

**AM SYLLABUS (2011)**

**INFORMATION TECHNOLOGY**

**AM 19**

***SYLLABUS***

<b>Information Technology AM 19</b> <b>Syllabus</b>	(Available in September) Paper I (3 hrs)+Paper II (3 hrs) + Coursework
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### Introduction

This course is meant to prepare students for work in industry in the information processing fields as well as prepare students for business and computer-related courses. In particular, it aims to:

- provide a basic knowledge of computer hardware and software;
- introduce the business areas to which computers may be applied;
- provide an introduction to business organisation and information systems;
- develop the skills in communication, verbal and written, which play an important part in business computing and information processing;
- provide sufficient training in programming to enable the design, writing and documenting of a program or suite of programs in a high-level language;
- develop knowledge of capabilities of generic software.

### Course Structure

Prerequisites: It is recommended that students following this course have a SEC standard in computing.

Duration: A 2-year period of study is assumed with a total of approximately 350 contact hours which include both lectures and lab work.

### Content

The syllabus consists of five major modules:

#### 1: Information Systems

Aim: To give students a broad foundation of basic computing/data processing knowledge and skills.

#### 2: Human communication and Business Organisation

Aim: To provide students with the necessary written and verbal communication skills to enable them to relate to others on computing and non-computing matters.

To give the student an understanding of the information needs of organisations, the various types of organisation and the various ways that Information Technology permeates within organisations.

#### 3: Software

Aim: To become familiar with the various types of software categories and their capabilities. Students will develop skills to use generic software especially of database and spreadsheet nature.

#### 4: Programming Techniques and System Development

Aim: To give students knowledge of the necessary techniques needed to implement algorithmic design using a high level language, which is object oriented (Java), as well as creating, testing and maintaining the implemented systems. (A working knowledge of a high level programming language at SEC level is recommended.)

#### 5: Exercises

Aim: To give students the opportunity to put into practice concepts learnt during the course.

### Assessment Procedure

Modules 1 and 2 are assessed on the basis of ONE WRITTEN EXAMINATION PAPER AT THE END OF THE 2-YEAR COURSE.

Modules 3 and 4 are assessed on the basis of ONE WRITTEN EXAMINATION PAPER AT THE END OF THE 2-YEAR COURSE.

Module 5 is assessed on the basis of a set of four school based exercises carried out by the candidate during the course of study, monitored and assessed by the tutor and moderated by the Markers' panel. All marks are to be submitted to MATSEC not later than the date stipulated by the MATSEC board.

**Note for Private candidates:** Private Candidates are to submit all exercises to the MATSEC Support Unit, for assessment by the Markers' Panel, by the date stipulated by the unit. Candidates may be called for an interview about their work.

### Weightings for final Grade

		Module	% Weighting
Paper 1 (3 hours)	Section A	Information Systems	20
	Section B	Human Communication & Business Organisation	20
Paper 2 (3 hours)	Section A	Software	20
	Section B	Programming Techniques and System Development	20
Set Exercises			20

Four exercises will be set during the course. The percentage values illustrate the weighting of each assignment mark as a percentage of the overall final grade.

- (i) Web Design Assignment 5%
- (ii) Database + Spreadsheet (linked) Assignment 5%
- (iii) Programming Assignment I 5%
- (iv) Programming Assignment II 5%

### Paper Structure

#### Paper 1

Duration three hours. Maximum mark 100.

This paper will comprise two sections:

Section A on Information Systems (maximum mark 50)

Questions are set on the syllabus content of Module 1.

Four questions are set.

One compulsory question, consisting of short questions and carrying 20 marks.

Three questions, to choose two, each carrying 15 marks.

Section B on Human Communication and Business Organisations (maximum mark 50)

Questions are set on part of the syllabus content of Module 2.

Four questions are set.

One compulsory question, consisting of short questions and carrying 20 marks.

Three questions, to choose two, each carrying 15 marks.

#### Paper 2

Duration three hours. Maximum mark 100.

This paper will comprise two sections:

Section A on Software (maximum mark 50)

Questions are set on the syllabus content of Module 3.

Four questions are set.

One compulsory question, consisting of short questions and carrying 20 marks.

Three questions, to choose two, each carrying 15 marks.

Section B on Programming Techniques and System Development (maximum mark 50)

Questions are set on the syllabus content of Module 4.

Four questions are set.

One compulsory question, consisting of short questions and carrying 20 marks.

Three questions, to choose two, each carrying 15 marks.

### Grading

The final grade will be based on an overall aggregate score and students must obtain a minimum mark in each paper to be established by the Markers' Panel.

### Resit

Candidates who fail to meet the criteria for a pass will have to resit the whole examination.

Project marks may be carried forward for subsequent sessions based on this syllabus.

## 1: INFORMATION SYSTEMS

### 1.1 INFORMATION SYSTEMS IN ORGANISATIONS

By the end of this section candidates should be able to:

- Have a basic understanding of Information Systems (IS) and their role in organisations;
- Appreciate the need for organisations to update constantly their information systems hence the concept of an information systems life cycle and the need for planning when developing an information system;
- Be aware of the issues related to implementing information systems in organisations.
- Define an expert system, its benefits and limitations;
- Understand issues pertinent to data and data capture;
- Understand the issues related to data verification and data validation, relevant to IS;
- Define causes of data loss and understand the basic issues required to set up a disaster recovery plan;
- The main aspects relevant to implementation of ICT related legislation in organisations;
- The need for training in order to maximise the advantages brought by IS;
- Define project management and the role of a project manager in organisations;
- Understand the importance of codes of practice in organisations.

