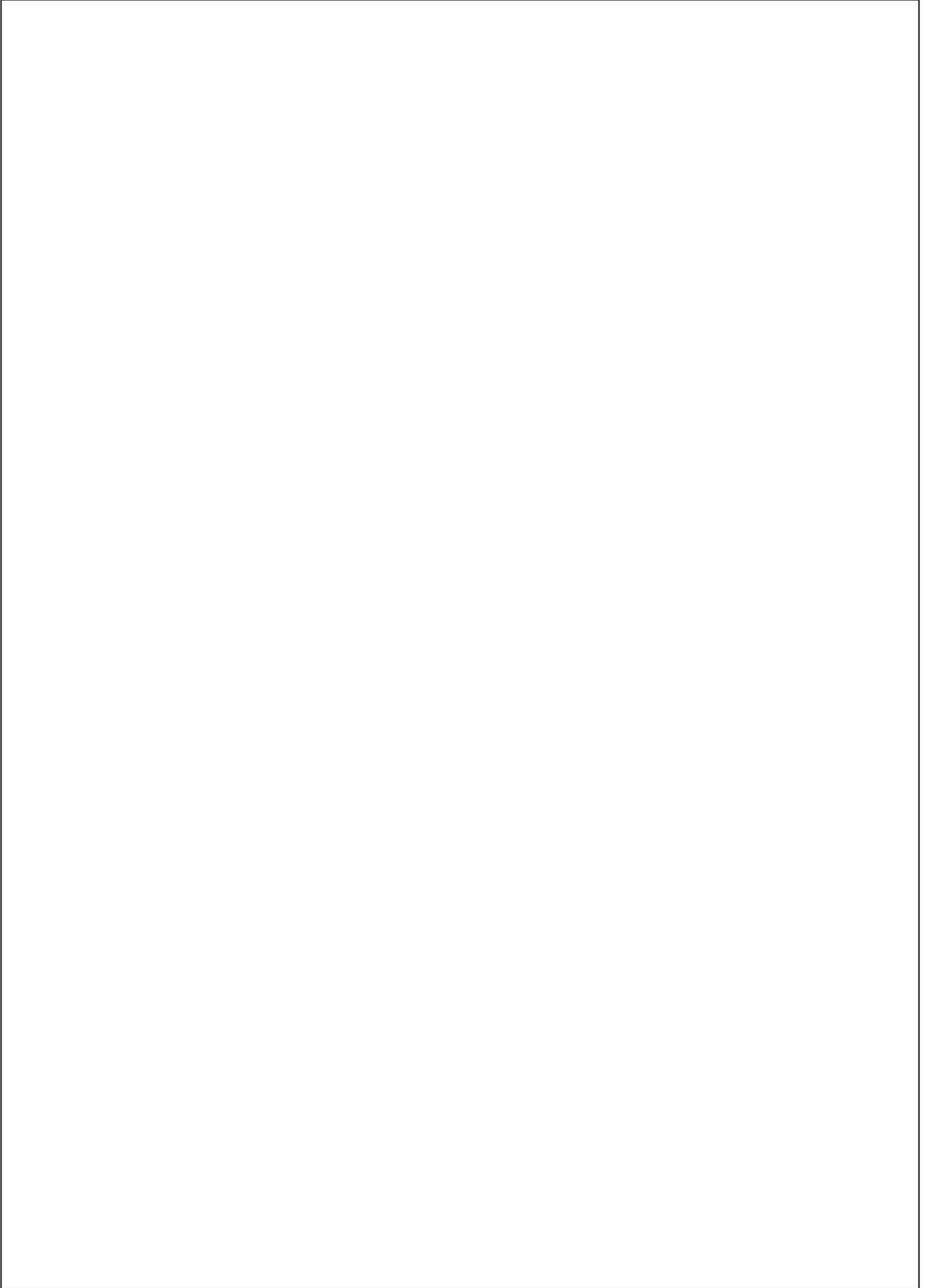
*The theories and practice of project management:*

