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Thanks.

INFORMATION TECHNOLOGY

FOR

ACCOUNTING TECHNICIANS SCHEME
WEST AFRICA
(ATSWA)

STUDY PACK
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PREFACE

INTRODUCTION

The Council of the Association of Accounting Bodies in West Africa (ABWA) recognised the difficulty of students when preparing for the Accounting Technicians Scheme West Africa examinations. One of the major difficulties has been the non-availability of study materials purposely written for the scheme. Consequently, students relied on text books in economic and socio-cultural environments quite different from the West African environment.

AIMS OF THE STUDY PACK

In view of the above, the quest for good study materials for the subjects of the examinations and the commitment of the ABWA Council to bridge the gap in technical accounting training in West Africa led to the production of this Study Pack.

The Study Pack assumes a minimum prior knowledge and every chapter reappraises basic methods and ideas in line with the syllabus.

READERSHIP

The Study Pack is primarily intended to provide comprehensive study materials for students preparing to write the ATSWA examinations.

Other beneficiaries of the Study Packs include candidates of other Professional Institutes, students of Universities and polytechnics pursuing first degree and post graduate studies in Accounting, advanced degree in Accounting as well as Professional Accountants who may use the Study Packs as a reference material.

APPROACH

The Study Pack has been designed for independent study by students and as such concepts have been developed methodically or as a text to be used in conjunction with tuition at schools and colleges. The Study Pack can be effectively used as a course text and for revision. It is recommended that readers have their own copies.
STRUCTURE OF THE STUDY PACK

The layout of the chapters has been standardized so as to present information in a simple form that is easy to assimilate.

The Study Pack is organized into chapters. Each chapter deals with a particular area of the subject, starting with learning objectives and a summary of sections contained therein.

The introduction also gives specific guidance to the reader based on the contents of the current syllabus and the current trends in examinations. The main body of the chapter is subdivided into sections to make easy and coherent reading. However, in some chapters, the emphasis is on the principles or applications while others emphasise methods and procedures.

At the end of each chapter is found the following:

- Summarry
- Point to note (these are used for purposes of emphasis or clarification);
- Examination type questions and
- Suggested answers.

HOW TO USE THE STUDY PACK

Students are advised to read the Study Pack and attempt the questions before checking the suggested answers.
FOREWORD

The ABWA Council in order to actualize its desire and ensure the success of students at the examination of the Accounting Technicians Scheme West Africa (ATSWA), put in place a Harmonisation Committee, to among other things, facilitate the production of Study Packs for students. Hitherto, the major obstacle faced by students was the dearth of study texts which they needed to prepare for the examinations.

The Committee took up the challenge and commenced the task in earnest. To start off the process, the existing syllabus in use by some member Institutes were harmonized and reviewed. Renowned professionals in private and public sectors, the academia, as well as eminent scholars who had previously written books on the relevant subjects and distinguished themselves in the profession, were commissioned to produce Study Packs for the twelve subjects of the examination.

A minimum of two writers and a reviewer were tasked with the preparation of a Study Pack for each subject. Their output was subjected to a comprehensive review by experienced imprimaturs. The Study Packs cover the following subjects:

PART I
1. Basic Accounting Processes and Systems
2. Economics
3. Business Law
4. Communication Skills

PART II
1. Principles and Practice of Financial Accounting
2. Public Sector Accounting
3. Quantitative Analysis
4. Information Technology

PART III
1. Principles of Auditing
2. Cost Accounting
3. Preparation Tax Computation and Returns
4. Management
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Although these Study Packs have been specially designed to assist candidates preparing for the technicians examinations of ABWA they should be used in conjunction with other materials listed in the bibliography and recommended texts.

PRESIDENT, ABWA
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Thanks.

ACKNOWLEDGEMENTS

The ATSWA Harmonisation committee, on the occasion of the publication of the second edition of the ATSWA Study Packs, acknowledges the contributions of the following groups of people: The ABWA Council, for their inspiration which gave birth to the whole idea of having a West African Technicians programme. Their support and encouragement as well as financial support cannot be overemphasized. We are eternally grateful to the Council of Institute of Chartered Accountants of Nigeria (ICAN) and Institute of Chartered Accountants of Ghana (ICAG), for their financial commitment and the release of staff at various points to work on the programme and for hosting the several meetings of the Committee, we say kudos to the various writers, reviewers, imprimaturs and workshop facilitators, who spent precious hours writing and reviewing the Study Packs cannot be overlooked. Without their input, we would not have had these Study Packs. We salute them.

Lastly, but not the least, to the Committee, we say well done.

Mrs. E. O. Adegite
Chairperson
ATSWA Harmonisation Committee
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PAPER 8: INFORMATION TECHNOLOGY (I.T.)

AIM:
To develop a practical knowledge and understanding of the role of information and communication technologies in an organization with special reference to the accounting functions.

OBJECTIVES:
On completion of this paper, candidates should be able to:

a. have an understanding of the roles of information technology to an organization;

b. understand the communication support systems;

c. describe the hardware and software systems of micro computers;

d. have knowledge of the main features of integrated packages with reference to word processing, database, spreadsheet, Powerpoint and other accounting packages;

e. describe the work practices for monitoring and maintaining the security of the computer environment;

f. be well acquainted on recent development in information and communication technologies;

g. understand how accounting functions are affected by information and communication technologies; and

h. interact with the operating system.

STRUCTURE OF THE PAPER
The paper will be a three-hour paper divided into two sections:

Section A (50 Marks): This shall consist of 50 compulsory questions made up of 30 multiple-choice questions and 20 short answer questions covering the entire syllabus.

Section B (50 Marks): Six questions, out of which candidates are expected to answer four, each attracting 12½ marks.

CONTENTS:

1. Information: Basic Concepts  7.5%
   - Definition of data and information.
   - Distinction between data and information.
   - Meaning of each of the following data concepts and their relationship: Bit, Byte, Field, Record, File, database.
   - Data representation, number base system (only bases 2, 4, 8, 10, 16) and their manipulations.
   - Role of information in the accounting environment
   - General characteristics of information

2. Computer Systems  5%
   - Evolution of computers (Hardware only)
   - Classification of computers: analog, digital, hybrid
   - Characteristics of digital general purpose computers with special reference to Microcomputers
   - Advantages and disadvantages of using computers
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- Types of microcomputers

3 **Hardware Fundamentals** 15%
- Block diagram of basic components of a computer system showing input, CPU, Output, secondary storage.
- Input devices: Types and their appropriate uses.
- Output devices: types and their appropriate uses.
- Storage Media types: magnetic and optical discs, and their uses.
- Central Processing Unit (CPU): composition, functions and processing powers.

4 **System Software Fundamentals** 5%
- Systems software: definition, examples and functions of: operating systems (OS), utility programs, language processors, editors.
- Operating Environments: single-user, multi-user, networking and window-based environment
- Types of operating systems used for: single-user, multi-user and networking

5 **Application Software** 10%
- Definition
- Criteria for selecting application packages
- Sources of application packages
- Software Suite and Integrated packages (e.g. database, word processing, spreadsheet, PowerPoint, etc): Features, advantages and disadvantages.
- Principles of programming in relation to business problems: Program flowchart, structured pseudocode, decision tables, decision tree.
- Characteristics of computer programming Languages
- Distinction among computer programming languages including Fourth Generation Languages (4GL)

6. **Information Processing Techniques** 7.5%
- Processing Methods: Centralised, decentralized, Batch, On-line, Real-time distributed and time sharing.
- Advantages and disadvantages of different processing methods.
- Multiprocessing, Multitasking, Multiprogramming

7. **Interacting with MS Windows** 5%
- Functions of mouse, Graphical user interface, desktop, Task bar, Title bar, Menu bar Tools bar, etc.
- Start Button, my computer, my Document, Control Panel, windows explorer

8. **Data Communication and Computer Networks** 10%
- Definition: Networking, Local Area Network (LAN). Wide Area Network (WAN), Metropolitan Area Network (MAN), Remote Job Entry (RJE), Intranet, Extranet, Internet
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Thanks.

- Network topologies: Star, Ring, Bus, Fully connected/Mesh.
- Data transmission media: Definitions and examples
- Modes of transmission: Simplex, half duplex, duplex, synchronous and asynchronous
- Data transmission equipment: MODEM, Multiplexors, etc
- Protocols, OSI - 7 layer model

9. Systems Developments 10%
   - Approaches to Systems Development: Traditional Systems Development life Cycle (SDLC), Prototyping, End-user developments.
   - Systems development cycle (in outline only): Linking systems development to identification of a problem, feasibility studies, systems investigation and specifications, systems design, acquisition, implementation, maintenance and review.

10. Computer Services 5%
    The role of micro computers in the accounting environment, role of users department.
    - Information centre: Staffing, services provided
    - Computer bureau: Services provided reasons for using a bureau, advantages and disadvantages.

11. Some Issues in Management of Information Technology (I.T.) 10%
    - Security: Hardware, Software and work place securities.
    - Computer Crimes: Examples and preventions
    - Computer virus: Definition, causes and preventions
    - Standard Health Implications.

12. Recent Developments in I.T. 10%
    - Office Automation: Hardware and Software requirement
    - Internet: Definition, Uses, advantages and disadvantages. Hardware and software requirements, Websites. Interacting with the Internet through browsing, downloading, etc
    - Application areas: Electronic mail, teleconferencing and telecommuting: e-business and e-commerce
    - Definition of Forensic computing, Cloud computing.
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RECOMMENDED TEXTS

1. ATSWA Study Pack on Information Technology

OTHER REFERENCE BOOK
CHAPTER ONE
DATA AND INFORMATION

1.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to

- understand the concept and principal elements of a system and recognize the elements of business organization;
- understand the interrelationships between the subsystems;
- understand the feedback and feed forward control systems;
- differentiate between data and information;
- appreciate the importance and benefits of information to an accounting environment.

1.1 INTRODUCTION

In this chapter, the concept and elements of system theory are discussed. The closed and open systems, with examples are highlighted. The business organization is recognized as an open system. The degree of interrelationship between subsystems is discussed, highlighting coupled and decoupled subsystems. Every open system needs control and the feedback and feed forward control systems are discussed with examples.

The internal and external forms of data/information representation in the computer are discussed and the binary data representation is given. Finally the usefulness of information in an accounting environment ends the chapter.

1.2 SYSTEM THEORY

Systems theory provides a spectrum of scientific principles, concepts and philosophy which may be applied to the study of systems of all types. In the context of this book, it embraces all types of business systems including control systems relating to quality control, production control, budgetary control, cost control, financial and cash control. These systems provide the fabric of a management information system.

A system may be defined as a combination of interrelated elements, called subsystems,
organized in such a way so as to ensure the efficient functioning of the system as a whole. This necessitates a high degree of coordination between the subsystems, each of which is designed to achieve a specific purpose.

A system element can be a tangible object (such as data, information) or an event (such as an anniversary day).

**Example 1.1**

Examples of systems include:

i. Business systems

ii. Manufacturing systems

iii. Service systems

iv. Information systems

v. Computer-based management information systems.

vi. Stock control systems.

A system must have an objective or goal. It is probably true to say that all systems have more than one objective.

A business organization, for example, might have the following objectives:

* Generate a reasonable financial return for shareholders;
* Maintain a high market share;
* Increase productivity annually;
* Offer an up-to-date product range of high quality and proven reliability;
* Develop a reputation as responsible employers;
* Acknowledge social responsibilities;
* Grow and survive autonomously.

In most cases, the differing objectives of a system will be conflicting, so that some form of compromise or trade-off between them must be reached. A system will not operate
as efficiently as it should if these compromises are not reached in a satisfactory manner. For example, the wish to reduce production cost might conflict with any of the following:

- High measure against health and safety conditions at work;
- The high costs used for the treatment of waste and effluent from production;
- The quality of goods produced;
- Spending on new technology or research and development (R & D).

1.2.1 System Environment

The environment of a system consists of elements which surround the system and interact with it. The environment is not part of the system. For example, the environment of a business system consists of the government and the competitors.

A system is normally delimited by a boundary, which separates the system from its environment. Anything within the boundary is part of the system; while anything outside the boundary is part of the environment. Elements included in the system and the elements included in the environment depend on the particular problem being studied.

For example, consider the problem of determining the turnaround time in Batch processing. The system elements will include people (in the form of the speed of data-entry operators and the schedule established by the computer operator). On the other hand, if the problem is to study how to make a particular computer program execute more efficiently on a given computer, the system elements will include purely technical details as the program, system software routines, the data used and the hardware, while people will be in the system’s environment.

Just as every system has an objective which ought to be identified and specific, so too will every system have constraints or limiting factors, which restrict its capacity to achieve its objectives. In a business system, constraints restricting the objective of profit maximization might include any of the following:

- Scarcity of key resources such as cash or skilled labour;
- Technological constraints limiting what goods and services can be produced;
- Economic constraints;
- Political and legal constraints;
- Product completion time;
- Responsibilities towards society and for preserving the environment from pollution.

1.2.2 Sub-systems

Every system can be broken down into subsystems (elements) and in turn, each sub-system can be further broken into sub-subsystems. Separate subsystems interact with each other and respond to each other by means of communication or observation.

Subsystems may be differentiated from each other by

- Function (e.g. in a manufacturing system, we might have, production, finance, marketing, sales, personnel etc);
- Space (e.g. Northern area and southern area sales managers)
- Time (e.g. morning shift, afternoon shift, and evening shift managers)
- People
- Formality
- Automation

Example 1.2

A manufacturing organization is a system with subsystems such as

* Personnel department,
* Marketing department,
* Audit department,
* Production department,
* Information technology (I.T.),
* Maintenance department, and
Purchasing department.

Note that in example (1.2), the manufacturing organization has been divided into subsystems (elements) by the functions undertaken by the elements.

**Example 1.3**

The production subsystem can be further divided into sub-subsystems such as:

- Machine operations control,
- Work-handling,
- Power supply, and
- Material production.

**1.2.3 Coupling and Decoupling of Systems i.e. (Integration and disintegration)**

A system is a combination of subsystems (elements), which are integrated to each other by means of their inputs and outputs. Coupling is a measure of the degree or extent of the dependence of the subsystems on one another. If subsystems are over-integrated, they may become too complex to understand and operate and if one part of the system ceases to function correctly, the other elements are affected and may cease to function completely. Decoupling, both in a physical and information sense, allows subsystems more independence in planning and control. When systems are decoupled, it is easier to administer them in some cases as they become less complex and more flexible. This enables them to react to random influences as they occur without too much disruption. Decoupling generally leads to system stability which is essential for continued operation and survival in a dynamic environment. Decoupling creates a situation whereby subsystems exist separately on a functional basis but are coordinated by the chief executive for the achievement of the overall objectives. Each functional sub-system has more independence even though they are still interrelated in reality, but loosely connected for administrative convenience.

**1.2.4 Components of a System**

When classifying systems, distinction is made between a system’s logical description and physical description. The logical description of a system is a representation that
specifies essential system elements in respective of how these elements may be implemented. The physical description addresses implementation. For example, in a computer-based management information system (CBIS), the terms input, processing and output are logical descriptions of the general transformation process. However, during implementation, keyboard can be used as an input device while the monitor or printer can be used as output devices. The three logical components of a system are INPUT, PROCESS and OUTPUT.

**INPUTS:** These provide the system with what it needs to be able to operate. Input may include matter, energy, human, data or information.

**PROCESSES:** These transform the input into output, such as task performed by human, plant, machines etc.

**OUTPUT:** These are the results of processing e.g. finished products, and work-in-progress (WIP).

### 1.2.5 Types of Systems

One way of classifying systems is the way in which they interact with the environment such as open and closed systems.