<p>Role of Information systems in Organisations</p>	<p>Issues related to organisations and information systems. IS as a means of extracting the required information by the organisations. Types of information systems found in organisations: data processing systems, knowledge work systems, and management information systems. Their main differences. Internal and external information with respect to the organisation Role of management information systems and how it helps managers in making decisions Characteristics of an MIS and factors affecting the success or failure of an MIS.</p>
<p>Information systems life cycles</p>	<p>Overview of the systems life cycle and the Waterfall model. The issues that indicate the need for a new system. Overview of main stages: feasibility study, requirements analysis, system design, implementation, methods of conversion, post-implementation review, system maintenance. Overview of prototyping – a different lifecycle – benefits and pitfalls of prototyping.</p>

Implementation issues of IS in organisations	What goes on during implementation of IS. Aspects of successful and non successful implementation.
Management Information Systems / Business Intelligence Software	Executive Information systems, drill down Data mining Data warehousing OLAP Business modeling systems Business process control Artificial Neural Networks (Expert Systems)
Expert systems	Definition of an expert system. What are expert systems and examples where they are currently used (medicine, engineering diagnostics). Benefits and limitations of current expert systems.
Data and data capture	Methods commonly associated with data capture (large volumes of data) such as bar codes, and magnetic stripe cards (advantages and disadvantages). Other uses of bar codes common today. Overview of Electronic Data Interchange (EDI) – used to link directly suppliers and retailers for fast information exchange. Use of smart cards. Their advantages and disadvantages. Keying in the data. Advantages and disadvantages.
Data validation and verification in IS	Concept of data capture. Categories of errors that are commonly found. Verification versus validation. The importance of accuracy and validity of the data. (Techniques are included in Section 1.3.)
Data loss and recovery methods	Defining negligence in an IS environment – effects of negligence. Main stages in disaster planning – and disaster recovery plan. Overview of a security plan – physical security and software related security. Criteria used to select a contingency plan.
ICT related legislation in organisations	Overview of laws related to ICT in organisations including the data protection act. Main issues to be considered in a data protection policy in organisations Aspects of software copyright, licensing and having backup copies allowed Health and safety – ownership of workspace by employees, taking regular breaks from workplace space, provision of the right furniture and equipment The responsibilities of the employer.
Training issues	The need for ICT related training in modern organisations Training for senior management, middle management and staff – characteristics of each group, the use of ICT tools by each and potential problems encountered Methods of training – computer based training, instructor led courses, skills updating Aspects of a corporate training strategy
Project Management	Defining project management and its importance in modern organisations Aspects of project planning and scheduling (setting of timescales, resources required, potential areas of slowdown in development). Project reviews – ways to analyse progress and take corrective action if required. Composition and characteristics of a good project team. Selection and characteristics of a good project manager – tasks for which project manager is responsible.

Codes of practice in organisations	Issues related to ethics and computing – factors that need to be considered in ethical decision-making. Formal guidelines in the computing industry. Codes of practice – employee code of conduct. Use of informal guidelines to make ethical decisions.
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## 1.2 INFORMATION: THE TOOLS REQUIRED TO HANDLE IT

By the end of this section the student should be able to:

- Define the basic components of a computer system;
- Understand the basic characteristics of a typical microprocessor;
- Be aware of the principal input devices currently in use;
- Be aware of the main storage devices currently in use;
- Be aware of the main output devices currently in use;
- Define the main issues relevant to network environments in modern organisations;
- Distinguish between the main modes of processing used;
- Understand the importance of user interfaces for IS and the main types of user interfaces found today;
- Appreciate the fact that all data in computers is stored in binary format and that the most frequently used number bases are binary and hexadecimal;
- Demonstrate an understanding of the different data representations;
- Appreciate that various verification and validation techniques exist to minimize the number of errors in data storage/transmission;
- Understand why various methods of representing numbers in a computer exist.

Computer system	Outline of a computer system as being made of various components. (I/O, processor, main memory, auxiliary storage). Type of components may vary and depend on requirements. Main categories of computers currently in existence and their use.
Microprocessor	Overview of a typical processor (ALU, CU, registers, buses as channels through which the various components are linked). Main types of RAM and ROM currently in use. The ASCII code as a means to represent characters. (EBCDIC, UNICODE)
Input devices	Brief overview of main input devices (no need to go in their detailed function). Important to indicate the advantages and disadvantages of each and hence the environment where they should be used.
Storage devices	Notion of primary and secondary storage. Main types of magnetic-based storage devices, and main types of optical-based storage devices. Advantages/disadvantages.
Output devices	Brief overview of main output devices (no technical details required). Advantages and disadvantages of each and areas of application of each.
Networks in organisations	Types of networks commonly used: LAN and WAN. Advantages and disadvantages of networks. Common LAN setups (Star, Ring, Bus). Server-based vs peer-to-peer networks. Wide Area Networks. Overview of Internet structure – mesh of interlinked networks Overview of communications links and common media used. ISDN lines. The use of bridges and gateways to link different networks together. Overview of Synchronous and Asynchronous transmission.