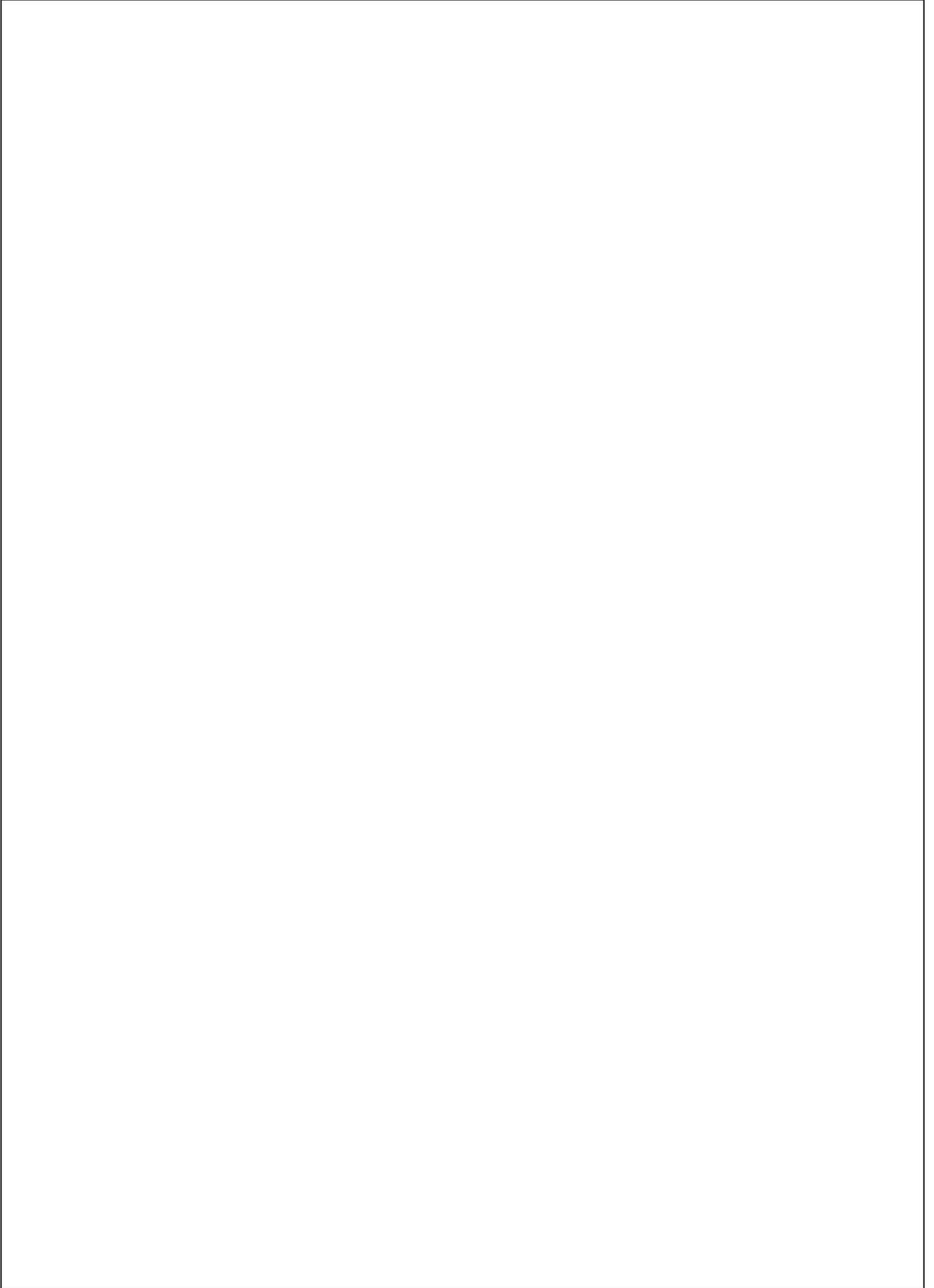
To include agile methodologies, project management tools and project leadership within the PLC.