#### a. OPEN SYSTEM

Open systems are those, which interact with their environment for the collection of information on business transactions with suppliers, customers, the general public, government departments, trade organization etc. Such system adapts to changes in the environment in order to survive which requires speedy reactions to competitive situations and other threats in the most effective way. All business systems are open systems.

#### b. CLOSED SYSTEM

A Closed system does not interact with its environment either for the exchange of information or business transaction. A closed system has neither an input nor output, i.e. it is self-contained. In fact, no such system exists, but the term is used for systems that interact only partially with their environment. An approximation is the reaction in a sealed, insulated container.
1.2.6 **Classification of Open Systems**

Open systems may be classified according to the degree of reaction to their environment in the production of output as

- Deterministic or Mechanistic,
- Probabilistic or Stochastic, and
- Adaptive (self-organising) or cybernetic.

**a. Deterministic or Mechanistic systems**

A deterministic or mechanistic system is one in which various states or activities follow each other in a completely predictable way. It is designed to operate on the basis of standardized rules and regulations which restrict its ability to react to its environment. A deterministic system enables the outputs generated from specific inputs to be measured without any error.

An example is a computer system. Business and economic systems are not deterministic systems, since they are highly unpredictable.

**b. Probabilistic or Stochastic Systems**

A probabilistic or stochastic system is one in which some states or activities can be predicted with varying degree of probabilities. Business and economic systems are probabilistic systems since they are subjected to random influences from the environment. The state of such systems can therefore be defined or known only within specified limits even when they are subject to control. For examples, stocks of raw materials, parts and finished goods are influenced by changes in demand and variations in supply. Generally in probabilistic systems, the outputs from specific inputs are not certain because it is not possible to ascertain what events will occur outside their boundaries.

**c. Adaptive or Cybernetic System**

Cybernetics is defined as the science of communication and control in man and machine systems. The term is derived from the Greek word “Kybernetes”, the derivation of the Latin work, “gubernator” meaning governor or controller. An adaptive or cybernetic system is one, which adapts and reacts to a stimulus. The way in which it adapts is uncertain as the same input (stimulus) to the system will
not always produce the same output (response). An adaptive system responds to changing situation by adjusting its behaviour on a self-organising basis. The system alters its inputs as a result of measuring its outputs. It attempts to optimise its performance by monitoring its own behaviour. Animals, human beings and business organizations are examples. A physical example is the thermostat controlled heating system in water boilers which cuts off current when temperature is high in order to maintain a steady water temperature.

Also computerized stock ordering system is adaptive in nature.

1.3 CONTROL SYSTEMS

A system must be controlled to keep it steady or enable it to change safely. Control is required because unpredictable disturbances may arise and enter the system, so that actual results deviate from the expected objective. For example, in a business organization, such disturbances could be

i. Entry of a powerful and advanced technological new computer into the market;

ii. An unexpected rise in labour costs;

iii. The failure of a supplier to deliver promised raw materials;

iv. Government legislation etc.

Control systems are often separately structured from the systems which they control. For example

* The production control system controls the production quantity;

* The quality control system controls the production quality;

* The cost control system controls the cost of production.

These control systems are basically administrative systems for monitoring the results and modifying the state of the physical systems to which they relate.

Control is for the purpose of detecting variations in the behaviour of a system so that control signals can be communicated to the appropriate manager.
**1.3.1 Elements of Control**

The basic elements of control in a business system are:

* **Planning**: This is the determination of objectives, or parameters such as
  
  i. standard times for an operation,
  ii. level of production activity required,
  iii. level of sales required,
  iv. maximum expenditure allowed, and
  v. performance levels required.

* **Collecting facts**: This involves the collection and recording of data in respect of such things as:
  
  i. actual times taken;
  ii. level of production achieved;
  iii. level of sales achieved;
  iv. expenditure incurred; and
  v. actual performance level.

* **Comparison**: This involves the computation of the difference between the objective and the actual results for the purpose of indicating variances and the reporting of significant deviations (variances).

* **Corrective Action**: This involves the action taken by the relevant manager (effector) to maintain a steady state.

**1.3.2 Closed and Open-loop control systems**

The basic types of control systems are:

Open – and Closed-loop control systems:
**Open-loop control system**

In an open-loop control system, the control is exercised regardless of the output produced by the system. Here control is exercised by external intervention. Physical examples are

- Automatic light switches and
- Traffic light.

**Closed-loop Control System**

In closed-loop control system, the control is exercised by part of the output, which is fed back into the system as input.

Many closed-loop systems are self-regulating as they contain a built-in control mechanism. Business systems containing integrated control systems performing continuous monitoring activities are also closed-loop systems because they contain the essential elements of feedback.

**1.3.3 Feedback Control System**

Business information is needed to plan or make rules. It is also needed to compare actual results against the plan, so as to judge what control measures are needed.

Feedback as a control is the return of part of the output of a system to the input as a means of control. Thus, feedback is a control of a process by its results by measuring differences between desired and actual results. A feedback is a closed loop as shown in figure 1.1. Feedback is essentially an output signal causing error signals to be generated as the basis for adjusting the input to a system which, in respect of an automatic control system, is achieved by an inbuilt control mechanism.
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Input → Process → Output

Corrective Action ← Comparison of actual and planned Performances ← Actual Performance

Planned Performance

Fig 1.1 Closed-loop control system

1.3.4 Negative Feedback

Feedback is part of the output which is returned to the input as a means of system control. When the actual output from a system is lower than the desired output, the differences between the actual and the desired outputs are detected as positive deviations (errors) and action is effected in the opposite direction to counteract them. Consider a production line with 10,000 units as required output in the month. If the actual monthly output is 9,000 units, then monthly errors of 1,000 units are detected as positive deviations. Corrective action would then be taken to increase the output to 10,000 units per month. This is an adjustment in the opposite direction to the error. Most business control systems are negative feedback control systems.

1.3.5 Positive Feedback

In a positive feedback control system, actions are taken to enlarge (amplify) the detected deviations. This is in contrast to what happens in the negative feedback control systems. For example, amplification applies to serve-mechanisms whereby a small manual force is detected and amplified to achieve a defined purpose.

1.3.6 Feedforward control system

Management can also act proactively on the feedforward principle. Here, the error signals (deviations) are noted over a period of time by a monitoring process and may be employed to forecast the projected performance of an organizational unit. This approach ensures that the historical trend or inherent behaviour of a system is allowed for when establishing control parameters for future operations. In conclusion, feedforward controls monitor both process operations and inputs in an attempt to predict potential deviations in order that adjustments can be made to avert problems.
before they occur.

1.4 NATURE OF DATA AND INFORMATION

Data are raw facts, events, numbers and transactions, which have been collected, recorded, stored but are not yet processed. Data consist of numbers and characters (i.e. alphabets and special symbols) which are used to record facts and events.

Information is processed data. It is obtained after subjecting data to a series of processing operations which convert related groups of data (raw facts) into a meaningful and coherent form. This makes information useful and meaningful.

Let us consider an example which distinguishes data from information. The costs of five different items are data while the total cost or average cost which is obtained from the different costs is information. Information must be communicated and received by a manager who uses it for decision making. On most occasions, what is information to one manager might be data needing further processing to another manager.

The conversion of data to information is represented diagrammatical in figure 1.2 below:

$$\text{Data} \rightarrow \text{Information processing} \rightarrow \text{Information}$$

Figure 1.2

1.4.1 Attributes of Information

The following are the essential attributes of information for management decisions:

a. It must be detailed enough to allow for effective decision

b. It must contain an appropriate level of details for the recipient. At the top management level, the information must be very broad in scope while at the operating or departmental management level, the information must be of a very detailed nature.

c. It must relate to the current situation and have acceptable level of integrity

d. It must be produced at an optimum cost and must be compatible with response time needs of the systems.
e. **Clarity:** It must be easily understood by the recipients. Presentation, in forms of charts, diagrams and tables may be essential. It must be concise and not contain unnecessary redundancy.

f. **Accuracy:** It must be precise and have an acceptable level of accuracy to the recipient. It must be producible at regular intervals and be relevant to its purpose. For example, bank balances are given to 2 decimal places for accuracy.

g. **Verifiable:** It must be verifiable. Many knowledgeable people acting independently will produce the same information.

### 1.4.2 Types of Information

Information needs of an organization can either be quantitative or qualitative.

**Quantitative Information**

Quantitative information deals with the magnitudes of variables, their variability or absolute values. Some examples are:

a. Annual sales of a production company,

b. Variation in the wages of low-level staff in an organization,

c. Prices of goods;

d. Number of hours worked on a production line.

**Qualitative Information**

Qualitative information is related to the attributes of an entity in respect of quality factors. This type of information is not exact (precise) in nature but it is very useful for comparative measurement.

Examples include:

a. Standard of finished product in respect of paintwork or electroplating

b. Variation of tolerances of manufactured parts i.e. deviation from standard dimensions.
1.4.3 Information System

With the proper definitions of data, information and the attributes of information given above, we can now define an information system as distinct from information. An Information system is the set of interconnected procedures, the purpose of which is to provide managers at all levels and in all functions of an organization with the information necessary to enable them make timely and effective decisions. These decisions are for

- Planning,
- Directing and
- Controlling of all activities for which they are responsible

The common characteristics of all information systems are:

a. The existence of procedures for orientating and/or collecting data;

b. The existence of procedures which sort and classify data, carry out arithmetic and logical operations on the data, holds data in the form of records for immediate or future use, summarise and analyse data and check the results for accuracy. All these activities constitute the processing of data.

c. The existence of procedures for communicating the processed data to appropriate managers.

1.4.4 Accounting Information System (AIS)

A special type of information system for Accounting professionals is the Accounting Information System.

An accounting information system (AIS) therefore consists of people, procedures and information technology (I. T). Just as we have above, the AIS performs three important functions in any organisation:

- It collects and stores data about activities and transactions so that the organisation can review what has happened.
- It processes data into information that is useful for making decisions that enable management to plan, execute and control activities.
It provides adequate controls to safeguard the organisation’s assets, including data.

These controls ensure that the data is available when needed and that it is accurate and reliable.

### 1.4.5 Subsystems of AIS

Most business organisations engage in many similar and repetitive transactions/activities. These transaction types can be grouped into the five basic cycles, which constitute the basic subsystems in the AIS:

* The Expenditure subsystem/cycle which consists of the activities involved in buying and paying for goods or services used by the organisation.

* The production subsystem/cycle which consists of the activities involved in converting raw materials and labour into finished products (only manufacturing organisations have production subsystem)

* The Human Resources/payroll subsystem/cycle which consists of the activities involved in hiring and paying employees.

* The Revenue subsystem/cycle which consists of the activities involved in selling goods or services and collecting payment for those sales.

* The Financing subsystem/cycle which consists of those activities involved in obtaining the necessary funds to run the organisation and in repaying creditors and distributing profits to investors.

The above basic subsystems suggest the most important work activities performed by professional accountants:

- Accounting systems and financial reporting
- Long-term strategic planning
- Managing the accounting and finance function
- Internal consulting
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- Short-term budgeting
- Financial and economic analysis
- Process improvement
- Computer systems and operations
- Performance evaluation (of the organisation)
- Customer and product profitability analysis

Remark: The AIS differs from other information systems in its focus on accountability and control.

1.4.6 Benefits of Information systems

Information systems can help an organization in any of the following ways:

a. **Operational Efficiency:** This entails doing routine tasks faster, cheaper, neater and more accurately. The use of transaction processing software, word processing and electronic spreadsheet help to make operations more efficient.

b. **Functional Effectiveness:** This entails the use of decision support softwares which are oriented towards helping managers to make better decisions.

c. **Provision of better improved services:** This entails the use of help technologies like the automatic teller machine (ATM), e-commerce and the reservation systems used by travel agents. All these are examples of provision of improved services to customers.

d. **Better Product selection:** The provision of information helps in the selection of products offered for sales by industries like Banks, insurance companies, travel and financial services. Products that can be differentiated largely on the basis of the information inherent in them are called Information-Intensive Products.

e. **Competitive Advantage:**

The provision of information and the creation of new products through
information technology can give some companies competitive advantage over other companies in the same industry.

1.4.7 Information Technology (I.T.)

In the definition of information systems (I.S) in (1.4.3), no reference was made to any form of mechanization: It is a definition of how information is used rather than how it is obtained.

In information technology (IT), processing is carried out with the assistance of machines (electronic machines).

I.T. is a computer –based information system (CBIS) in which the computer plays a major role. All the various aspects of electronic technology include

- the use of microcomputers for the processing and storage of information;
- the application of electronic spreadsheet to the modelling of business problems;
- the use of word processing software for preparing standard reports and other correspondence at high speed;
- the use of electronic-mail (e-mail) for transmitting messages. It partially eliminates the physical postal systems;
- the introduction of electronic trading (e.g. e-commerce, e-marketing) and electronic banking (which includes principally electronic money transfer)
- the introduction of electronic library enables the business to conduct its activities in a more efficient manner and stand above its competitors in the same trade.

1.4.8 TYPES OF DECISIONS

One major objective of the AIS is to provide information for management decision making. The IT aids AIS to meet this objective. To understand the roles played by IT and the design of such an AIS, we now explain the kinds of decision made by an organisation. Decisions can be categorised either:

(1) in terms of the degree of structure that exists OR

(2) by the scope of the decision

(1) Decision Structures: Decisions vary in terms of the degree to which they are
(a) **Highly Structured Decisions** are repetitive routine and understood well enough that they can be delegated to lower level employees and in fact such decisions can be automated. For example, the decision to grant credit to established customers requires only the

- PIN
- Customer credit limit and
- Current balance

(b) **Semi-Structured Decisions** are characterised by incomplete rules for making the decision. There is need for subjective assessment and judgements to supplement formal data analysis. Such decisions can be made using Computer Based Decision Aids such as Neural systems, DSS, EIS etc. For example, setting a marketing budget for a new product requires

- the marketing status of the other products
- the level of advertisement and
- other subjective decisions.

(c) **Unstructured Decisions** are non-recurring and non-routine. Examples include:

- choosing a cover for a magazine
- hiring a senior management
- the choice of basic research project to undertake

In this case, no framework or model exists to solve such problems. Instead, they require considerable judgement and intuition. Nevertheless, they can be supported by Computer Based Decision aids that facilitate gathering information from diverse sources.

(2) Decision Scopes are:

(a) Operational Control
(b) Management control and

(c) Strategic planning

(a) **Operational Control** is concerned with the effective and efficient performance of specific tables. Lower-level supervisors and employers face semi-structured or structured decisions involving operational control. Examples include decisions relating to inventory/stocks management and extending credits.

(b) **Management Control** is concerned with the effective and efficient use of resources for accomplishing organisational objectives. Middle managers deal with semi-structured decision; involving management control. For example, budgeting, developing human resources practices, deciding on research projects and product improvement are management control activities.

(c) **Strategic Planning** is concerned with establishing organisational objectives and policies for accomplishing those objectives. Top management faces unstructured and semi-structured decisions involving strategic issues. Examples include:

- setting financial and accounting policies
- developing new product lines and
- acquiring new businesses.

In conclusion, accounting information plays two major roles in management decision making. These are:

(1) It identifies activities requiring action. For example, a cost report with a huge variance might stimulate investigation and possible corrective action.

(2) It reduces uncertainty and thus provides a basis for choosing among alternative action. For example, it often used to set prices and determine credit policies

### 1.5 DATA REPRESENTATION IN A COMPUTER

The introduction of computer technology into information systems compels us to learn how data/information are transformed or coded to facilitate their storage and processing in the computer – based information system (CBIS).