	Factors affecting the rate of data transmission. Protocols as standards required to link different network types together.
Processing modes	Understand the principles of batch processing and interactive processing Concept of master files and transaction files. Real-time and pseudo real-time processing. Criteria for the choice of processing mode.
User interface in IS	The importance of a good interface Main interface styles – Command Line Interface (CLI) and Graphical User Interface (GUI). Advantages and disadvantages of each. New ways – script recognition, speech input/output.
Number base systems	Decimal (denary), binary and hexadecimal. Conversion from decimal to binary and vice-versa. Conversion from decimal to hexadecimal and vice-versa. Conversion from hexadecimal to binary and vice-versa. Long and quick methods.
Data representations	Data representation in binary to code text, numbers and control signals. Different file formats and common file extensions: Binary (.bin or .exe), graphic (bit-mapped, JPEG and GIF), sound (WAV, MP3), video (AVI), text (.txt), database records (.DBF) and hypertext (.HTML)
Validation and verification techniques	Validation checks: range and check digit Verification checks on files. Error correction techniques: parity and CRC.
Number representations	Signed and unsigned fixed point integer representation. Signed and unsigned fixed point real representation, binary fractions. Notion of floating point representation. Normalisation. Range, overflow and underflow. 2's complement notation.

### 1.3 INFORMATION POLICY, STRATEGY AND SYSTEMS

By the end of this section, the student should be able to:

- Understand the main issues related to information policy and strategy;
- Appreciate the main mechanisms used in security and backup policies;
- Understand the main issues relevant to security of data;
- Define the main issues relevant to network security;
- Understand the main modes used for data communication and the need for standards in this regard;
- Appreciate the main basic aspects of human-computer interaction (HCI).

Information policies and strategies	Defining the challenge of information management in modern organisations – to use information to obtain knowledge for the benefit of the organisation Consistency of information with organisations' business priorities. Comparing/contrasting centralisation with decentralisation with respect to managing information across the organisation. The different needs of different users and ways how these can be catered for. Hardware and software choices/upgrading hardware and software so as to constantly update the information management system.
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Security mechanisms	Types of backup strategies – full backup, incremental backup Online backup (RAID) versus, grandfather-father-son backups(batch) Categories of hardware required for backups
Security of data	Importance of data integrity. Physical security, restriction of access, biometric security measures. User ID's and passwords, access rights. Securing against malicious damage. Protection against viruses. Communications security, data encryption, firewalls. Disaster planning and backup strategies.
Network security	The need to train users in issues related to security (password policy) Defining access privileges and access controls. Performance management as a means to ensure quality and also detect security related problems. Data encryption as a means to keep data secure (even if intercepted)
Computer networks	Common communications software in use today. Speed of transmission (base-band and broad-band). Direction of transmission (simplex, half-duplex, full-duplex). Serial and parallel transmission. Telecommunications standards and protocols – ISO-OSI model. The Internet protocol.
HCI aspects	Understanding the basic psychological factors that are needed to design good software. Distinguishing between short term memory and long term memory and their relevance on software design. Text versus graphics – pros and cons.

## 2: HUMAN COMMUNICATION AND BUSINESS ORGANISATION

To outline the formal means of communication and the development of personal relationships within the organization. This should be more practical than theoretical.

To provide a broad understanding of the world of business, how businesses function internally and how they interact with the world around them.

### 2.1 HUMAN COMMUNICATION

At the end of the module candidates will be able to:

- Describe the nature of communication;
- Understand different means of communication;
- Appreciate related technologies, their basic functions and relative advantages;
- Appreciate the power of the Internet as a means of human communication;
- Understand the information structures used for dissemination of information internally and also externally;
- The need for user support in IS based organisations and the basic elements of user support systems.



<p>Introduction to Communication</p>	<p>What is communication?                      The communication model.                      Different types of communication: verbal, written and visual.                      How electronic communication is affecting business: Tele-working, Internet. (in brief as it will be explained later on), Video Conferencing, E-Government (information about government services, payment and actual delivery of services, )</p>
<p>Verbal communication</p>	<p>The advantages and disadvantages of verbal communication.</p> <p>Speech: Preparation, Delivery, The subject, Public speaking, Assessment technique. Non Verbal Communication.</p> <p>Related technologies – features and advantages</p> <ul style="list-style-type: none"> <li>– Telephone</li> <li>– Mobile telephony</li> </ul>
<p>Written communication</p>	<p>The advantages and disadvantages of written communication.                      The concept of written media: content, structure, style, layout.</p> <p>Examples: Letter, memos, reports, Curriculum vitae, minutes</p> <p>Related technologies – main features and advantages</p> <ul style="list-style-type: none"> <li>– word-processing,</li> <li>– e-mail</li> <li>– document systems (like groupware and workflow systems)</li> </ul>
<p>Visual communication</p>	<p>The effects of visual communication</p> <p>Examples: Posters, wall charts, notice boards, photographs, films, slides and videos, CCT, microfilm and visual aids.</p> <p>Related technologies – main features and advantages.</p> <ul style="list-style-type: none"> <li>– the traditional printing process – books, newspapers, journals,</li> <li>– desktop publishing</li> <li>– digital Image Processing</li> <li>– facsimile machine</li> <li>– photocopier</li> <li>– television</li> </ul>
<p>The Internet as a Human Communication Media</p>	<p>What is the Internet?</p> <p>Internet utilities that can be used as human communication tools: Email, Chatting, Newsgroups and Discussion Groups, Web Conferencing. (The student should know how one could use the above services in a business both in internal and external communications.)</p> <p>Advantages and disadvantages of the internet as a communication tool.</p>
<p>Internal communication in an organisation</p>	<p>Structures for dissemination of information</p> <p>Upward Communication: Purpose and Content of reports, Suggestion scheme systems, Interviews, Employees groups, Staff development and appraisal.</p> <p>Downward Communication: Purpose, Policies of communication, The different ways that a company can take in order to communicate with the employees (magazines, induction manual, annual reports, letter, notice</p>