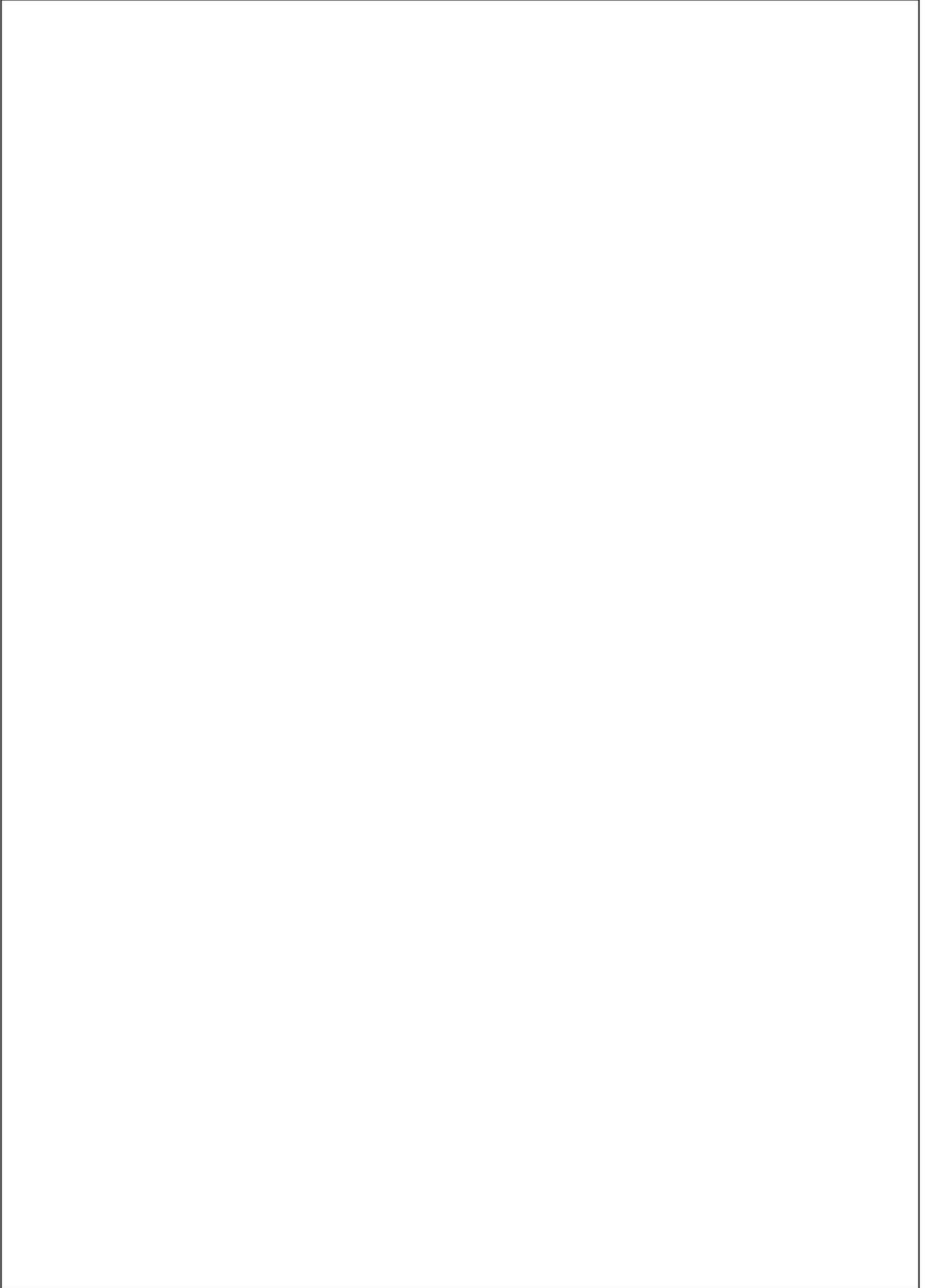
*Project documentation:*

To include the project initiation document, project plan, cost benefit analysis and work breakdown structure.