There are two types of data, namely characters and numbers.
A character is an alphabet or any special symbol (such as punctuation marks). For example, the character set includes

- the 26 uppercase alphabets, A,B,C,D,E,......, Z
- the 26 lower case alphabets a,b,c,d,e,......,z
- the punctuation marks such as . , ; : (see the standard keyboard)
- the special symbols such as ! ^ * + _

A number is composed of digits and there are 10 of such digits namely 0 ,1 ,2, 3, 4, 5, 6, 7, 8, 9 in the decimal number system. Examples of decimal numbers are 5.1, 126, 5897.

A data that is a string of alphabets and numbers is called an alphanumeric.

1.5.1 External and Internal Data Representation

a. **External data representation:** This is the representation of data in the usual normal language of the user. For example, the use of English alphabets to represent characters. When documents are presented for coding and processing, the data in the document is in external representation for the computer.

b. **Internal Data Representation:** Physical devices used to store and process data in computers are two-state devices as we have in:

i. Punched cards. The two states are the presence and absence of a hole on the card.

ii. Magnetic devices: The two states are achieved when a magnetic surface is magnetized in either one of two opposite directions.

iii. Conducting devices: The two states are achieved when the material is in conducting mode or non-conducting mode, as in semiconductors.

Thus, all data to be stored and processed in computer are transformed or coded as strings of two symbols, one symbol to represent each state. For convenience, let us denote the two different states by 0 and 1. In punched card phenomenon, 0 represents a punched hole and 1 represents not punched.

In magnetic devices, 0 represents magnetic poles aligned left to right (S ———>N) and 1 represents magnetic poles aligned right to left ( N ———>S).

In conducting devices (such as diodes) 0 represents conducting 1 represents non-
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

conducting mode, mode and

In general, for any switch (i.e. a device that can exist in two states), let 0 represent OFF and 1 represent ON.

**BIT**: These two symbols 0 and 1 are called bits, an abbreviation for binary digits. Thus, a bit is the smallest unit of data in a computer system.

The string of bits is then used to code data in a computer. The number of bits in each string will depend on the technology (i.e. architecture) of the computer involved. For example, in a 2-bit computer, each character is represented by 2 bits. The possible characters then are

00 01 10 11

Thus, the maximum number of characters that can be processed by a 2-bit computer is 4, i.e. $2^2$.

For a 3-bit computer, the maximum number of characters that can be processed will be $2^3 = 8$, and the possible unique representation of the characters is

000 001 010 011 100 101 110 111

For a 4-bit computer, the maximum number of characters that can be processed will be $2^4 = 16$ and the possible unique representation of the characters is

0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111

In the normal usage of data, there are

- 26 upper case alphabets;
- 26 lower case alphabets;
- 10 decimal number digits; and possibly
- 36 other special characters.
Hence, in standard usage of data, we need a computer that can process at least \((26 + 26 + 10 + 36) = 98\) unique characters.

For such an \(n\)-bit computer, \(2^n > 98\) and \(n = 7\) since \(2^7 = 128\) and \(2^6 = 64\).

Hence a computer in which each unique character is represented by a string of 7 bits is adequate to code the 98 characters in normal usage.

In order to facilitate the exchange of recorded data between computers, coding of characters has been standardized. The standard coding form in which each character is coded using 7 bits is known as ASCII (American standard code for information interchange).

Another standard coding form (International Business machines corporation) developed by IBM in which each character is coded using 8 bits is known as EBCDIC (Extended Binary coded Decimal Interchange (code)).

In the case of BCD (Binary coded Decimal) coding form, each character is coded using a string of 4 bits.

A byte is a string of bits used to represent a character.

For the BCD, a byte is made up of 4 bits. For the ASCII, a byte is made up of 7 bits while for the EBCDIC a byte is made up of 8 bits.

**Definition of a byte:** In normal practice, a byte is defined as 8 bits i.e. 1 byte = 8 bits. This is the standard definition of a byte.

A WORD is defined as a combination of 2 bytes. i.e. 1 word = 2 bytes

In information technology, \(2^{10} = 1024\) is called a kilo. For easy of calculation, 1 kilo is taken as \(10^3\) which is a close approximation to \(2^{10}\).

We now present higher dimensions of the byte

\[
\begin{align*}
1000 \text{ bytes} & = 10^3 \text{ bytes} = 1 \text{ kilobyte} = 1\text{KB} \\
10^3 \text{ KB} & = 1 \text{ Megabyte} = 1\text{MB} \\
10^3 \text{ MB} & = 1 \text{ Gigabyte} = 1\text{ GB} \\
10^3 \text{ GB} & = 1 \text{ Terabyte} = 1\text{ TB}
\end{align*}
\]
1.5.2 Data Train or Data Stream

In the ASCII coded form, the following characters are coded as

A → 1000001
E → 1000101
J → 1001010
T → 1010100
SPACE → 0100000
M → 1001101
O → 1001111
. → 0101110
, → 0101100

Then the internal computer representation for

M.O. AJE is

| 1001101 | 0101110 | 1001111 | 0101110 | 1000001 | 1001010 | 1000101 |

Figure 1.3

Observe that the punctuation marks (full stops) following the letters M and O are also coded. Figure (1.3) is known as a data train/data stream. Thus, a stream is a sequence of characters that flow into or out of a process. Each stream is either an input stream or output stream for the process.

1.5.3 Representation of Integers:

Decimal integers are also represented in the computer in the binary form as a string of bits. A number in binary form is said to be in base 2. Given a binary equivalent of a data (i.e. character or number), the leftmost bit is called the most significant bit while the rightmost bit is called the least significant bit. For example, in 10010 the leftmost bit 1 is the most significant bit while the rightmost bit 0 is the least significant bit. Conversion of decimal numbers to binary numbers and vice versa is done automatically by the computer. Let us illustrate how this is done manually.
Example 1: Convert the decimal number 4903 to a binary number.

Solution: Dividing the given number by 2 continuously and recording the remainder after each division are as follows:

\[
\begin{array}{c|c}
2 & 4903 \\
2 & 2451 \text{ R } 1 \\
2 & 1225 \text{ R } 1 \\
2 & 612 \text{ R } 1 \\
2 & 306 \text{ R } 0 \\
2 & 153 \text{ R } 0 \\
2 & 76 \text{ R } 1 \\
2 & 38 \text{ R } 0 \\
2 & 19 \text{ R } 0 \\
2 & 9 \text{ R } 1 \\
2 & 4 \text{ R } 1 \\
2 & 2 \text{ R } 0 \\
2 & 1 \text{ R } 0 \\
\end{array}
\]

Then

\[4903_{\text{ten}} = 1001100100111_{\text{two}}\]

Note that the result is recorded from bottom to top following the direction of the arrow.

Example 2: Convert the decimal number 29 to a binary number

Solution

\[
\begin{array}{c|c}
2 & 29 \\
2 & 14 \text{ R } 1 \\
2 & 7 \text{ R } 0 \\
2 & 3 \text{ R } 1 \\
2 & 1 \text{ R } 1 \\
\end{array}
\]
Hence

\[ 29_{\text{ten}} = 11101_{\text{two}} \]

### 1.5.4 Conversion of binary number to Decimal numbers

A binary number is converted to a decimal number by attaching weights to each position and sum the products of the weights and the bits. The weights are \(2^0\), \(2^1\), \(2^2\), \(2^3\), \(2^4\), etc starting from the right most bit to the leftmost bit. Given the binary number

\[
\begin{array}{c}
1 \\
1 \\
1 \\
0 \\
1
\end{array}
\]

Left most bit \hspace{1cm} right most bit

Then the decimal number is

\[
1\times2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 + 1 \times 2^4
\]

\[= 1 + 0 + 4 + 8 + 16\]

\[= 29_{\text{ten}}\]

Example (1.4): Convert 100111 to a decimal number.

### Solution

\[
100111_{\text{two}} = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0
\]

\[= 1 + 0 + 4 + 0 + 0 + 32\]

\[= 39_{\text{ten}}\]

### 1.5.5 Computer Representation of Fractions

Decimal fractions are interpreted as follows: For example

\[
0.625_{\text{two}} = 6 \times 10^{-1} + 2 \times 10^{-2} + 5 \times 10^{-3}
\]

In the same way, binary fractions are interpreted as: for example

\[
0.1101 = 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}
\]

\[= \frac{1}{2} + \frac{1}{4} + \frac{0}{8} + \frac{1}{16}\]

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Let us now see how to convert a decimal fraction to binary fraction. We first observe the following:

\[
\frac{1}{2} = 0.5 \\
\frac{1}{2^2} = \frac{1}{4} = 0.25 \text{ (i.e. } 0.5 \div 2) \\
\frac{1}{2^3} = \frac{1}{8} = 0.125 \text{ (i.e. } 0.25 \div 2) \\
\frac{1}{2^4} = \frac{1}{16} = 0.0625 \text{ (i.e. } 0.125 \div 2) \\
\frac{1}{2^5} = \frac{1}{32} = 0.03125 \text{ (i.e. } 0.0625 \div 2) \text{ etc.}
\]

Given a decimal fraction, disintegrate it into the sum of the weights \(2^{-1}, 2^{-2}, 2^{-3}, 2^{-4}, 2^{-5}\) etc

i.e. 0.5, 0.25, 0.125, 0.0625, 0.03125 etc

Then the binary fraction has a bit corresponding to each of these weights from the binary point to the right.

Example (1.5): Covert 0.625 to a binary fraction

**Solution:** 0.625\text{ten} = \frac{5}{10} + \frac{0}{100} + \frac{2}{1000} = 0.5 + \frac{0}{10} + \frac{1}{100} = 0.5 + 0 + 0.0625 = 2^{-1} + 0 + 2^{-3} = 0.101_{\text{two}}

Example (1.6): Convert 39.8125 to a binary fraction

**Solution:** First convert the integral part to a binary number before considering the decimal fraction. Now,
Solution

\begin{center}
\begin{tabular}{c|c}
2 & 39 \\
2 & 19 R 1 \\
2 & 9 R 1 \\
2 & 4 R 1 \\
2 & 2 R 0 \\
\hline
& 1 R 0
\end{tabular}
\end{center}

Now, $39_{10} = 100111_{two}$

0.8125 \text{ten}

\[
= 0.5 + 0.3125 \\
= 0.5 + 0.25 + 0.0625 \\
= 2^{-1} + 2^{-2} + 0 + 2^{-4} \\
= (1)(2^{-1}) + (1)(2^{-2}) + (0)(2^{-3}) + (1)(2^{-4})
\]

\[
\therefore 0.8125_{10} = 0.1101_{two}
\]

Thus $39.8125 = 100111.1101_{two}$.

1.5.6 Alternative method of Representing Decimal fractions

We can utilize a similar algorithm used in the direct method of converting decimal integers to binary numbers to the conversion of decimal fractions to binary fractions. Here, we continuously multiply the decimal fraction by 2 and record the integral part in each case. These sequences of integral parts form the binary fraction starting with the most significant bit.

Example (1.7): Convert 0.625 to a binary fraction.
Solution: Continuously multiply 0.625 by 2 and record the integral part.

\[
\begin{align*}
2 \times 0.625 & = 1.250 \text{ Record 1 (most significant bit)} \\
2 \times 0.250 & = 0.500 \text{ Record 0} \\
2 \times 0.500 & = 1.000 \text{ Record 1(Least significant bit)}
\end{align*}
\]

Thus 0.625 = 0.101\text{two}

Explanation: Recall that

\[
0.625 = 0.5 + 0.125 = \frac{1}{2} + \frac{1}{8}
\]

\[
= 1(2^{-1}) + 0.(2^{-2}) + 1.(2^{-3})
\]

Now

\[
\begin{align*}
2 \times 0.625 & = 1 + 1.(2^{-2}) \text{ Record 1} \\
& = 0 + 0.500 \text{ Record 0} \\
2 \times 0.500 & = 1.000 \text{ Record 1}
\end{align*}
\]

Example (1.8): Convert 0.8125 to a binary fraction

Solution

\[
\begin{align*}
2 \times 0.8125 & = 1.6250 \text{ Record 1} \\
2 \times 0.6250 & = 1.2500 \text{ Record 1} \\
2 \times 0.2500 & = 0.5000 \text{ Record 0} \\
2 \times 0.500 & = 1.0000 \text{ Record 1}
\end{align*}
\]

Thus

\[
0.8125 = 0.1101\text{two}
\]

Apart from the inputs to the above functions, accountants also analyse the information generated on payrolls and pay slips, stock report, list of debtors and creditors, cost summaries, budget reports and labour turnover statistics.

Information on the above functions or activities allows the decision making process of
the accountant to be fast and accurate. This decision making is aided by some decision support systems (DSS)

1.6 SUMMARY AND CONCLUSIONS

Business organization is an example of an open system which interacts with its environment for the exchange of information. The elements or subsystems of a system interact with themselves and the extent of interaction determines the coupling or decoupling of the system. Every open system needs a form of control which is implemented either as a feedback or a feed forward control system. Data are raw facts, while information is the processed data. Data and information are represented in the computer in binary form. The smallest element of data is called a bit and 8 bits make a byte, which is a character or digit number.

MULTIPLE CHOICE QUESTIONS (MCQ)

1. One of the main technologies in Information Technology is..........................
   (A) Information System
   (B) Communication Channels
   (C) MODEM
   (D) Computer System
   (E) Humanware

2. Which of the following is a personal Computer?
   (A) Mainframe
   (B) Supercomputer
   (C) Minicomputer
   (D) Microcomputer
   (E) Computer chips

3. Semi-conductor memory is made from
   (A) Silicon chips
   (B) Mercury chips
   (C) Memory chips
   (D) Core chips
   (E) RAM
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

4. Micro processor consists of...........................
   (A) Main memory and computer processor
   (B) Arithmetic Unit
   (C) Logic unit
   (D) Control unit
   (E) Computer processors

5. Which of the following is not a kind of data?
   (A) Text
   (B) Picture
   (C) Voice
   (D) Information
   (E) Signal

SHORT-ANSWER QUESTIONS

1. A special purpose digital computer used in the production of office document is called......................

2. An output organized in a meaningful fashion prepared for both internal and external use is called......................

3. Protocol is a set of rules governing the exchange of...................between two systems.

4. Pixel is the smallest particle of Information that appears on a......................

5. A program is an algorithm written in a particular......................

Solutions to MCQ

1. D
2. D
3. A
4. E
5. D
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

Solutions to SAQ

1. Word Processor
2. Report
3. Data/Information
4. Monitor/VDU Screen
5. Computer Language
CHAPTER TWO

HARDWARE

2.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to learn about:

- The classification of computers as Digital, Analogue and Hybrid.
- The classification of digital computers and their properties
- Components of the hardware system: Input devices, Output devices, Storage devices and the Processor unit.

2.1 INTRODUCTION

The introduction of the computer system has changed the working habit of several people. The computer hardware (i.e. assembly of electronic components) has evolved over the years to the extent that we now have large capacity direct access memories and very fast processors. The input devices now use direct input technique which includes speech system. The monitor is no longer CRT (Cathode Ray Tube) but flat panel. The technologies used for the external storage media are magnetic and optical, flash disk being the most widely used. The impact printers are now being replaced by non-impact printers, the Laser and Ink jet printers being the most widely used.

2.2 TYPES OF COMPUTERS

A computer can be defined as a data processing machine that is under the control of stored programs which automatically accepts and processes data, and supplies or stores the result of that processing.

The key elements in the definition are that a computer is an automatic machine that

i. accepts data,

ii. processes the data into information using the logic applied by the end-user,

iii. and stores or supplies the information.
2.2.1 Classification of computers:

One way to classify computers is the way data is represented in the computers. This classification is as follows:

i. Digital computers are those in which data and information are represented in digital form by a coded set of electrical pulses. Examples are programmable calculators, mainframe, minicomputers and micro computers.

ii. Analog computers are those in which data and information are represented in a more direct manner by a physical quantity that is proportional to it or to its defined function. Examples include thermometer, pressure gauge, and voltmeter.

iii. Hybrid computer consists of the combination of both the digital and analog computers connected together in a single system. They combine the high speed of the analog computer with the flexibility of the digital computer. They are mostly found in scientific and technical applications.