	board, pay envelope inserts).  The Grapevine lateral Communication.
External communication in an organization	Why does a company have to spread information to the outside world: <ul style="list-style-type: none"> <li>- Suppliers (what info should they know),</li> <li>- Customers (present and future),</li> <li>- Public relations.</li> </ul> Different ways and means of how to spread information: <ul style="list-style-type: none"> <li>- Newspaper, letters to customers and other media.</li> </ul>
Use of Communication Technologies in a business organisation	Telephone (fixed line and mobile), Voice Mail, Facsimile, TV, Video-conferencing, Radio. Internet as a general communication tool.
User support systems	The need for support within the organisation and to external customers. Characteristics of a 'help desk' and help desk software that may be in use today. Aspects of technical support. Role of bulletin boards, user booklets, newsletters and support articles Support over the Internet – online help. The role of 'traditional' documentation such as manuals.

## 2.2 BUSINESS ORGANISATION

### 2.2.1 ORGANISATIONS

Upon successful completion of this module the students will be able to:

- Describe the information and different types of organisation in the public and private sectors;
- Describe the fundamental characteristics of an organisation;
- Construct an organisational chart showing the various working relationships;
- Outline the various functional areas within organisations;
- Understand the activities that take place in various departments;
- Identify the types of documentation used in offices;
- Understand how change can be managed.

Formation of organisations	What is an organisation? Behavioural science; from Barter Trade to Modern Organisations; specialisation; profit/non-profit-making organisations.
Types of organisations	Economics systems - Mixed Economies. Organisations in the Private and Public Sectors: Sole Trader; Partnership; Private and Public Ltd. Companies; Co-ops; Public Corporations.
Characteristics of organisations	Essential components of organisations; open vs closed systems; formal vs informal organisations; authority, responsibility and delegation; centralised and decentralised; decision-making management functions.

Organisational Structure	<p>Departmentalisation: By Function, by Product; by Location; by Project/Contract.</p> <p>The Organisational Chart: Vertical, Horizontal and Circular</p> <p>Working Relationships: Line, Lateral, Staff and Function.</p>
Introduction to Functional Areas	<p>Outline the various functional areas;</p> <p>develop an organisational chart;</p> <p>explain the work carried out in each function;</p> <p>the duties and responsibilities of the personnel at various levels within each functional area.</p>
Documentation	<p>Identify and describe the various types of documentation used in organisations:-</p> <p>Sales and Purchases documentation,</p> <p>Production documentation,</p> <p>Personnel documentation,</p> <p>Finance documentation,</p> <p>Administration documentation.</p>
Managing Change	<p>Reasons leading to change;</p> <p>Classical example is the introduction or development of an information system: this will result in change that must be managed. Factors could include re-skilling, attitude, organisational structure, employment pattern and conditions, internal procedures.</p> <p>Overcoming resistance to change. Effects of and coping with Stress.</p>

## 2.2.2 THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) TODAY

By the end of this section the student should be able to:

- Distinguish clearly between data and information, and appreciate the relevance of information in modern organisations;
- Define clearly computer-related crime and the counter-measures employed to combat such crime;
- Appreciate the need for data protection legislation;
- Have a basic understanding of how ICT is affecting various spheres of modern society.