*Directing projects:* Differentiating between large and small-scale projects and those used in the public, private or not-for-profit sectors.







## Introduction to Research

### Introduction

The aim of this unit is to offer students the opportunity to engage in 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.

### Learning Outcomes

LO1 Examine appropriate research methodologies and approaches.

LO2 Analyse research relevant to a research project.

LO3 Communicate the outcomes of research to an appropriate audience.

LO4 Reflect on research methodologies, concepts and explain general pitfalls.

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 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 nonprobability 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 research to an appropriate audience.

#### *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 research methodologies, concepts and explain general pitfalls.

#### *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.

## Multimedia Development

### Introduction

The aim of this unit is to help students understand the latest technology and design technology and tools when planning, designing and developing multimedia on various platforms. The students will learn how to design and develop advanced websites and web-content to have an understanding of JavaScript and PHP, improving the user's experience.

### Learning Outcomes

LO1 Understand multimedia and website technologies, tools and software used to develop websites.

LO2 Understand multimedia content creation tools and software.

LO3 Be able to create a multi-page website using multimedia content.

LO1 Understand multimedia and website technologies, tools and software used to develop websites.

Explain the concepts of design flexibility, performance, functionality, User Experience (UX) and User Interface (UI). Improving User Experience (UX) using JavaScript and CSS frameworks and packages.

Evaluate a range of tools and techniques including HTML, CSS, and JavaScript available to design and develop a custom-built website.

Evaluate the use of content management systems for website design and maintenance.

*Developing schemes of user interaction influenced by characteristics of good design, such as: learnability, robustness, flexibility, usability, performance, accessibility, adaptability, customisation*

*Developing dynamic content using JavaScript and PHP: Interfacing with a database (limited knowledge of SQL syntax is required to allow iterating over a data set)*

*Standards & conformance: W3C, WAI and CSS.*

*ISO 9126 characteristics of quality.*

*Streaming media, RSS, IRC, Wiki, Blog, Web Forum, Portals. Joomla, WordPress, Drupal, etc.*

LO2 Understand multimedia content creation tools and software.

Evaluate tools available to create multimedia content for websites.

Explain regulatory and ethical considerations in creating multimedia content for websites.

*InDesign, Adobe Illustrator, Photoshop, Dreamweaver & CorelDRAW.*

*Disability Discrimination Act 1995 (DDA) and the related Special Educational Needs and Disability Act 2001 (SENDA)*

*Web Accessibility Initiative (WAI) from the World Wide Web Consortium (W3C)*

*Lab hours demonstrating InDesign, Adobe Illustrator, Photoshop, Dreamweaver & CorelDRAW use.*

Evaluate tools available to create multimedia content for websites.

LO3 Be able to create a multi-page website using multimedia content.

Create a design document for a branded, multipage website following client and user requirements.

Create a branded, multipage website supported with realistic multimedia content to follow given design specifications.

Critically evaluate the design and development process

*Computer Lab/workplace creation of website.*

Critically evaluate the design and development process

## **Business Intelligence**

### Introduction

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.

### Learning Outcomes

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.

### **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.

## Interactive Systems Design and Evaluation

### Introduction

User Experience (UX) and User Interface (UI) Design is the process by which software applications and user interactions can be designed to be simple, accessible, effective and attractive for the end user. The objective of UX and UI Design is to create user interactions and software application experiences that are appropriate for specific platforms or devices and provide desirable end user outcomes utilising insight and understanding about the practical, emotional and experiential motivations and values of the end user. UX and UI Design explores the motivations and desires of the end user and seeks to design user's interactions that best satisfy those motivations and desires in a concise manner.