2.2.2 Comparison of Digital and Analog Computers

Digital computers have the advantage of accurate output, high arithmetic speed particularly in the solution of mathematical problems and mathematical modelling, ease of programming and coding.

Analog computers are very cheap and have the advantage of high speed of output but the output may not be accurate.

Most of the computers in use today are digital computers.

2.2.3 Classification of Digital Computers

Digital computers are classified as

i. General – purpose and

ii. Special – purpose

General-purpose digital computers are those computers which are completely programmable and can be used to perform a variety of numerical calculations and
business problems.

Special-purpose computers are designed for special type of application and have their programs pre-written.

2.2.4 Digital General Purpose Computers

The computers used in the homes, schools, offices and for business applications are digital general purpose computers.

These computers are generally classified according to their processing power, memory capacity and the number of peripherals that can be simultaneously supported such as

i. Supercomputer
ii. Mainframes
iii. Minicomputers and
iv. Micro computers

However, the rapidly changing technology has made this traditional classification very difficult. In fact, today, many super microcomputers are more powerful (in terms of processing speed) than the minicomputers so we can at best use the following features for the classification:

- Processing power
- Memory capacity
- Heat evolution
- Environment in which the computer is used,
- Cost
- Security measures put in place in the environment,
- Installation procedure,
- Maintenance inter-periods,
- The number of peripherals that can be simultaneously supported,
- Word size
- Bus size
- The capabilities of the peripheral devices, and
- The extent of usage.
A word size is the number of bits of data that can be processed in one cycle. Now 128 bit microprocessor chips are in use.

The processor power is the overall power and speed of a microcomputer, which is the frequency of the processor's electronic clock, that is, how many cycles a computer can execute per second, which is measured in Hertz. Also, the Bus size is the number of bits transmitted at one time from one computer location to another.

We now give brief descriptions of these computers (in itemized form).

**Microcomputer**

- It is used as part of a network
- It is very small in size (usually placed on table), but now in smaller sizes in the form of laptop, pocket form etc.
- Consists of a processor on a single silicon chip mounted on a circuit board together,
- Has a keyboard to enter data and instructions
- Has a screen also called monitor, or VDU (Video Display Unit) to display information
- Has interfaces for connecting peripherals (e.g. graph plotters, cassette units, disc drivers, light pen, mouse, joystick etc.)
- Has a small word length size (32 bits)
- It is the cheapest in the range of computers
- It operates under normal room condition
- It can be operated by unskilled users.
- It can be installed by unskilled users.
- It is used as stand-alone computers and midi computer.

**Mini computers (or Minis)**

- Smaller in size than a mainframe
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

- It has a low cost compared to the mainframe
- It is easier to install but still by a professional
- Used by medium-sized companies
- Its use has no complex management structure
- Can be used in networking
- It is used for engineering and scientific applications
- Its capabilities are lower than that of a mainframe but higher than that of a micro computer.

Mainframe

- It is very expensive
- It is a large system
- It is used mainly by large multinational companies
- It is capable of handling multiple simultaneous functions such as batch-processing, and interactive processing under the control of operating system
- It supports a wide range of peripheral equipments e.g. high speed storage devices and communication line
- It evolves large quantity of heat;
- It is normally housed in air-conditioned rooms surrounded by security measures and run by a team of professional operators,
- It can run for several uninterrupted hours,
- It has a large primary memory (in the order of 128Mb) with several disk units each with a capacity of 3-6 T

Super computers

These are computers which are generally more powerful than the mainframe computers. They make use of parallel processing. They are more expensive than the mainframe computer and can work at extraordinary fast speeds and are
exceptionally accurate. These features make them to be used for

- Computer – generated movies and commercials;
- Weather forecasting and structural modelling.

Major disadvantages are that it requires highly trained staff for its operations and its software is poor.

2.3 COMPUTER HARDWARE STRUCTURE

A Computer System consists of three broad components: The Hardware, the software and the human ware. The hardware is the physical unit, which is the connection of electronic components of the computer system, which make up the computer configuration.

The software is the suit of programs which are processed by the hardware and allows the hardware to function effectively and efficiently. A program is a sequence of instructions written in a particular computer language, which is carried out by the hardware to solve a given problem.

The humanware consists of people who operate and maintain the computer system. Since no computer system can function without human beings no matter how remotely controlled, humanware is omitted for now.

Hardware Components

The hardware is divided into two major components: The central processing unit (CPU) and the support devices (see figure 2.1)
The CPU consists of the processor and the primary memory. Working in concert with the processor during processing is the primary memory, which temporarily stores incoming data and processed results for easy access.

The support devices are primarily involved with input, output and/or secondary storage functions. Storage devices provide an area to keep programs and data/information as well as a means to save and retrieve them.
Support equipment is often classified with respect to its relationship with the CPU as either peripheral equipment or auxiliary equipment.

### 2.3.2 Online and Offline Equipment

A support equipment that is currently setup so that it can transmit data to or receive output information from the CPU over a communications line is said to be online (i.e. a support equipment that is connected to the CPU), whereas a support equipment without this capability is classified as offline.

A peripheral equipment is a support equipment that is designed primarily to be used in an online mode.

Examples include

- communication terminals
- Printers and VDU
- Keyboard

An auxiliary equipment is a support equipment that is designed to work in an offline mode. Examples include

- the microfilm reader found in many libraries and
- the data-entry devices that are used in large data processing centres to enter data offline onto a tape or a disk.

### 2.3.3 Summary of the Elemental structure of the Hardware

i. **Input Device** is one which transfers data and programs to the internal memory.

ii. **Central Processing Unit (CPU)** is the main unit of the hardware. It consists of the internal memory, Arithmetic Logic Unit (ALU) and the control unit. It accepts data from an input device, performs instructions specified by the program and results are sent to an output device. The control unit interprets and executes instructions received from the computer system. The processor is the combination of the ALU and the Control unit.

iii. **Output Device** receives the results of processing from the processor.

iv. **Storage Device** is an external (bulk) auxiliary device providing for the storage
2.4 COMPUTER INPUT UNIT

Data to be stored or processed in a computer system is first converted to a form (machine readable form) which can be read by an input unit. The data in machine readable form is read by an input unit, transformed to appropriate internal code and stored in the memory (see fig 2.2).

Fig 2.2 Data Entry System

2.4.1 Direct and Indirect Input Devices

Data input is categorized into direct and indirect.

The term “direct” means that data is in a form suitable for processing without the need for data conversion. Examples of data input devices that produce direct data input include optical mark reader (OMR), Magnetic Ink Character Reader (MICR), Optical Character Reader (OCR).

Examples of systems that need data conversion include punched card, barcode, tag and paper tape. In these systems, the data they contain is usually converted to magnetic media prior to being input for processing.

2.4.2 Categories of Input media

The input media can be categorized as follows:

- Tags / barcode systems
- Punched cards/paper tape systems
- Magnetic media
- Optical Media
- Voice-input devices
- Imaging devices

The magnetic, optical, voice and imaging devices are direct data entry devices. The direct data entry system has the advantage of source data automation where data is captured electronically at the point where it is penetrated. For example, when a sale is made, source data entry implies that the transaction is recorded immediately in machine-readable form. This means that

i. data is made available quickly for use,

ii. fewer errors are made in data input since there is no manual data transcription

iii. Data integrity and accuracy are enhanced through the use of validation programs in the system

iv. Data can be made available on a real-time basis or on a fast batch turnaround basis.

**Magnetic Media** are systems where data is converted to the machine readable form (electronic pulses) using magnetic properties, these systems include:

i. **Keyboard**

   The primary input device to the microcomputers is the keyboard, which is a device that contains typewriter-like keys that, when depressed, provide input to the computer system. The keyboard contains

   - Alphabetic keys
   - Numeric keys
   - Punctuation keys
   - Arithmetic operation keys
   - 12 function keys (labeled F1 – F12)
   - Control keys and
   - Some special symbol keys.
The keyboard is used in conjunction with a screen as an input device.

ii. **Mouse:**

This usually contains a rolling metal ball and one or more buttons that can be pressed to execute commands and is used particularly with computers having windows. As the mouse is moved gently around on a flat, smooth surface, the ball rolls and feeds electrical signals to the computer moving the cursor on the screen (The cursor is a screen element, such as a blinking underline character or a small arrow, that points to a particular position at which the next character may be entered on the screen).

The mouse is not designed to replace the keyboard; it merely enhances the user's cursor moving ability.

iii. **MICR (Magnetic Ink Character Recognition)**

Here magnetic ink made of ferromagnetic substance is used for printing the characters, designed in a special type font. These characters can be interpreted both by human and machine. An input device known as a magnetic ink character reader (MICR)/sorter accomplishes magnetic ink character recognition. The technique of MICR is mainly used in banks and other financial institutions for the processing cheques.

iv. **Key-to-disk system**

This includes a number of key stations, which enable many operators at one time to read data from source document and encode the data onto magnetic disks. This system verifies data and validates data fields. All these are done under the control of READ ONLY MEMORY (ROM). Data is then transmitted to the mainframe some distance away.

The essential elements of key-to-disk system include the key station, mini-processor, disk drive, tape decks and a supervisor’s console for monitoring the status of the system.

v. **Key-to-diskette system**

Here a data station is used for recording data onto floppy diskettes as data is entered, it is stored in a buffer on the data station and displayed on a screen for the
purpose of correcting errors before being recorded on a diskette. It also verifies data if set to verify mode.

Input onto a computer system is accomplished by means of an integrated floppy disk unit built into a processor’s cabinet or by a free standing floppy disk unit.

vi. **Joystick:** This is familiar to those who play any electronic arcade games. When attached to microcomputer, the joystick is used much like a mouse but instead of using a rolling ball, there is a moveable stick that is used to position the cursor on the screen. Buttons mounted on the stick or elsewhere on the unit are pressed to execute commands.

vii **Magnetic stripe card**

This is a rectangular shaped card on which machine – sensitive data are contained on a magnetic stripe, which is a thin strip of magnetic recording tape stuck on the card. The magnetic stripe card reader converts the information into directly computer – sensitive form. It has applications as bank credit or service cards for use in automated teller machines (ATMs) and bank payment systems.

viii. **Smart Cards**

This is similar to a magnetic stripe card but the information on a smart card is held on a plastic card for the customer to use at will. It is a plastic card on which is embedded a microprocessor chip, which utilizes Erasable Programmable Read Only Memory (EPROM). Besides basic accounting data, a smartcard would contain a memory and a processing capability. The smart card is used in a similar way like a magnetic stripe card for money transmission. A smart card has the advantage of being much harder to duplicate, and so is more secure than the magnetic stripe card.

**Optical Devices**

Input devices that use optical phenomenon include

i. **OCR (Optical Character Recognition)**

Here, optical characters are designed in a special type font capable of being interpreted both by human and optical scanning equipment. Special ink is not required in this case as we have in MICR, for the printing of OCR characters. Optical
Characters are often read by a scanner that is attached to another device, such as an electronic cash register. In existence, the most familiar optical code is the barcode, called the universal product code (UPC) found on supermarket goods and on many other retail products. OCR equipment is very widely used in the retail and grocery industries.

The term “point-of-sale” (POS) applies to situations in which an optical scanning equipment is used to record purchases for source data entry in transaction processing systems that interface with the consumer. At the hub of any POS system, is an electronic cash register, which is a microcomputer system or communications terminal, which allows data to be transmitted online to appropriate managers.

ii. OMR (Optical Mark Recognition)

Here, the source document is pre-printed as a turnaround document, with pre-designated column values and a mark in penciled (graphite), ball point pen or typed line or cross is recorded in the appropriate column. The card is then read by a device (scanner), which senses the graphite in each column using an electric current, and translates it into machine code. OMR is applied in the marking of examinations using multiple-choice questions such as University examinations. A turnaround document is a document that is initially produced by the computer to collect data for the computer and then re-input to the computer for processing. OMR and OCR are turnaround documents.

iii. Source Data Automation

An example of source data automation device is the scanner. Scanners are means of inputting documents to a computer system. A document in the form of text or an image is fed into the scanner, which passes a light band along the page, and the pattern is transferred to the computer. Scanners can be used for document image processing (DIP) or in desktop publishing (DTP) to input an image to the desktop published document.

iv. Light Pen

This is an electronic device in the form of a photo-diode on the end of a cable which is used in combination with a VDU (a display device). It is used to display, modify or detect images on the screen in CAD (Computer Aided Design) applications. This is across the surface of the screen to trace the outline of the image to be displayed.
The computer can detect the position of the pen on the screen by counting the number of vertical and horizontal synchronization pulses.

v. **Touch Screen**

Some computer systems have display screens that are touch-sensitive. When a finger is pointed at a command displayed on the screen, the command is executed. Touch screen finds applications in:

* Factory work, where a factory worker wearing gloves, can point to a selection displayed on a screen to initiate some actions.

* Banks and stores, where untrained or unsophisticated customers, reluctant to read instructions, can interact with the system through the labeling on the touch screen.

**IMAGING INPUT DEVICES**

An imaging device is a hardware device that is designed to transform graphical images such as drawings, photographs and maps into machine readable form.

i. Graphic Tablet (or digitizing tablet) is constructed from a sensitive semi-conducting material, which can trace the movement of a stylus forming graphical shapes. The shapes are converted into digital signals, which are input directly into the computer system’s memory and sent to the display device.

ii. A cross hair cursor is an imaging device that is used when it is necessary to input such graphical intensive objects as maps, surveys, and designs of floor plans or electrical circuits. It operates similarly to the stylus of the digitizing tablet: An image is digitized and stored as the cross hair on the cursor mechanism passes over it. A keypad on the cursor allows other information such as names to be entered.

iii. Image scanner is another imaging device. It is particularly useful for digitizing images such as photographs and documents upon which important signatures are recorded into the computer memory.

iv. Digitizing camera/copier can take pictures and immediately store them into a digital memory and be displayed on the screen.
VOICE INPUT DEVICE

This consists of an equipment that is designed to recognize the human voice and converts the human voice into input which the computer can understand. The recognition of speech is achieved using allophones, the basic speech sound, by storing a digitized pattern in the form of reference matrix: This is a pattern of signal unique for each vocabulary word.

2.5 COMPUTER OUTPUT DEVICES

The primary output devices are Monitor, Printer, MODEM, and loudspeaker.

Computer output is categorized as softcopy or hardcopy

A softcopy is a transient message, which will disappear when power is off. It cannot be touched or kept for a long time. It can only be seen or heard. Examples of a softcopy are

* the display on the monitor;
* the information transmitted by a MODEM;
* the sound given by a computer loudspeaker during computer operation.

Computer programs are designed so that the loudspeaker will beep when a mistake is made in entering data or command or when a wrong keypad is depressed.

A hardcopy is a permanent message on paper or other writing material. It can be touched and stored for a very long time. Examples include the output from a printer or a graph plotter.

Advantages and Disadvantages of display equipment

Display equipment such as a monitor produces softcopy.

Advantages: The display equipment has the following advantages over the other output equipment e.g. Printers and plotters that produce hardcopy. It

i. allows easy access to vast amount of data;
ii. does not encourage paper wastage.
Disadvantages

i. Output cannot be removed from the screen;

ii. the amount of output that can be handled at any one time is limited by the size of the screen and by the rate at which one can flip through screen-sized pages;

iii. One cannot output with a pencil or pen;

iv. One must be physically present at the display device site to see the output it provides.

2.5.1 Monitor

A monitor is a display device, which works in conjunction with a keyboard. As noted earlier, a monitor alone is an output device while the monitor and the keyboard together serve as an input device for microcomputers. The monitor is also called

* VDU (Visual Display Unit) or (Video Display Unit); or

* Screen.