Data and Information	<p>Definition of each.</p> <p>The idea that from information one is able to extract knowledge (i.e. learning from interpretation of information).</p> <p>The input-process-output cycle – information obtained by processing of ‘raw’ data.</p> <p>Direct and indirect sources of data. The importance of quality of data /information (i.e. up-to-date, accurate and complete).</p> <p>The significance of data and information to modern organisations – ability to take effective decisions for the benefit of organisations (such as entering a new market and doing research into a promising area).</p> <p>External and internal forms of data with respect to organisations.</p> <p>Modern organisations/individuals are subjected to overexposure to data and information. The need to find only what is required, when it is required.</p> <p>The notion of the Information Society – a society based on information and knowledge.</p> <p>The use of ICT to facilitate data organisation. Benefits and limitations of ICT systems.</p>
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Computer-related crime	<p>A society based on information is threatened by itself. Data/information has become vital to most organisations/individuals that they may seek illegal ways to obtain it.</p> <p>A new type of crime – computer based crime. Defining computer crime/computer misuse. Authorities were initially unprepared.</p> <p>Categories of illegal practices – hacking, theft (money, data, etc), computer based fraud, malicious code – viruses. The Internet as a means to perpetuate these crimes beyond physical borders.</p> <p>Modern legislation has been introduced to combat computer/digital crime (Malta/UK) computer misuse/ acts.</p> <p>Software copyright laws – main issues (illegal to make, use and transmit unauthorised copies to other users).</p>
Data protection legislation	<p>The need to protect a person’s personal privacy in lieu of the fact that a person’s personal details are relatively more easy to access online than with previously used systems.</p> <p>Principles of data protection and the data protection act (Malta/UK).</p> <p>Exemptions (e.g. due to national security reasons).</p> <p>Defining a data subject (i.e. persons whose details are stored in some database). Their rights.</p> <p>The role of the Data Protection Registrar</p>
ICT in the modern society	<p>An awareness of the limited role of computing in the past and its much wider role today</p> <p>Typical examples* of ICT use today would be:</p> <p>Teleworking and the changing nature of work and employment resulting from ICT</p> <p>ICT and leisure – ICT related entertainment, ‘chatting’, booking of holidays, flights etc via use of ICT.</p> <p>(*other topics such as e-commerce are listed individually and in more detail)</p>
e-commerce & e-business	<p>The emergence of e-business such as marketing as buying, selling, ordering of stock and settling bills and customer support. E-commerce as a tool for buying and selling.</p> <p>The trade cycle</p> <p>The Value chain</p> <p>EDI</p> <p>Emarkets</p> <p>Internet commerce</p> <ul style="list-style-type: none"> <li>– Advantages to business and to customers</li> <li>– Disadvantages to business and to customer</li> <li>– Distinction between business to business (B2B) and business to consumer (B2C)</li> </ul>
e-government	<p>Life events</p> <p>Portals – one stop shop</p> <p>Admin to Admin, Admin to Business, Admin to Citizen</p> <p>Procuring systems – inhouse/outsource, ASP</p> <p>Informing</p> <p>Transacting - applications, payments, licenses</p> <p>Email, request tracking,</p>
e-learning	<p>E-learning vs online learning</p> <p>Use of Websites, downloads, Email, newsgroups</p> <p>Virtual classroom</p> <p>Adv / Disadv</p> <p>Computer Based Training CBT</p> <p>Synchronous / Asynchronous communication</p> <p>One online techniques</p> <p>Learning management systems</p>

ICT in Science and Engineering	Design tools – CAD Simulation – traffic, piloting (air, sea) Data tracking systems, telemetry GIS Weather forecasting Statistical packages (SPSS)
Health and Safety	Computers and health – people are using ICT more than ever before hence exposed to hazards that were not common in the past Stress, Repetitive Strain Injury (RSI), Eyestrain, Extremely Low Frequency (ELF) radiation. Computers, health and the law. The ergonomic environment – recommendations regarding the design of ICT work environment

### 2.2.3 INFORMATION IN ORGANISATIONS

At the end of this module the candidates will be able to:

- Understand the methods that organisations may use to fulfil their information requirements;
- Discuss the need for, and describe, a corporate information security policy;
- Appreciate the need for organisations to have an IS strategy.

Information	Nature and uses of information. Describe the methods and mechanisms of information flow within an organisation both formal and informal and the constraints imposed upon this by organisational structures. Gathering and Presenting Information: Sources; forms; collecting information without printing or writing; various methods of presenting information. Classifying, Storing and Retrieving information. Indexing; Index Storage; Filing; File Storage; Follow-Up Systems; Retention Policy. Information Integration. The benefits gained from the use of COMPUTERISED SYSTEMS. The strategic, implementation, operational level of task/personnel of a typical Information Systems department in an organisation.
Information security-risks and protection	Understand the need for a corporate information security policy and its role within an organisation. Factors could include prevention of misuse, detection, investigation, procedures, staff responsibilities, disciplinary procedures. Describe the content of a corporate information security policy.
IS strategies within organizations	The issues that need to be taken when creating an IS strategy. The notion of end – user computing. ICT to gain competitive advantage (by organisations). Comparing ‘just- in – time’ with ‘just – in – case’ scenarios.

### 3: SOFTWARE

#### 3.1 CATEGORIES OF SOFTWARE

At the end of this module, students will be able to:

- Distinguish between the major categories of software;
- Describe the functions of the basic components found in an operating system;
- Understand the notions of software capabilities with reference to upgradeability, ease of use and reliability;
- Evaluate a software package to assess its suitability.