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

Among the topics included in this unit are: classification and terminology of UX and UI Design techniques, the relationship between UX and UI Design, how UX and UI Design relates to the rest of the software development lifecycle, understand a user's emotions, desires and attitudes about using a particular feature, product, system, platform or software application, modes of interaction, human-computer interaction models, usability, accessibility, aesthetics, design thinking, value proposition design, user journey mapping and gathering meaningful insights from users feedback and research.

### Learning Outcomes

LO1 Research what aspects of User Experience and Interface Design are necessary and appropriate to satisfy end user emotions, desires and attitudes when using a user interface concept.

LO2 Plan an appropriate User Experience map and Interface Design for a User Interface concept with a specific target end user in mind and also outline the tests you mean to conduct.

LO3 Build a User Interface concept and test it with users to see if it satisfies their emotions, desires and attitudes as planned.

LO4 Evaluate user feedback, test results and insights gained from end users interacting with your User Interface concept to determine success or failure and steps to improve in future versions.

#### **LO1 Research what aspects of User Experience and Interface Design are necessary and appropriate to satisfy end user emotions, desires and attitudes when using a user interface concept**

*Identify formats, characteristics and appropriateness of UX and UI Design*

Present an overview of UX and UI Design, how they are produced and their appropriate use in software development.

Identify what UX and UI Design is by researching the role, purpose, terminology and methodology of UX and UI Design.

Recognise the various forms of UX and UI Design by researching the history of, current trends and use in the product development lifecycle.

Recognise the use of appropriate UX and UI Design patterns.

Define the characteristics of UX and UI Designs by investigating how they can be used to satisfy end user emotions, desires and attitudes.

*Recognise specific forms, patterns and trends of UX and UI Design:*

Research, debate and agree current functionality, patterns and trends in UX and UI Design.

Identify various forms of UX and UI Design.

Define the advantages and disadvantages of using UX and UI Design.

*Define standard tools available for use in UX and UI Design:*

Identify standard tools available to create UX and UI Designs.

The advantages and disadvantages of UX and UI Design tools.

How UX and UI Design tools can be used to capture end user feedback.

Appropriateness of various tools for different end user testing outcomes.

## **LO2 Plan an appropriate User Experience map and Interface Design for a User Interface concept with a specific target end user in mind and also outline the tests you mean to conduct**

*Identify a specific end user and an appropriate UX and UI Design to test with this user type:*

Choose a specific end user to conduct tests against.

Evaluate the benefits, features, advantages and disadvantages of different UX and UI Design methodologies for various end user testing outcomes.

Review different end user categorisations, classifications and behaviour modelling techniques.

Select the most appropriate form of UX and UI Design to achieve desired end user testing and outcomes.

*Describe a plan to use appropriate UX and UI Design methodology and tools to conduct end user testing:*

Apply end user classification and behaviour modelling to select an appropriate UX and UI Design methodology.

Outline the end user characteristics, desired testing criteria and results your UX and UI Design addresses.

Select an appropriate form of UX and UI Design necessary to achieve desired results.

Use your selected end user, appropriate UX and UI Design methodology and desired testing criteria to create a plan for a UI concept.

## **LO3 Build a User Interface concept and test it with users to see if it satisfies their emotions, desires and attitudes as planned**

*Utilise appropriate tools to develop a UX and UI Design:*

Employ an appropriate set of tools to develop your plan into a UI.

Run end user experiments and examine feedback.

Reconcile and evaluate end user feedback and build a new iteration of your user interface modified with the most important feedback and enhancements.

Make multiple iterations of your user interface and modify each iteration with enhancements gathered from user feedback and experimentation.

## **LO4 Evaluate user feedback, test results and insights gained from end users interacting with your User Interface concept to determine success or failure and steps to improve in future versions**

*Asses the success of your UX and UI Design:*

Assemble and appraise end use feedback from multiple iterations of your user interface.

Undertake a critical review and compare your final user interface and your test results with the original plan.

Evaluate the advantages, disadvantages, strengths and weaknesses of your UX and UI Design methodology.  
Critique the overall success of your UI and discuss your UX insights.