The message displayed on the screen is a softcopy. The screen allows users to see what they have typed in and how the system is responding. In a microcomputer, the VDU is connected to a keyboard.

The VDU has the following primary features:

- Screen Resolution;
- Colour Presentation; and
- Screen shape;
- VPU (Visual Presentation Unit) is another name for VDU.

Screen Resolution

This refers to the clarity of the images formed on the screen. The display device forms images from tiny dots – called pixels (i.e. picture elements) that are arranged in a rectangular pattern. The more pixels available to display any image on the screen, the sharper the image is. More pixels imply higher resolution.

Colour Presentation
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

VDU can be either monochrome or colour. Monochrome display devices output in a single foreground colour (e.g black on a white background). The colour screens include

- VGA – Video Graphic Array
- CGA – Colour Graphic Adapter
- EGA – Enhanced colour Graphic Adapter
- MCGA – Multi Colour Graphic Adapter
- SVGA – Super Video Graphic Adapter.

Colour screens allow for better presentation of material because important items can be highlighted. Many display devices can produce both text and graphic outputs. Text output includes alphabetic characters, digits and special characters, while graphic output includes images such as drawings. Output and images maps. Graphics are used for presentation purposes by managers for information – intensive images such as bar chart, pie chart and line charts.

**Monitor shapes**

Monitors are either the CRT (cathode ray tube) type or flat-panel type.

The CRT type uses a large tube-type element that looks like the TV set. CRT types are bulky and limited in the resolution which they provide but they are rather inexpensive.

Flat –panel display monitor uses either a liquid crystal display (LCD) technology or a gas-plasma technology.

LCD devices use crystalline materials sandwiched between two panes of glass. When voltage is applied, the crystals line up, preventing light from passing through certain areas, and thus producing the display.

In the gas – plasma displays, gas is trapped between glasses to form images. Gas-plasma displays provide better resolutions than LCD. The major advantages of flat – panel display are as follows:

- they are lightweight;
- they are compact;
- they provide better resolution than CRT.
2.5.2 **Graph Plotter**

A plotter is a peripheral device that is primarily used for the output of complicated fine graphical information. It produces hardcopy which can be multicolour. It is used for engineering and scientific applications as well as business presentation graphics.

Modern plotters can produce three dimensional and multicolour drawings.

2.5.3 **COM (Computer Output on Microfilm/Microfiche)**

COM is used to store massive data in a compact form. It is often used for archival purposes. The output from the computer, which is alphanumeric or graphics instead of being printed out, is displayed on a high resolution cathode ray tube and then photographed into a very much reduced form – that is a microform. The microform can be in the form of a microfilm or a microfiche.

A microfilm is a continuous strip, with images formed in frames one at a time, along the strip of the film.

On the other hand, a microfiche consists of separate sheet of film, each sheet containing many frames or “pages” of information. A special microfilm reader is used to read the output. It is easier to read a microfiche with a microfiche reader than a microfilm.

Some microfilm readers also produce a hardcopy using xerographic process.

2.5.4 **Printers**

These are computer output devices that produce hardcopy. One way of classifying printers is whether or not they make noise during printing.

**Impact and Non-impact Printers**

Impact printers work by having wires or embossed characters strike a piece of paper or a ribbon, so that a character is formed on a page.

On the other hand, non-impact printers use some quieter method, such as heating, spraying or electrically forming characters onto a page.
Another way to classify printers is the output quality and the speed of the device, as

- **Character printers**;
- **Line printers**; and
- **Page printers**.

**Character Printers** (also called serial printers) print a character at a time and are bi-directional. Examples include Dot-matrix and daisy wheel which are impact printers. The letter quality of the Dot-matrix is enhanced when in “Near letter quality (NLQ)” mode but the speed is now reduced. Unlike the dot matrix, daisy wheel cannot print graphical images, although the output quality is exceptionally high but it is slow.

**Line Printer** is an impact printer, which prints a complete line at a time. Examples include the chain or barrel printers and the band printers. They are used for large volume printing requirements in mainframes and minicomputers, as they are operated at high speeds.

**Page Printers** are non-impact printers which, due to their high speed of operation, appear as if a page is printed at a time. Examples of page printers include printers that work by LASER (Light Amplification for the Simulation of Emitted Radiation) technology. In LASER printers, images are formed by charging several dots on a plate with a laser beam. Toner is then affixed to the plate and, when paper comes into contact with it, an image is formed from the toner that adheres to the charged dots. Here, the quality of a daisy wheel is combined with the flexibility of a dot-matrix. It produces a very high quality output material including graphics, but it is more expensive.

Page printers are also computers. They contain a processor and a memory. The memory is used to store fonts and forms for automatic document preparation.

**Ink-jet Printer** is a non-impact, character printer in which electrically charged ink is sprayed onto a page through small apertures (fine nozzle) in a print head to produce images. It is capable of graphical output in multi-colour by means of a selection of ink wells connected to the printing head.

**Thermal Transfer Printers**
This is a non-impact character printer which uses thermal electro-sensitive paper, which has a thin coating of aluminium over a black-inked or blue-inked surface. It can be used to produce letter-quality texts and graphics in colour. It is expensive.

2.6 Central Processing Unit (CPU)

The CPU is the brain of the computer system. It is divided into two parts, namely

- the processor and
- the primary memory

2.6.1 The computer Processor

The processor consists of the arithmetic – logic unit (ALU) and the control unit

The set of operations that the processor performs is known as the instructions, and this partly determines the processor’s speed.

i. The Arithmetic – Logic unit (ALU) is the part of the processor where arithmetic and logic operations are carried out. The arithmetic operations include

* Addition and subtraction,
* Multiplication and division,
* Exponentiation.

The logic operations include:

- Comparison;
- Branch operation (a branch operation changes the order of program execution); and
- Movement of data.

ii. The control unit (CU) of the processor performs the following operations: it

- receives instruction in a program one at a time, from the main memory
interprets the instructions

• sends out control signals to the peripheral devices (particularly the I/O devices).

The operations of the control unit are coordinated by a clock. The number of pulses (cycles) produced per second is measured in hertz (MHZ) and is an indication of the processing speed. Other measures of the processor speed are Mips and Flops. Mips means million instructions per second, which measures the number of MIG (micro instructions) (each of which is executed during one clock cycle) performed per second. Flops means floating - point operations per second and are used to compare microcomputer speeds.

Central Processor and Specialised Processor

One way to distinguish among computers is whether they possess central or specialized (slave) processor. A central processor does a variety of operations. Such processors are in the microcomputers.

A specialized (or slave) processor is dedicated to perform specialized tasks, such as

* speeding up computation; and

* Providing better graphics.

Slaves are embedded into a peripheral device such as computer key boards, printers and they are under the cover of the computer unit itself.

The development of slaves has led to the development of reduced instruction set computing (RISC) computers, which contain smaller instruction set than the conventional computers, which increase the speed of the processor.

2.6.2 The Primary Memory

This is also called main or internal memory. A memory is made up of a large number of cells, with each cell capable of storing one bit. It contains the following:

• Programs which contain instructions that will be used for processing;

• Data that have been read from an input device or a secondary storage device;
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

- Intermediate results; i.e. data that are currently being processed or are used for processing other data;
- Output information that is ready to be sent to an output device or a secondary storage device.

Data and instructions stored can be addressed and accessed very quickly and hence it is referred to as immediate access storage (IAS). The reasons for holding programs and data in the memory are to speed up processing. The transfer of data, such as program instructions, within memory is slower than the transfer of data between the processor and peripheral devices. It has a small capacity and hence it is complemented by the external storage, which has a larger capacity, but a slower access time.

Data and programs needed for immediate uses are in the main memory while data and program needed for later use are in the backing storage. It must be clear that all data and programs must be resident in the internal memory before processing can take place. The primary memory is produced from silicon chips and is based on metal oxide semiconductor (MOS) technology (also called metal oxide semiconductor field effects transistor technology (MOSFET) and is divided into RAM and ROM.

i. **RAM (Random Access Memory):**

This is the larger part of the primary memory and is used for working storage requirement when running application programs i.e. it holds the data and program in current use. Data can be written on to or read from RAM.

RAM has the ability to access any location in the memory in any order with the same speed.

The term “random access” implies that the computer can go directly to any given address within the memory and read or write data there. The time taken to read a symbol from a cell is called read-time and the time taken to write a symbol is called write-time.

Since RAM is the larger part of the memory, the primary memory is loosely called RAM Relative to other forms of memory. RAM is expensive.

RAM is volatile i.e. it loses its contents when the computer's power is shut off. So the data and instructions in RAM are temporary.
Normally, reading a symbol from a cell should leave it undisturbed. Such a cell (memory) is known as one where readout is non-destructive otherwise it is destructive.

ii. ROM (Read only memory)

A memory is said to be read only if information is permanently written and can only be read. Such a memory cannot be written to. ROM is non-volatile micro programs for I/O operations and the booting programs are kept in ROM.

The following variants of ROM are available:

- **PROM (Programmable ROM)**
  
  This can be programmed by the user unlike ROM which is preprogrammed by the manufacturer. A special device is required for putting the bit pattern into a PROM programmer.

- **EPROM (Erasable Programmable ROM)**
  
  When data are recorded on EPROM, they are just like ROM in behaviour, but the contents of the ROM can be changed by the use of an ultraviolet light to revert all the cells to “I”s. Then new data and programs can be written on the chip. Another important memory is the Cache memory

**Cache Memory**

This is a high –speed memory capable of keeping up with the processing speed of the processor. It acts as a buffer between the processor and the slower primary memory. As the processor is not delayed by memory accesses, the overall speed of processing is increased. The operating system (OS) transfers segments of programs and data from disk backing storage into the Cache buffer.

2.7 External Storage Devices

External storage devices are also called secondary, auxiliary, backing or bulk storage devices. They are used to save (store) programs and data for repeated use. They are non-volatile and have higher capacity than the primary memory. Also they cost far less than the primary memory. A major disadvantage is that they are slower than the primary memory.
Secondary storage involves both the medium and a peripheral storage device or unit. The medium is used to store programs and data, whereas the medium is mounted on the device (or unit) which has the read/write mechanism.

Magnetic and optical technologies are used for the external storage media.

2.7.1 Magnetic storage media

These are in the form of disks and tapes.

i. Magnetic disks

These are smooth metal plates coated on both sides with a thin film of magnetic material. A set of such magnetic plates are fixed to a spindle: one below the other to make up a disk pack. Data is held on a number of circular, concentric tracks on the surfaces of the disk, and is read or written by rotating the disk past red/white heads. A set of corresponding tracks in all surfaces of a disk pack is called a cylinder. The tracks are divided into sectors, and the data on a disk is located by its sector.

Read/write head does not come in contact with the disk surface but floats above it on a cushion of air, preventing wear. During rotation, it is possible for a dust particle to accidentally settle between the surface and the head thus causing a crash. Such a crash will damage the disk surface and the head.

An exchangeable disk medium is commonly called a hard disk.

ii. Winchester Disk

In a Winchester disk, the head assembly in these disks is sealed—in with the disk pack in order to alleviate the problem of crashing caused by dust particles.

Winchester disks are non-exchangeable as they are in sealed units.

Generally, magnetic disks are direct or random access media i.e. records are retrieved in any sequence, independent of the specific addresses of the record.

iii. Magnetic Floppy disk (or Diskette)

A diskette is an exchangeable circular, flexible disk which is made of magnetic oxide—coated Mylar platters. Today, a diskette is available in $3^{1/2}$ inch and $5^{1/4}$ inch diameters, which is held permanently in a rigid plastic case or a square paper sleeve.
The case or sleeve contains identification label for recognizing the disk and its contents. The 3\(\frac{1}{2}\) inch floppy disk is encased in a hard sleeve for protection and does not feel floppy to handle compared to the 5\(\frac{1}{4}\) inch floppy disk. The sleeve or case has openings for moveable combined read/write head. The medium is inserted into the disk unit/drive on the CPU casing during Read/Write operations.

The 5\(\frac{1}{4}\) -inch disk is packaged in a square plastic envelops with a long slit for read/write head access, a hole in the centre for mounting the disk drive hub, and a hole for index mark sensing.

Today, the optical media have completely replaced the magnetic floppy disks.

iv. **Cartridge Disk**

This consists of a hard disk packaged into a plastic cartridge. In order to access the data and programs on the cartridge, it must be inserted into the appropriate unit/device.

Cartridges generally have more capacities than Winchester disks. The cartridges are also more secured because they are removable.

v. **Magnetic Tapes**

A magnetic tape memory is similar to the commonly used audio tape. It is no longer in use since it has been superceded by the disc storage technology which has a higher speed due to direct access nature. Although the speed of the tape is low, it is still useful for archival purposes because of its low cost.

Tapes use serial/sequential access mechanism. The most common is the nine-track tape which is the standard data interchange between PCs and main frames. Out of the nine tracks, eight tracks are used to record a byte of data and the ninth track is used to record a parity bit for each byte. Here, data are recorded in blocks and the distance between two blocks is called inter-block gap (IBG). The block should be at least 10 times as long as the IBG to reduce wastage of tape.

<table>
<thead>
<tr>
<th>BOT File</th>
<th>File</th>
<th>Block of</th>
<th>Block of</th>
<th>EOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marker</td>
<td>Mark</td>
<td>IBG</td>
<td>IBG</td>
<td>Marker</td>
</tr>
<tr>
<td>records</td>
<td></td>
<td>record 56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig 2.3 File Organisation on a magnetic tape

The beginning of the tape (BOT) is indicated by a metal foil called a marker. When a write–command is given, a block of data is written on the tape and it waits for the next block. The next block is written after the IBG. A series of blocks are written in this manner. The end of tape (EOT) is indicated by an end of tape marker which is a metal tail stuck in the tape. The tape is read sequentially, i.e. the data is read one after the other in the order in which the data has been written hence the data recorded on a tape cannot be addressed.

vi. **Digital Cassette Tape**

This is also used as a storage medium for microcomputers. It is cheap but has a slow speed and data is retrieved sequentially. It is popular because it is easily available.

vii. **Streaming Tape**

This is used to backup the contents of hard disk and has much higher capacity. It has a high speed and it is inexpensive

viii. **Video Tape Recorder**

This is a high density backup tape used for the video and audio.

### 2.7.2 Optical Storage Media

The optical storage media are divided into the flash EPROM and the optical disks.

a. Optical disks are similar to the compact disk audio system used in the homes; the most common are the COMPACT DISK – READ ONLY MEMORY (CD-ROM), WRITE ONCE READ MANY (WORM) video disk and the magneto-optical disk.

i. **CD-ROM Disks**

CD-ROM (compact disk read only memory) allows for the reading of the content of the disk but data on the disk cannot be changed. The data on the disk are prerecorded and are read by using optical disk unit.

Today, CDs are available which can be written using CD-writer and the data are “burnt
in” i.e. the contents of the CD cannot be changed.

CD-ROM has a higher capacity than the magnetic disk and it is more secure than the floppy disk.

ii. **WORM (Write Once Read Many)**

WORM media allow data to be written onto them but once written, the data cannot be changed. The data can only be read several times.

WORM media are written in sequences i.e. access is sequential. They have a very vast capacity and it is not possible to erase data on a WORM medium. It is very ideal for archiving very large amount of data.

iii. **Video Disk**

This is an optical disk that stores audio, video and text data. It can be accessed a frame at a time for motionless viewing or can be played like a video tape for moving action and sound. It can be accessed very quickly.

iv. **Magneto – Optical Disks**

These are erasable disks. They have both magnetic and optical properties. They comprise a magnetized recording medium sandwiched between two plastic disks. The contents of the disk can be altered magnetically at high temperature.

b. **Flash EPROM Disks**

Today, these are the most widely used optical storage. Data can be stored and erased in a flash. It is very small in physical size but has a very high storage capacity.