Software categories	Main two categories are System Software and Application Software. Definitions of each.
System Software	Types of: Operating system, Utility programs such as antivirus, compressors and defragmentation. Translators (compilers, interpreters and assemblers). Monitoring software for both hardware and software. Communication software. Students should know that some Operating systems contain most of the system software above. Candidates are expected to be familiar with the properties and capabilities of the various types of system software.
Application software	Types of: specific, general purpose (generic), and application generators. Integrated and software suites. Advantages and disadvantages of each type. The scenarios in which each type of software may be applied.
Operating System (OS)	Purpose of OS. Candidates should know that the OS is software that controls all operations. Components of OS. Kernel (supervisor or control program), memory manager, input/output manager, backing store manager, resource allocation and scheduler, accounting, error handling and security, interface between hardware and user. Types of operating systems. Single program OS, multitasking, multiprogramming and networked. Command line interface and GUI interface. Candidates are expected to be aware of different types of operating systems.
Software Capabilities.	Portability between programs. Portability between files. Upgrades compatibility. Object Linking and Embedding (OLE). Differences between linked and embedded objects. Reliability tests.
Software Evaluation	Evaluation criteria. Some examples of criteria are: Hardware needs. Quality of documentation. Compatibility with existing software. Ease of use and learning. Technical support. Cost. Benchmark tests. Software house reputation. Evaluation report. Students should be able to write an evaluation report on one particular application package.

### 3.2 GENERIC SOFTWARE

In this module, students will:

- Become conversant with the nature and capabilities of the most common generic software;
- Improve their development skills by using generic packages namely word-processing, spreadsheet and database.

Word processing	Page layout, formatting, spell and grammar checkers, index and table of contents creation, importation of files, mail merge and template creation.
Spreadsheet	Cell formatting, manipulation of cells, rows and columns, use of functions (sum, average, maximum, minimum) plus standard mathematical operators, sorting and querying simple database sheets, multiple linked worksheets, cell absolute and reference, creation of charts and graphs. Pivot tables. Goal seek solver. Use of macros. What if analysis.
Database	Creation of tables, queries, forms and reports. Creation of well organised and linked relational tables. Field data types: numeric, string, boolean and date. Enforcement of referential integrity. Use of macros. Creation of customised menus. Execution of multi-table queries.

Manual operational skills of how to use particular generic software will not be assessed. However, examination questions will assume a reasonable level of knowledge and understanding of the capabilities of database, spreadsheet and word-processing.

### 3.3 DATABASE SYSTEMS

At the end of this module, students will be able to:

- Describe the nature and purpose of database systems and how they work;
- Describe the functions of the tools readily available in database packages;
- Appreciate the advantages of relational database systems over traditional file systems;
- Describe the components of a database management system;
- Generate structured query language (SQL) statements;
- Describe the different types of database organisations;
- Distinguish between shared and distributed databases.

Introduction to Database systems	Notion of a file. Program files and data files. Database systems and flat-file systems. Their definitions. Relative advantages and disadvantages of each. Database management system (DBMS). Role of DBMS as the interface between user and database in a database system. Database as a collection of data organised in tabular form – base table.
Relational Tables	Table organisation Definition of entity, field (attribute), key field (primary key), secondary key, record (tuple). Links between tables. Definition of foreign key. Representation of relational tables by the use of the notation in which the name of each table is followed by a list of all the fields in brackets. Key fields are underlined and foreign keys are in italic, or have a line over them. (Entity name in block capitals whereas field names are in lower case.) Field types in relational tables – text, numeric, date, boolean and memo.

Tools in database packages	<p>Tables: creation of relational (base) tables. Operations on tables such as search, deletion, amend and sort. Referential integrity taken care of by database package.</p> <p>Forms: types of. Advantages of forms with special reference to validations in entry forms.</p> <p>Queries: definition of. Done via Graphics User Interface or by Structured Query Language (SQL). Answer table.</p> <p>Reports: definition of.</p>
Traditional file systems vs database systems	Relative advantages and disadvantages of each. Issues to be considered: data consistency, portability, data redundancy, security, complexity, cost, data size and robustness.
Database management system	<p>Structure and features of. Meaning and purpose of data dictionary. File manager. Data manipulation language. Data description language. Query language. Security.</p> <p>Role of database administrator.</p> <p>The three level schema – conceptual, logical and physical. Generation of different views.</p>
Conceptual model	<p>Design of the conceptual model irrespective of dbms type to be used. Entities, attributes and relationships.</p> <p>Entity-Relationship (E-R) diagrams. One-to-one, one-to-many and many-to-many.</p>
Normalisation	<p>Purpose of normalisation.</p> <p>1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> normal form. Boyce-Codd normal form.</p>
Structured Query Language	<p>Querying a relational data base by SQL statements. SQL constructs:            SELECT... FROM... WHERE,            SELECT... FROM... WHERE...AND,            SELECT... FROM... WHERE...ORDER BY...,            SELECT... FROM... WHERE...GROUP BY...            SELECT ... FROM...INNER JOIN... ON</p> <p>During the examination, students may be asked to create SQL statements from the constructs above.</p>
Database Organisations	Flat file, Relational, Hierarchical, Network and Object Oriented. Definition and major characteristics of each organisation
Shared and Distributed database systems	Definition of each. Characteristics of each. Relative advantages and disadvantages.



### 3.4 INTERNET-RELATED SOFTWARE

At the end of this module, candidates will be able to:

- Describe internet related terms;
- Describe the capabilities of internet-related utility software;
- Try most of the internet utilities listed below;
- Appreciate that all internet applications and utilities run on top of standard protocols;
- Appreciate existence of software to improve security.

Introduction to the Internet	How the Internet was developed. Internet structure. Internet registries. Domain names. DNS and TLD. Intranets and Extranets.
Internet utility software	All Internet software is based on client-server technology. Internet is not just the WWW. Other utilities are: e-mail, ftp, telnet, usenet groups, chat lines and videoconferencing. Students are expected to describe the purpose, features, advantages and disadvantages of each software utility. Awareness of mobility. Connecting to the Internet via mobile phone. Advantages/disadvantages.
WWW	Internet service provider. Web site. Web page construction. Web server. Web browser (URL, HTML, bookmark, history, downloading, hyperlinks).
Internet protocols	SMTP. POP and IMAP. FTP. HTTP. TCP/IP. Candidates need only know the purpose of each protocol.
Security problems	Internet based fraud. Password hacking. Viruses. Some solutions to these problems: Encryption and decryption keys. Firewalls. Anti-virus software. Digital signatures and certificates.

## 4: PROGRAMMING TECHNIQUES AND SYSTEM DEVELOPMENT

After covering this module, students should be able to demonstrate problem solving skills which can easily be applied to programming. Students should have experienced programming and testing techniques by using JAVA.

### 4.1 PROGRAMMING TECHNIQUES

At the end of this module, candidates will be able to:

- Describe the different generations of programming languages;
- Distinguish between different programming paradigms with special reference to imperative and object-oriented;
- Describe the major features and be familiar with the constructs of an object oriented high level programming language (Java)
- Build well designed programs using structured techniques with an objected oriented type of programming language;
- Implement algorithms in problem solving;
- Know how to use debugging facilities within an Integrated Development Environment.

Generations of Programming languages	Natural versus formal languages. Major types of programming languages: machine language, assembly language, high-level languages and 4GLs. Purpose of language translators. Features of compilers, interpreters and assemblers.
Programming paradigms	Imperative, functional, declarative and object-oriented. Their major characteristics and areas of application. Emphasis will be given to object-oriented type of languages with Java as the language to be used for the programming related exercises.
Imperative paradigm	Character set; reserved words; identifiers (both standard and user-defined); variables and constants; simple and structured data types (such as integer, floating, string and records); statements; expressions; control structures (sequence, loops and branching); subroutines/subprograms/functions/procedures (parameter passing by value and by reference); scope of variables; one and two dimensional arrays; file handling operations (text and record type). Usage of unconditional branches (such as goto) should be highly discouraged.
Object oriented paradigm	Concepts of Objects, Properties, Controls, Events, Methods for objects, Control arrays, Polymorphism and Inheritance
Structured programming techniques	Top-down and bottom-up approaches in problem solving; modularity; Techniques for expressing sequence, selection and iteration constructs; Advantages of building programs using structured techniques.
Problem solving techniques	Algorithms for creation, initialisation, filling and displaying contents of one-dimensional and two-dimensional arrays. Search algorithms (linear and binary), hash functions. Sorting algorithms (one iterative and one recursive). Validation checks algorithms (range & data types). Operations on different file organisations (serial, sequential, direct, indexed-sequential) Operations of files. Creating, writing to and reading from files. Updating (inserting & deleting) of files. Merging of files. Students should be highly encouraged to write algorithms before writing computer programs. Questions assuming a particular high level language syntax will not be set, but students are expected to express the solution for given tasks in pseudo-code.
Error types & Debugging	Candidates are expected to be familiar with the various debugging utilities found in an integrated programming development environment. Program error types – syntax, logical, run-time. Facilities such as trace, identifier evaluation and breakpoint.

#### 4.2 SYSTEM DEVELOPMENT

Students will learn how to:

- Plan the time schedule to complete system objectives;
- Investigate the client's requirements and set objectives during the design phase;
- Use structured techniques involved in system design;
- Implement and test the designed subtasks by means of software tools and/or good programming techniques;
- Produce the final documentation of the system being developed.

<p>Planning</p>	<p>Before a system starts taking shape it must go through a number of development stages each of which must be well planned. Candidate learns how to plan the time schedule keeping in mind that all objectives are to be realistically chosen and achieved in the time frame available. Any standard system life cycle may be followed.</p>
<p>Analysis Problem Identification and Investigation</p>	<p>Problem must be completely understood before solving it systematically. Candidates are expected to practise methods for collecting information, such as interviews, questionnaires, observations and inspection of documents.</p>
<p>Feasibility Study</p>	<p>Candidates are expected to practise writing feasibility study reports based on the outcomes of the investigation. Technical, financial and social aspects should be considered.</p>
<p>System and information requirements</p>	<p>Input and output formats. System type such as single/multi user, on-line, batch or real-time. Storage requirements. User interface needs. Representation of data flow within the present system. Creation of Data Flow Diagrams (DFDs). Processing requirements. Proposal of alternative methods of solution</p>
<p>Design</p>	<p>One method of solution is chosen. Reasons of choice are to be documented. Criteria considered could be costs, needs for development, knowledge and time frame available. A suitable paradigm for implementation of software should also be selected. Selection of existing software tools. Structured techniques. Top-down and bottom-up approaches. Structured charts. Jackson Structured Programming method. Decision tables. The purpose of each module. Input/output interface of each module. Entity-Relationship diagrams, normalised tables. Data structures and file organisations. Choice of data types. Description of algorithms in each module. Pseudo-coding. Human Communication Interface. Input and output formats. Data capture and validation methods. Systems design flowchart symbols (for input/output, screen, process, direct access and serial access storage, manual operations and hardcopy). Testing strategy for individual components and for testing overall system(dry run, unit testing, integral testing, test data, test solution, black box and white box testing).</p>
<p>Implementation and testing</p>	<p>Mapping of modules' design into a programming paradigm or application generation tool. Testing is carried out according to chosen testing strategy. System testing (acceptance testing, alpha and beta testing). System implementation method (parallel, direct, pilot or phased). Staff training. Conversion of data files. User's guide and technical documentations.</p>