2.8 **SUMMARY AND CONCLUSION**

1. The components of the hardware system are Input, Output, Storage and the CPU.

2. The CPU is composed of the main memory and the processor, which consists of the ALU and the control unit.

3. The three types of hardware (called computer) are the digital, analog and the hybrid, which are distinguished by the manner in which data are represented in
them.

4. The digital computers are classified as supermachine, mainframe, minicomputer and micro computer. They are being distinguished by their size, heat evolved during processing, purchase price, security measures involved around them, the level of usage etc.

5. The input devices are of magnetic or optical technology, the input device can be classified as pointing devices, document reader and speech devices. The most common are the keyboard and mouse.

6. The most common output devices are the monitor which produces softcopy and the printer, which produces hardcopy.

7. The storage devices are divided into internal memory, which comprises ROM and RAM, and the external storage. The internal memory is direct access and is made of the metal-oxide semiconductor, while the external memory is either direct access or sequential access, and are made of the optical and magnetic technology.

**MULTIPLE CHOICE QUESTIONS**

1. One of the following is not a model.
   (A) Mathematical
2. The external environment in an organization consists of..........................

(A) all forces outside the organisation  
(B) all buildings outside the organisation  
(C) all functions outside management activity  
(D) all functions outside technical activity  
(E) Competitors’ actions

3. An approach to problem solving that involves using modeling theory in combination with sampling experiment is called.........................

(A) Mathematical model  
(B) Optimisation model  
(C) Monte Carlo Simulation model  
(D) Linear programming model  
(E) Non-linear programming model

4. Which of the following is correct?

(A) A logical description specifies essential part while physical description specifies implementation.  
(B) A logical description specifies implementation while physical description specifies essential  
(C) Logical representation gives physical implementation  
(D) Physical implementation gives logical description  
(E) Both logical and physical descriptions do not exist separately.

5. One thousand megabytes is equivalent to one

(A) Terabyte  
(B) Kilobyte  
(C) Gigabyte  
(D) Multibyte  
(E) Polybyte

SHORT-ANSWER QUESTIONS (SAQ)

(1) Auxiliary equipment is an equipment which is offline to the....................

(2) During data processing, Turn-around is the time that elapses between job
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

submission and return of..............

(3) Magnetic disk and Magnetic tape are examples of external............devices.

(4) Magnetic tape can be used as both serial and..............access memory.

(5) A videodisk is an optical disk that can store text, pictures and............data.

SOLUTIONS TO MCQ
1. C
2. A
3. C
4. A
5. C

SOLUTION TO SAQ
1. Central Processing Unit
2. Results or Information
3. Memory
4. Sequential
5. Audio or sound

CHAPTER THREE
SOFTWARE

3.0 LEARNING OBJECTIVES
After reading this chapter, you should be able to learn

- the category of software: System software and Application packages.
- The category of system software
- The types and sources of application packages

### 3.1 INTRODUCTION

The software is a suite of programs that allows the hardware to function optimally and which allows the end user to interact with the hardware. The system software is produced by the computer manufacturer while the application packages are acquired from many sources. The application packages, which can be off-the-shelf or bespoke software are intended for specific tasks.

The most important systems software is the operating system (O.S.). There are operating systems for various task/processes such as single user, multiprocessing, multiprogramming and distributed processing.

### 3.2 DEFINITION

Software is a generic term used for all computer programs that run on the hardware system and their accompanying documentation. The documentation i.e the complete set of instructions, enables computer system users to use the computer system to perform some tasks.

The computer programs are divided into systems software and Applications software (often called application packages).

A computer program can be defined as a sequence of instructions to solve a particular problem written in a particular computer language.

### 3.3 SYSTEMS SOFTWARE

This consists of background programs that enable application software (application packages) to run smoothly on a specific set of hardware. In essence, a systems software refers to the suite of programs that facilitates the optimal use of the hardware system and provides suitable environment for the writing, editing, debugging, testing and running of users’ programs.

Thus, systems software forms an interface between application programs and the
hardware system. Usually, every computer system comes with a collection of these programs because they constitute an essential part.

The types of systems software include operating system, language processor, utility routines, Loaders and Editors.

### 3.3.1 Operating System (OS)

The most important systems software is the Operating System. It is a collection of programs that manage the CBIS resources in the wisest manner possible. It provides the user with features that make it easier to code, test, execute, debug and maintain user’s programs while efficiently managing the hardware resources.

The functions of the OS include

1. Resources sharing;
2. Provision of a virtual machine (virtual storage is an interleaving technique performed by some OS in which disc storage is made to operate as a logical extension of RAM);
3. Input and output (I/O) handling;
4. Memory management;
5. Filing system;
6. Protection and error handling;
7. Program control
8. Initial set-up of the computer, when it is switched on. This is achieved by the boot/or bootstrap program, which is normally resident in ROM. It leads the rest of the OS from the secondary storage into RAM.

The main components of an operating systems are

- A supervisor;
- A command language translator;
- An input/output control system (IOCS) and
- A librarian
Examples of OS

a. DOS (Disk operating system) used on stand-alone microcomputers. This includes MS-DOS, PC-DOS which are used on the IBM-PC and compatibles.

DOS has the following limitations:

i. It cannot be used for multi-tasking operations;

ii. It is not suited for networking activities

b. Windows offers a full graphical user interface (GUI) simplifying DOS commands

c. OS/2 used with IBM PS/2 line of microcomputers. It allows multitasking using GUI

d. Unix is a multi-user, multi-tasking OS used on micro and mini with Xenix and Venix as variances of Unix.

e. MVS, VM are used with IBM mainframes

f. Novell’s Netware is a network OS

g. Windows NT improves on windows by offering multi-tasking activities also.

3.3.2 Language Processor

A language processor (or language translator) is a program that converts the user’s code (i.e. source code) into the machine code.

The user’s code is called the SOURCE code while the machine code is called the OBJECT code.

The computer machine can only process data that are in binary form (i.e. as a string of 0 and 1). This form is called the machine code and it is very difficult for many people to write. Users write (code) data in some familiar languages, called the sources code. This source code is then converted to the machine code by a language processor before processing can take place.
There are three most popular language processors; namely Assembler, Compiler and Interpreter.

i. **Assemblers**

These are programs which translate a source program written in low-level (assembly) language into the machine code object program. The translation process is performed by the computer itself. The purpose of the assembler is to simplify and speed up the task of programming and enabling the programmer to write programs in a language much simpler than machine code.

After translating, the linkage editor binds the object codes to form a load program, which the processor executes. Programs can be saved on disk either as source program, object program or load program form.

![Fig 3.2 Assembly conversion process](image)

ii. **Compilers**

These are programs which convert a source program written in a high level language into a machine code object program. A compiler performs the task of assembling the object program, just like the assembly, but it is generally more complex. All the same, both compiling and assembling are performed to reduce the complexity and time involved in writing programs.

iii. **Interpreters**

Interpreters, like compilers, convert high level languages into machine code object programs, but unlike compilers which convert into machine code all at once, before program are run, interpreters convert programs a line at a time, as they are being run. With an interpreter, each statement is converted into machine language just before it is
executed. No object code is ever produced. BASIC Programming language uses an interpreter.

Advantages and Disadvantages of Interpreters over Compilers

Although, interpreters have the glaring weakness of inefficiency, because they need to translate over and over again the same statement, they have the following advantages:

- They are fast and easier to use, since one is not bothered with distinct and time-consuming compilation process;
- They produce superior error messages which are easy to trace.
- They require less RAM space than compilers. So they can be used in environment with limited memory space.
- They are cheaper
- They are suitable for interactive work, where the programmer wishes to test (or amend) the program on –line in segments as the result can be seen immediately
- They are very useful for small programs writing.

However, they have the following disadvantages:

- It takes a longer time for a program to run;
- Since it does not compile, when a run program is to be re-run, it needs to be interpreted again.

However, many small computers now have compilers available on them, which means that it is necessary to translate the program only once, during the compilation run, and the compiled program is then stored on secondary storage until the relevant application is to be run. As each statement does not have to be translated at run time, the program runs faster than an interpreted program

3.3.3 Utility Programs

These are also called Service or General-Purpose Programs as they are used for applications in general regardless of the nature of specific application programs. They perform the following operation
File copy;

File re-organisation;

File maintenance;

Sorting

Dumping routines (This program transfers a working program/data into secondary storage at regular intervals, from where the program can be reloaded using a restart program);

Housekeeping operations: They include programs to clear areas of storage, writing file labels, and updating common data;

Conversion of programs in ASCII code into EBCDIC code;

Disk copying and formatting.

3.3.4 Loader

Before an instruction can be executed, it must have been placed somewhere in the primary memory. It is the loader that places the program segments into the appropriate locations in the memory ready for execution.

Thus, the output from the linkage – editor during program compilation process is usually the input to the loader.

3.3.3 Editors

The primary function of an editor is to convert input into a particular format output, based on the editing commands which accompany the input. Most editors work on the source program allowing the user to format, delete, insert or modify all or part of a file. We consider two types of editors: The text editors and the linkage-editors.

i. Text Editor

A text editor is a utility program closely associated with application packages. It solves the problem of cutting and pasting programs together, changing data files by editing data fields, or changing the format of data. Text editors are not word processors which are specifically designed to prepare document materials e.g. letters and reports.

Text editor lacks the extensive text-formatting and document printing capabilities.
ii. **Linkage - editor**

This is a more important editor. It is a piece of system software. It works on object programs (during program compilation) resolving undefined references, linking together several object programs which should work together and reassuring all relocatable addresses.

### 3.4 ASSOCIATED PHENOMENA

We now examine some phenomena associated with systems software.

#### 3.4.1 Multi-user Application

Multi-user (or time-sharing) application allows a number of users consisting of various people in different departments to process their own particular requirements in an online basis. It allocates to terminal users several small, fixed slices of time as their jobs are being processed.

This way, the computer is able to work so quickly that each user feels as though he has exclusive use of the computer system.

Multi-user application requires:

i. terminal controllers for controlling the operations of groups of terminals;

ii. if the terminals are located remotely, it requires

   - MODEMS (Modulator – demodulator);
   - Multiplexors and
   - Front-end processor

iii. Private leased communication lines

iv. A powerful processor to support the multi-user environment as it must be capable of polling the lines to allocate time slots (time slices) to each terminal.

v. large memory capacity for storing the various user program as well as the high overhead required for storing the OS (overhead is the area of the primary memory which is inaccessible to the user)

vi. Protection features for preventing system crash as a result of several users processing the same file simultaneously.
vii. Record/file locking and unlocking facilities to prevent a record file being updated by another users.

The individual terminals in a multi-user system cannot communicate with one another, this being unnecessary since they share common files.

A major disadvantage is that if the connecting cable of a terminal is severed, it becomes inoperative as it has no link with the central computer (i.e. server). Here, networking (distributive) is an advantage, because the microcomputer disconnected from the network can still continue to process.

3.4.2 Multi-tasking Environment

This refers to the ability of the microcomputer OS to execute a user’s tasks concurrently. For example, printing a word processed document and typing simultaneously.

3.4.3 Multi-Programming Environment

This is a process whereby the mainframe computer works on several programs concurrently. Since a single computer can do only a single operation at one time, it will work on one program for a while and then switch over to another program. Thus, with multi-programming, the OS keeps the CPU busy.

Time-sharing (i.e multi-user) differs from Multi programming in that, with time-sharing, a predetermined time slice is given to each user while in multiprogramming, the time slice is determined by I/O interrupts that are logically encountered in each program.

3.4.4 Multi processing Environment

Multiprocessing (or parallel processing) involves the use of several CPUs (i.e. processors), linked together to perform coordinated work at the same time.

Note that in multi programming, only one processor is involved.

3.4.5 Spooling

Because of the low speed of I/O devices, jobs are batched to the input devices which store the contents on a magnetic disk which are later fed into the CPU, because the
speed of the magnetic disk is close to that of the processor. The results (information) are also transformed to magnetic disk which later transfers them to a printer. These methods of batching inputs and placing them on a magnetic medium and queuing the output on the same magnetic medium is known as spooling.

3.4.6 Virtual Memory Capability

In a virtual memory system, the operating system continually moves data back and forth between primary and secondary memories so that the system appears to have a virtually unlimited amount of primary memory.

3.5 APPLICATION SOFTWARE

Application software is written to perform specific functions and to support users. Application software is divided into user application programs and application packages (which is used by specialist and for generalised purposes).

We now treat user application programs. This focuses on expanding the role of the computer beyond traditional tasks. Examples include Decision Support Systems (DSS), Expert Systems (ES) and Artificial Intelligence (AI).

Application softwares are also called application packages. These are pre-written computer programs which are widely used for specific applications in order to avoid unnecessary duplication of similar programs by many users. They consist of programs which carry out specific tasks for the user as opposed to the systems software programs which control the working of a computer.

A package consists of a suite of programs and documentation in the form of a program/system manual, which are details of how to setup the program and run it on a computer, and the relevant medium on which the program is stored, which is usually a magnetic disk or a CD-ROM. The documentation should also include specifications of input and output formats and file layouts, user instruction manual, the minimum RAM capacity and details of how the package may be varied to suit the user’s individual needs. Some packages are made to be compatible with a specific make of computer or to run on a model with certain minimal memory capacity or on a specific operating system like windows.

Some application packages are written in-house by the programmers in an organization to meet a specific process i.e. they are tailored to a specific need. These are called
Some other application packages could be bought off-the-shelf and are for general use. These could still be tailored to specific use either by the vendor; or the end-user.

3.5.1 **Examples**

Some application packages on microcomputer are

i. **Electronic spreadsheet:** e.g. Excel, Multiplan, PC-focals, professional plan, Quattro, supercals, Lotus 1-2-3, SUN. These packages turn a computer system into a sophisticated electronic calculator in which data are presented in rows and columns and the user will determine how the data or information should be presented on the grid and how the data should be manipulated by the program.

The program has presentation graphic generators, which take data and other graph for management presentation at meetings. These packages are mainly used for accounting purposes.

ii. **Word Processors** e.g. WordStar, WordPerfect for Windows, Display Write, MS-Word, MultiMate, Professional Write.

These packages turn the computer system into a powerful typewriting tool. They make available the use of special type fonts for document presentation. It is menu driven which executes commands such as PRINTS, SAVE, SAVE AS, EXIT e.t.c. It also has facilities for formatting document pages such as margin justification, underlying words, deleting, highlighting and pasting of paragraphs.

Some have facilities for desktop publishing, electronic calendaring and electronic mail.

iii. **File Manager and Database Management Systems**

Database Management System application packages include: Dbase, Rbase, Reflexive Oracle database.

A database is a collection of data files which are integrated and organized so as to provide a single comprehensive file system.

The data is governed by rules which define its structure and determines how it can be accessed. The purpose of a database is to provide convenient access to the common
data for a wide variety of users and user needs.

A database management system (DBMS) is the software that builds, manages and provides access to a database. It is a system which allows a systematic approach to the storage and retrieval of data in a computer system.

They are designed to store large amounts of data, as well as to provide rapid access to these data and to prepare reports from them.

A database system is used to

(a) avoid data duplication (or redundancy) by allowing a single data to be used in a number of applications;
(b) make data independent of the programs which use it;
(c) ensure consistency in an organization’s use of data

A file manager is a proprietor, applications generator that allows users or programmers to organize data into files and process those files one at a time. It is used for information retrieval and report preparation. File managers on microcomputers allow end users to create files with easy-to-use, menu-driven routines that accompany the package. Although file manager can be used to create and store as many files as is necessary, it constrains users and programmes from transparently interrelating data appearing in different files since it processes only a single file at a time.

iv. **Graphics Generators**

These are used to construct quickly such graphs as line chart, bar chart, pie chart, histograms and scatter diagrams.

Most graphic generators are bundled as adjunct routines with packages like spreadsheets and reporting packages.

v. **Desktop Publishing (DTP)**

Examples of DTP software packages include Corel Draw, Adobe PageMaker, and PowerPoint.

DTP involves the use of microcomputer systems that are equipped with special
hardware and software features to produce documents that look as though they were done by a professional print shop.

In using DTP, users can combine word processing text with artwork, photographs and a variety of magazine–style fonts.

vi. **Statistics Packages**

These are used for the analysis of statistical data to aid management decisions. One important statistical package is SPSS (Statistical Package for Social Sciences)

vii. **Mathematics Packages**

These packages are used in mathematical modeling such as creation of

- Systems of equations
- Differential Equations
- Symmetries

and in giving numerical solutions of such models. Examples of such packages include Mathematica and Matlab.

3.5.2 **Integrated Software**

This is a suite of programs that perform a variety of different processing operations, using data which is compatible with whatever operation that is being carried out. Integrated software aimed at microcomputer systems, allows the user operations, such as transferring data from spreadsheet into a word processing document. Examples of such packages include Framework, Enable, and Symphony. Jazz and MS-Works.

3.5.3 **Off-the-Shelf Packages**

These are application packages which may be acquired separately or as part of an integrated system and are tailored to specific user’s requirements.

Many application packages used by small organizations on microcomputers are off-the-shelf packages. Examples of such application areas are:

- Insurance;
Marine; and

Banking.

3.5.4 Advantages and Disadvantages of Off-the-Shelf Application Packages

We consider the merits and demerits of acquiring off-the-shelf application packages over the In-house application developed from scratch (bespoke software)

a. Advantages

(i) It is written by software specialists and so it has a very high quality.

(ii) It is continually updated by the software manufacturers, so the purchased version is up-to-date.

(iii) It is long in the market, so it will be error-free and well-suited to the general public.

(iv) It will be well documented with ease to follow user’s manual;

(v) It is cheap compared to the “in-house” packages which will take long time to develop and are costly;

(vi) It is well tested, so the end-user can start to use it immediately after purchase;

(vii) In some cases, off-the-shelf packages are general purpose packages which could be tailored to the user’s requirements unlike in-house packages which are tailor-made customized packages.

b. Disadvantages

(i) It produces standardized solution which may not be well suited to individual user;

(ii) The end-user will be dependent on the manufacturer or vendor in case of any serious trouble-shooting or maintenance;

(iii) It may not have some special features required by the end-user.
3.5.5 **Sources of Application Packages**

Application packages can be acquired (rented or purchased) from the following sources:

(i) Mail order sources as advertised in computer magazines and dailies;

(ii) Over the counter from retail shops or stores;

(iii) Dealers (Vendors) in microcomputers;

(iv) Manufacturers of microcomputers who also develop software;

(v) Specialist organizations, known as “software -houses”, which develop software;

(vi) Private organizations and Institutions who have developed software for their own use which they make available to other users for a fee;

(vii) Computer Bureaux and Information Centres with expanded activities;

(viii) In–house programmer, who are specialist staff of an organization who develop software as part of their official routine.

3.5.6 **Checklist for Selecting Application Packages**

In order to acquire an application package, we need to consider the following factors:

(i) A feasibility report indicating the choice between off-the-shelf-and in-house packages;

(ii) Purchase price of the off-the-shelf package;

(iii) Type of hardware and operating system designed for the environment e.g. single-user or multi-user

(iv) Is the package integrable with other standard packages i.e. will the new package accept download data from the packages?

(v) Will the RAM capacity of the hardware on which it will be installed be adequate?
(vi) After sales maintenance agreement;

(vii) History of usage elsewhere, i.e. the performance of the package and the vendor with previous users;

(viii) The technology version of the package i.e. whether the package is the most recent model.

3.6 **Computer Bureaux**

A computer service bureau is a company that operates computer services to process data for other companies particularly those which cannot justify acquiring a computer system.

3.6.1 **Types of Computer Bureaux**

We consider two types of computer bureaux:

(i) Independent companies specially formed to provide computing services to clients

(ii) Computer users with spare capacities, who allow other forms to use their computer systems either for standby facilities or for program testing to installation of a similar computer system.

3.6.2 **Services Provided**

The services provided by a computer bureau include:

(i) **Data Preparation:** This service consists of the conversion of source data into a machine code object data for computer processing.

(ii) **Program Preparation and Testing**

This service consists of testing prepared programs for debugging purposes and other characteristics

(iii) **Hiring of Computer Time:**

Clients to the bureau use their computer operators to process their data using their own programs. They only use the computer time and resources of the bureau except the programm
(iv) **Hiring of Computer Systems:**

This allows clients to take the computer system away for a short duration usage. In this case, the system is operated by the client or by his staff in a private safe location.

(v) **Do-it-yourself service**

The provision of computing facilities to allow the clients’ computer operators to process data with their own programs.

(vi) **Time-Sharing Facility**

This implies access to the bureau’s computer system by means of communication links which in effect provide each user with computing facilities as if he had an in-house computer system.

(vii) **Sales of Computer System Resources**

Some well-established bureau offer some resource for sales. These resources include printer, mouse, keyboard, monitor, cables etc.

(viii) **Repairs and Maintenance**

Well-established bureau with skilled technicians offer the repairs and maintenance of the clients’ hardware and software components.

(ix) **Acts As Information Centre**

Some bureaux offer information on general computer resources, source of data, use of data etc.

(x) **System Installation**

Bureaux offer facilities for clients’ systems installation.

(xi) **Training of Staff**

Bureaux provide training facility for clients’ operators. This is particularly useful in the case of installation of new operating system or database software.

(xii) **Feasibility Study Consultants**
During feasibility study for systems development, bureaux staff may act as consultants on the feasibility study team.

3.6.3 Reasons for using A Bureau

(i) To obtain valuable initial experience of processing by computer system before deciding whether or not to install an in-house computer system.

(ii) To provide standby facility, by arrangement, in case of breakdown of the in-house computer;

(iii) To provide facility for coping with peak data processing loads owing to insufficient capacity of the in-house computer;

(iv) Non-availability of liquid fund for the installation of an in-house computer;

(v) Space restriction for accommodating a computer installations. This happens in the case of big computer systems like the mainframe and minis;

(vi) To avoid the responsibility of operating an in-house computer, the repairs and installation of software are done by the bureau.

(vii) Insufficient volume of work to justify the installation or possession of a computer system.

3.6.4 Disadvantages of Using A Bureau

(i) Loss of control over the time taken to process data suffered by an organisation, because of the computing requirements of other clients of the bureau;

(ii) Loss of adequate acquired experience for not using in-house computer system, thus giving an advantage to competitors using similar application packages or services;

(iii) Lack of adequate security for data processed at the bureau;

(iv) There is no secrecy of the client’s data processing activity.

3.7 SUMMARY AND CONCLUSION

i. The software is divided into system software and Application packages.
ii. Some examples of System softwares are Operating System (OS), Language translator, utility routine, loader, Editor. Etc.

iii. Operating Systems is the most important system software. There are Operating Systems for standalone computers, minis, and mainframe.

iv. There are also Operating Systems for different environments such as integrated application, multiprocessing, and multiprogramming.

v. The language processor converts the source code into machine readable form.

vi. Application packages are meant for specific process and every process that runs on the computer has an associated application package.

vii. The bureau plays important functions to those people or companies that could not acquire computer system or as a standby facility for those that have computer systems.

viii. Off-the-shelf packages are general application packages while bespoke softwares are tailored application packages.

MULTIPLE CHOICE QUESTIONS

1. Which one of the following is not a programming language?
   
   (A) Machine Language
   (B) Symbolic Language
   (C) Narrative Language
   (D) High-level Language
   (E) 4GL

2. C++ is an example of..........................
   
   (A) Object Oriented Language
(B) Machine Language
(C) Symbolic Language
(D) Low-level Language
(E) High-level Language

3. Computer Operating System is

(A) an application software
(B) a user application package
(C) a system software
(D) an interface
(E) a machine driver software

4. MS Excel is an example of

(A) Word processor
(B) Spreadsheet
(C) Presentation software
(D) Graphical Software
(E) Desktop Publishing Package

5. Multiprocessing capability can be achieved by

(A) Operating system
(B) Application Package
(C) User software
(D) Computer memory
(E) Language processor

SHORT ANSWER QUESTIONS

1. Coaxial Cables, telephone lines and fibre optics are examples of channel.

2. LAN, WAN, MAN and VAN are examples of

3. A 4GL package that enables a user or a programmer to develop a set of programs that comprise an entire application is called

4. Compiler, Interpreter and Assembler are examples of

5. A data field that uniquely identifies a record is called
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

SOLUTIONS

1. C
2. A
3. C
4. B
5. A

SHORT ANSWER QUESTIONS

1. Communication
2. Network
3. Application Generator
4. Language Translator or Processor
5. Primary key.
CHAPTER FOUR
PROGRAMMING

4.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to know the

- Categories of computer languages
- Programming techniques; and
- Properties of good programming

4.1 INTRODUCTION

Microcomputers have increased the computing capability of many non-computer professionals and the use of application packages has become widespread. Some off-the-shelf packages, e.g. database packages, can be made more efficiently and tailored towards specific processing task if the end-user can write some computer codes to supplement the package. We introduce in this chapter the technique of writing packages and some important computer languages.

4.2 COMPUTER LANGUAGES

The computer hardware processes data and program instructions which are in binary form, called the machine code or language. The machine language is not very convenient for programmer because it is time consuming. Over the years, many computer languages had evolved and we now consider them

4.2.1 Machine Language

Each computer has its own machine language, which is interpreted by the computer's internal circuitry.

A machine language code is in the form of binary digits represented by zero (0) and one (1). An instruction code in machine language consists of an operation code which specifies the operation to be performed and an operand address which specifies the address in memory where the operand would be stored.

Writing in machine language requires meticulous attention to details and knowledge of the internal structure of the computer. This takes time and only highly skilled
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Thanks.

Programmers can do this.

Machine language is a first generation language developed around 1945 – 1955.

An example of a code in machine language is 0001101000111011.

**Advantages of Machine Language**

1. It does not need a language processor, since it is already in the form in which it can be used by the hardware.
2. It occupies less space in the memory
3. Processing is very fast with machine language.

**Disadvantages of Machine Language**

- It is machine dependent. The code on one machine will not run on another machine
- It is very difficult to write, since the programmer has to pay attention to machine architecture during coding
- It is only written by highly skilled programmers

**4.2.2 Symbolic Assembly Language**

Assembly language is a second generation language developed around 1955 – 1965. It is a low-level language and the codes are written in mnemonics (symbolic form such as ADD, SUB, MULT).

Assembly language must be translated into the machine code. The language processor used is called Assembler. When the assembly language source program has been translated by the assembler into the object machine code program, the translated code is saved on magnetic disk and can be used for data processing.

The symbolic program has to be assembled only once. The language is machine dependent, since the assembled code on one machine cannot be run on another machine.

Note that Assembly is the term used to describe the translation process from a symbolic
language code to an equivalent machine code. The language translator is the Assembler program.

In this study pack, we use the words Assembly program and Symbolic program interchangeably.

**Advantages of Assembly Language**

- The task of learning and writing the language is easier than in machine language because it is written in mnemonics.
- The machine language resulting from the assembly language is very efficient since it is very close to the machine language.

Note that the machine language is also a low-level language

- Assembly language can be used to write applications programs that take special advantage of computer architecture
- It runs faster than high level languages
- It uses less memory space than high-level languages.

**Disadvantages of Assembly Language**

- It is machine dependent (like the machine language). A program written on one machine cannot be executed on another machine, i.e. it is not portable from one machine to another.
- It can only be written by a highly skilled programmer who knows much about the logical structure of the computer.
- The coding is difficult and time consuming compared to high level languages.

**4.2.3 Highlevel Languages**

These are third generation languages developed around 1965 – 1975. Examples are BASIC (Beginner’s All purposes Symbolic Instruction Code), FORTRAN (Formula Translator), COBOL (Common Business - Oriented Language), Pascal, PLI (Programming Language I), APL (A Programming Language), Ada, C.

A high-level language is written in the programmer’s language (hence they are called natural languages) and there is less coding details to worry about. Anybody who knows
a little about logic can write in high-level. It is accessible to a large number of end-users. A high-level language needs a language processor, such as a compiler or interpreter, to translate the source code into machine object code, One high-level statement is translated into many machine statements, This is one-to-many translation. The terminology, high-level language, arises due to this. High-level languages are procedure-oriented languages because they have the power to express a general class of sequence of instructions. They express in detail the procedure used to solve a problem, i.e. the programmer gives details of how to solve a problem.

Some high-level languages are also problem-oriented i.e. they are to solve a narrow class of problems. In this case, the end-user needs not express in detail the procedure used to solve the problem. These are the fourth Generation Languages (4GL) or very High level languages.

A high-level language is machine independent i.e., a program in high-level can be compiled on one machine but executed on another machine.

4.2.4 Features of High-level Languages

i. Facility to describe the nature of the data to be processed i.e. specification of the data types e.g. integer, Real, Alphanumeric

ii. Facility to describe operators on appropriate data items e.g. division operation on integers.

iii. Inclusion of allowable character set e.g. upper case and or lower case alphabets.

iv. Allowable control (or Branching ) structures and the syntax used e.g. Logic IF statement, repetition (looping) statements, etc.

v. Input and Output statements i.e. statements that allow data to be read through the keyboard or from files and statements that allow information to be sent to the screen or magnetic disk.

vi. It must include syntax and semantic structures for all the statements i.e. the precise specification of work and allowable operations.

4.2.5 Advantages and Disadvantages of High-level Languages

The advantages and disadvantages of high-level languages over the low-level languages (i.e. machine and assembly) are discussed as follows:
a. **Advantages**

i. It is easier to write and understand, since it is written in the programmer's spoken language e.g. English;

ii. It is machine independent i.e. it can be compiled and executed on different machines;

iii. It is problem-oriented i.e. it may be written to solve a particular problem easily;

iv. It is a procedure-oriented language i.e. it expresses in detail the procedure used to solve a problem (4GL are not procedure oriented languages);

v. It speeds up program testing and error correction

b. **Disadvantages**

i. It is less efficient in terms of speed since it is necessarily more abstracted and cannot usually take advantage of specific hardware facilities;

ii. It is less efficient in the use of internal memory management

4.2.6 **Very high-level Languages**

These are the fourth generation (4GL) computer languages.

A 4GL is an easy-to-learn, easy-to-use, more or less error-free high-productivity language. It can be created quickly and it involves much less maintenance. Very high-level language consists of a variety of software tools that enable end-users to develop software applications with minimal or no technical assistance.

4GL are computer languages developed after the third generation languages with the following objectives;

i. It is intended to help users to develop their own application programs more quickly, cheaply and easily;

ii. It demands fewer lines of code to achieve a given task compared to a 3GL;

iii. It is a non-procedure – oriented language i.e. it only requires the user to specify the task needed and not how to do it;
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

iv. It is best used for retrieval and reporting of information.

Examples are:

i. RPG (Report Program Generator)

ii. SQL (Structure Query Language)

iii. QBE (Query-B-Example)

iv. Data

v. Easytrieve Plus

vi. Mark IV

vii. Intellect

In general, 4GLs can be divided into seven categories as

i. Query Languages e.g. SQL

ii. Report generator e.g. RPG

iii. Graphics Languages

iv. Application generators

v. Very high-level programming languages

vi. Application software packages and

vii. PC tools e.g. Word processing, Spreadsheet packages.