Maintenance	Issues that make a system easy to maintain. Issues that may be considered are technical documentation, implementation of modularity and structured programming techniques.
System evaluation	System evaluation based on usability, effectiveness and maintainability.

## 5: EXERCISES

### 5.1 GUIDELINES ON EXERCISES

Problems chosen by students should be realistic and reasonable in the sense that the objectives planned may be implemented in the time-frame available. Candidates should be encouraged to use different sources of information – books, internet, newspapers and journals.

In marking the assignments, credit will be given to the inclusion of the appropriate features as described in the following sections.

### 5.2 COMBINED DATABASE & SPREADSHEET

#### Features in Database assignment

- Entity-Relationship Diagrams
- Well organised tables
- Field types well chosen and explained. Inclusion of any default values and validations
- Demonstration of referential integrity
- Creation and use of forms for data entry
- Queries on multiple tables
- Creation and display of reports
- Use of macros
- Creation of switchboard

#### Features in Spreadsheet assignment

- More than one worksheet
- Linked worksheets
- Use of labels, numbers and formulae
- Absolute and reference cells
- Validation of data entered
- Pivot tables
- Goal seek and solver
- Locking sheets
- Macros to control input/output and processing
- Customisation of menus and toolbars
- Built-in presentation tools such as charts

#### Examples of Database projects that may require links to spreadsheet

- Library system
- Car licensing system
- Video rental system
- Course organiser

### 5.3 PROGRAMMING ASSIGNMENTS I & II

#### Features in Programming assignments

- Use of right variable types
- Easy-to-read variable names
- User defined data types
- Use of structured data types such as record and arrays (up to two dimensional)
- Demonstration of structured programming techniques
- Modularity
- Parameter passing by value and by reference
- Validation on data entry
- Algorithm description
- Input/output operations on files
- Easy-to-use interface
- Implementation of sorting/searching
- In-line documentation in source code

With an objected-oriented programming paradigm, candidates are still expected to demonstrate most of the features listed above in their work submitted. Emphasis is expected to be made on the use of structured programming techniques in problem solving.

### 5.4 WEB DESIGN ASSIGNMENT

#### Features in the Web Design Assignment

- Use of Tables
- Hyperlinks
- 'Mail to' facility
- Images
- Anchors
- Optional Frames
- Image Maps
- Use of Javascript
- Form validation (client side)

### 5.5 THE DOCUMENTATION AND ITS MARKING SCHEME

The overall objective of the exercises is to test the programming ability, knowledge of the subject and the ability to analyse, test, solve and document an application problem.

What follows is a layout of the sections that are expected to be produced in the documentation of the coursework assignments together with a suggested marking scheme. The candidates producing the documentation and their assessors should find the suggested schema below useful. The marking scheme below is based on a maximum project mark of 100.

- (a) Selection, analysis, and formulation of problem (20 marks)
- (b) Selection and Design of Method of Solution (20 marks)
- (c) Implementation (20 marks)
- (d) Testing and Evaluation of Complete System (20 marks)
- (e) Overall objectives and Quality of the project (20marks)

## **Books**

The following books may be used as textbooks and/or as reference books.

‘A’ Level Computing (4<sup>th</sup> ed), by P.M. Heathcote (2000), Payne-Gallway Publishers Ltd  
ISBN 1-903112-21-4

‘A’ Level ICT (2<sup>nd</sup> ed), by P.M. Heathcote (2000), Payne-Gallway Publishers Ltd  
ISBN 0-9532490-8-5

Business Systems Development , by Tudor Dorothy and Tudor Ian (1997), NCC Education Services Limited  
ISBN 1-90234-305-0

Human Communication and Information Systems, by Stuart Harris (1988), NCC Education Services Limited, 1998  
ISBN 1-90234-300-X

The Complete A-Z ICT & Computing Handbook, by Bob Penrose and Bill Pollard, Hodder & Stoughton Ltd  
ISBN 0-340-80277-4

Understanding Computer Science for Advanced Level, (4<sup>th</sup> ed) by Ray Bradley, Stanley Thornes Ltd  
ISBN 0-7487-4046-5

Using Information Technology. A Practical Introduction to Computers and Communications. (3<sup>rd</sup> ed) by Williams, Sawyer & Hutchinson (1999), Irwin/McGraw-Hill Companies  
ISBN 0-07-115867-7

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