Two powerful features of 4GL are report and application generators. To produce reports, a programmer must select and format data, specify titles and page numbers, calculate totals and specify the number and width of columns, report generators were developed to make customising reports easier and faster.

Also an Application Generator produces a program to accomplish tasks specified by its users. Application generators include a programming language, a code generator, a library of commonly used program code, tools for creating files, databases and a data dictionary.
4.2.7 Fifth Generation Languages

Important areas in the development of 5GL are expert systems, natural languages, object-oriented languages and parallel processing languages.

Object-oriented Language (OOL) and Object-Oriented Programming (OOP)

An approach to prevent the complete re-writing of new programs line by line is to introduce a form of sub-routine called objects. An object is a predetermined set of program code that, after having been written and tested, will always behave the same way, so that it can be used for other applications. In object-oriented programming (OOP), an object is written for each specific task and saved in a library so that anyone can use it. Rather than writing a new program line by line, a programme selects objects by pointing to a representative icon and then linking these objects together, objects can be modified, used, copied or created.

Advantages of Object-Oriented Programming

1) It uses graphical interface
2) Ease of use
3) Faster program development
4) Enhanced programmer productivity
5) Programmes produced are
   (a) more reliable
   (b) contain fewer errors, since the modules being used have already been extensively tested.

Disadvantages of Object-Oriented Programming

1) It has a steep initial development costs
2) More extensive start-up time
3) Programs produced are:
   (a) larger
   (b) slower
(c) use more memory and other computer resources than programs produced by traditional methods

Examples of OOP are

- Smalltalk
- C++
- Visual Basic and
- Java

4.3 DOCUMENTATION TOOLS

We now develop the technique of writing and the properties of a program

4.3.1 Algorithms

An algorithm is a finite sequence of instructions to solve a given problem. For example, to find the product of ten non-zero numbers, we obey the following instructions;

i. Input the first two numbers,

ii. Find the product and call this product PROD,

iii. Input the third number and find its product with PROD also,

iv. Continue this way, until we reach the tenth number. Multiply this also with PROD

v. PROD. is now the product of all the ten numbers.

Properties of an Algorithm

An algorithm has the following properties:

i. it begins with an instruction to accept data. These data are then processed by the subsequent instructions in the algorithm

ii. The processing rules specified in the algorithm must be precise and unambiguous i.e. the instructions can be carried out. For example, “GO TO HELL” is a precise instruction but it cannot be carried out, because there is no place called HELL
iii. Each instruction must be sufficiently basic (such that it can, in principle, be carried out in finite time by a person using pencil and paper)

iv. The total time to carry out all the steps in the algorithm must be finite,

v. An algorithm must produce one or more outputs.

4.3.2 Programming

A computer program is an algorithm written in a particular computer language i.e. either in machine language, Symbolic Assembly languages, any of the high-level language or very high-level languages.

4.3.3 Computer Operations

The basic operations performed in a computer program are:

i. Arithmetic operations: These are the usual Additive, multiplicative and exponentiation operations.

ii. Input/Output operation: These are statements which allow data to be read by an input device and information to be written out to the screen or stored on appropriate output media.

iii. Logical Operations: These compare two data items. The result is always a Boolean value i.e. TRUE OR FALSE. The operations are:

- Less than
- Less than or equal to
- Greater than
- Greater than or equal to
- Equal to

The Boolean values (i.e. TRUE OR FALSE) are connected by the three basic connectives: OR, AND, NOT.

iv. Data Initialisation: A specific value can be assigned to a data item

v. Control or Branching Operations: Computer program instructions are made to be obeyed sequentially. This sequence can be changed by using a branching
vi. **Start and End Operations:** These are instructions which indicate the beginning and end of a program.

### 4.3.4 Branching Operations

Computer program instructions have three logical structures; namely:

a. **Sequencing:** Computer instructions are obeyed as they are written in a sequence. For example READ a data item from a file; WRITE this data item into another file

b. **Selection Instruction:** This offers the program some choices and the consequent action taken depends on the choice selected.

Examples of these selection instructions are:

- Logical IF
- Arithmetic IF
- IF – THEN –ELSE
- COMPUTED GOTO
- CASE

These are examples of conditional branching.

**GOTO** Statement is also a branching operation but it is unconditional

### c. Repetition or Looping

Sometimes, a program is required to execute certain basic instructions several times. The repetition of a sequence of same program instruction is called a loop. This loop is
a sequence of instructions that are executed repeatedly until a specified condition is satisfied. Example of a looping instruction is

*       DO – UNTIL

4.4 PRINCIPLES OF GOOD PROGRAMMING PRACTICE

The following norms are expected when preparing a program:

i. The problem to be solved should be specified in full and in writing in order to avoid ambiguities.

ii. All working papers used during program development, such as program flowchart and decision table, should be kept, in case there is a need to refer to them for possible error checking.

iii. The program coding should be as short as possible i.e. it should be well logically structured.

iv. After writing a program, it should be “dry run” or “table run” i.e. the programmer should read over the source code to ascertain the logic.

v. After dry running, the program should be run with a test data to establish whether the program will run according to specification and detect possible errors.

vi. Provision should be made for program amendment by using large gaps between instruction number sequences.

vii. Appropriate comments should be inserted in the program to indicate the purpose of some routines.

4.5 Aims of Programming Techniques

(a) Reliability, i.e. the program can be depended upon always to do what it is supposed to do.

(b) Maintainability, i.e. the program will be easy to change or modify when the need arises.

(c) Portability, i.e. the program will be transferable to a different computer with a minimum of modification.
(d) Readability, i.e. the program will be easy for a programmer to read and understand (this can aid items (a), (b) and (c) above).

(e) Performance, i.e. the program causes the tasks to be done quickly and efficiently.

(f) Storage saving, i.e. the program is not allowed to be unnecessarily long.

4.6 Software Engineering

Software Engineering is the adoption of systematic methods and engineering principles to the specification, design, implementation and testing of programs, including the management of such activities.

Literally, software engineering is just another name for good programming principles and practices, it is nevertheless a useful term to use when one wishes to indicate that what is meant is professional software development to industrial standards rather than amateur code-writing.

4.7 PROGRAM CONSTRUCTION

The construction of a program means the construction of the algorithm and the selection of an appropriate computer language to use in coding the major tools used in formulating. The sets of logic in the algorithm are

a. Structured Narrative/English

b. Program Flowchart

b. Decision table

d. Decision tree

4.7.1 Structured Narrative / English

This is a design tool, written in any international spoken language, like French, English, German, Chinese and Japanese, which describes the algorithm in a highly detailed program words which are written in the upper case alphabets. When English language is used, it is called structured English. The available English vocabulary used is limited but it tries to follow the layout and logical operation of a computer program. Since it appears to be a fairly literal translation of a program, it closely resembles the finished product.
This technique is best suited for describing specific program activities.

The basic features of structured English are:

i. It is more like spoken English than programming in the third Generation languages;

ii. It is much more limited in vocabulary than normal English, as it has to follow a strict logical order.

Let us illustrate some programming operations in structured English

i. **Initialisation:**

\[
x = 5
\]

is a statement that assigns 5 to the variable \( x \). Until otherwise changed, \( x \) will have this value

ii. **I/O Instructions:** These are often omitted.

iii. **Arithmetic Operations:** The arithmetic operators used are ADD, MULTIPLY, SUBTRACT and DIVIDE

*Example:*

MULTIPLY unit pay by hours worked to get basic pay

ADD basic pay to bonus to get total pay

iv. **Logical Operation:** This is often achieved using the Logical IF. For example, IF hour worked \( \leq 50 \) THEN increase pay by 10%

### 4.7.2 Program Flowchart

A program flowchart is a pictorial diagrammatic representation of an algorithm.

The following symbols are used in program flowcharting.

- Oval stands for start or end
**Program Flowchart Conventions**

i. The horizontal flow is from left to right;

ii. The vertical flow is top-down unless when indicating a loop.

iii. Connector symbol is used where a flowchart goes off at the end of a page and continues at another page. Same letter is inserted in the connector where it goes off and where it started again.

**Purpose of Program Flowchart**

i. To clarify the logic of an algorithm,
ii. To analyse the actions result from a set of conditions;

iii. To sort out the procedural steps in the program

iv. As an aid to program construction and coding

v. As a communicating document. It is part of the program documentation.

Example 4.1

ABC Co. LTD has 120 labour forces. The labour normal (regular) pay is computed at an agreed rate per hour to a maximum of 40 hours per week. Extra hours worked per week attract an additional 50% of the normal rate.

Use a program flowchart to compute the pay per week for each labour staff and the total pay bill for the staff.

Solution
Let us now give an example peculiar to mathematics.

**Example 4.2**
Draw a program flowchart to evaluate $\sum_{n=1}^{100} \frac{n}{n+3}$

**Solution**

```
START

Initialisation
n=1    Sum = 0

Evaluate
Value = $\frac{n}{n+3}$

Sum= sum + value

Increment n by1,
n = n + 1

Is
n < 100

No
PRINT SUM

END

Yes

PRINT

SUM

END
```
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

General Principles for Drawing Program flowcharts

i. Make the flowchart clear, neat and easy to follow, so that it has a good visual impact and is an effective means of communication.

ii. It must have a logical start and end

iii. Avoid crossing flow lines

iv. All comparisons must result in a Boolean (i.e. Yes or No)

v. Always follow the flow program

vi. Try to “Dry run” the program

vii. Make the flow chart consistent in the level of detail illustrated.

Advantages and Disadvantages of Program Flowchart

a. Advantages

i. It is an aid to problem definition and program writing. It helps to simplify the logic of a program

ii. It is more complete than a decision table, since it contains both the start and end instructions and it illustrates loops in a program

iii. It can be used to test whether a program will work by dry running.

iv. It is included as part of the program documentation.

b. Disadvantages

i. The flowchart of a complex program might extend to several pages

ii. It is fairly difficult to amend

iii. It tends to produce a bad structured program design. The logic shown in the flowchart is not necessarily the best or most efficient.

4.7.3 Decision Tables

Decision table is a technique used in program development to define the logic of a process (i.e. the processing operations required) in a compact manner.
The basic format consists of four quadrants divided by two lines intersecting at 90°, as shown below:

<table>
<thead>
<tr>
<th>Condition stub</th>
<th>Condition entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action stub</td>
<td>Action entry</td>
</tr>
</tbody>
</table>

i. **Condition Stub**

The condition stub section contains the different values of the data under processing. These values may be mutually exclusive of each other i.e. the answer to one will not affect the answer to the other.

ii. **Condition Entry**

The condition entry section is divided into columns, each column consists of a Boolean value i.e. Truth (Y) or False (N). Here Truth (T) is identified with Yes (Y) and False (F) is identified with No (N). If there are n conditions in the condition stub, there will be $2^n$ columns in the condition entry section. These $2^n$ Boolean values are combined in the following manner:

The first row is made up of $2^{n/2}$ sequence of Y followed by $2^{n/2}$ sequence of N.

The next row is made up of $2^{n/4}$ sequence of Y followed by $2^{n/4}$ sequence of N and this arrangement is repeated until the row is completed. The next row is made of $2^{n/8}$ sequence of Y followed by $2^{n/8}$ sequence of N and this arrangement is repeated until the row is completed. This algorithm is followed until we get to the last row. Each column now represents a unique result or rule of all the conditions. Any inconsistent Boolean value is indicated by a “−” or a blank in the appropriate condition entry box.

For example, suppose we have 4 conditions in the condition stub section. Then the condition entry section will have $2^4 = 16$. The Boolean values in the columns of each row will then be

Y Y Y Y Y Y Y N N N N N
Y Y Y N N N Y Y Y N N N
Y Y N Y Y N Y Y N N Y N
Y N Y N Y N Y N Y N Y N
When the value of $n$ is large, $2^n$ will be very large and the condition entry section may become very untidy. On most occasions, the value of $n$ is reduced by making the conditions in the condition entry mutually exclusive.

iii. **Action Stub**

The Action stub section consists of all the actions to be taken as specified in the processing operation required.

iv. **Action Entry**

The action entry section shows the action(s) that will be performed for each rule. The column(s) is(are) marked with the symbol “X” opposite the action to be taken.

**Example (4.4)** ABC company processes customers requests using the following rules:

i. If an order is between \( N10 \)m and \( N100 \)m, give 5% discount;

ii. Orders above \( N100 \)m attract 10% discount;

iii. Orders below \( N10 \)m attract no discount;

iv. New orders must be above \( N100 \)m and without discount;

You are required to construct a decision table to reflect these procedures.

**Solution**

There are four conditions?

i. Is order below \( N10 \)m?

ii. Is order between \( N10 \)m and \( N100 \)m?

iii. Is order above \( N100 \)m?

iv. Is order new?

There are three actions: Give

i. 0%

ii. 5%

iii. 10%
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

There are $2^4 = 16$ rules

The number of rules can be reduced since condition (i) can be removed because if conditions (ii) and (iii) are N, then (i) is Y. Thus, we now have $2^3 = 8$ rules. Also new order is only relevant to orders over N100m. So, since an order cannot be over N100m and be within N10m–N100m simultaneously, we have the impossible region.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is order N10m–N 100m</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Is order &gt; N 100m</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Is order new</td>
<td>Y</td>
<td>N</td>
<td>-</td>
<td>-</td>
<td>Y</td>
<td>N</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Give 0% discount</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Give 5% discount</td>
<td></td>
<td></td>
<td>combinations</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give 10% discount</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

**Remark**

1. The rules resulting in impossible combinations can be removed.
2. Columns 3 and 4 and 7and 8 are identical. So they can be combined.

We now redraw the decision table.

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is order N10m–N 100m</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Is order &gt; N 100m</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Is order new</td>
<td>-</td>
<td>Y</td>
<td>N</td>
<td>-</td>
</tr>
<tr>
<td>Give 0% discount</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Give 5% discount</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give 10% discount</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

**Advantages of Decision Tables**

The main advantages of using decision tables are as follows:

- It is possible to check that all combinations have been considered.
They show a cause and effect relationship;

- It is easy to trace from actions to conditions (unlike in flow charts).
- They are easy to understand and copy as they use a standardised format.
- Alternatives can be grouped to facilitate analysis

Disadvantages of Decision Table

- When a small number of logical alternatives exist, the decision tree is more convenient than the decision table.

- It does not provide a graphic representation of the various choices or decisions which are available, the events which might occur and their consequences.

4.7.4 Decision Trees

A decision table is a graphical representation of the various choices or decisions which are available in a process, and the events which might occur and their consequences.

A decision tree is a design tool which aids in analyzing the decisions that should be made within the processing and the sequence in which they occur.

Thus, a decision tree describes the path or sequence of events and decisions which will lead a system to some final position or outcome.

Consequently, a decision tree describes an action to be taken if some conditions are observed.

The graphic nature of a decision tree makes it preferable to a decision table, but in a complex process, a decision tree could be too extensive. In drawing a decision tree, each condition results in two branches Y or N (Boolean values). The drawing is top-down.

Let us consider an example under decision table.

Example 4.5 ABC Company processes customer’s requests using the following rules:

i. If an order is between N10m and N100m, give 5% discount;

ii. Orders above N100m attract 10% discount;
iii. Orders below ₦10m attract no discount;

iv. New orders must be above ₦100m and without discount

Solution

Receive order
Is order new?

N
Order > ₦100m

Y
Order > ₦100m

N
Order ₦10m - ₦100m

Y
Give 10%

N
Give 0%

Y
Give 5%

Y
Do not Process

Y
Process 0% discount

4.8 SUMMARY AND CONCLUSION

- There are now five generations of computer languages: Machine languages, symbolic assembly language, high-level languages, very high-level language and the fifth generation languages which are used in artificial intelligence (AI).

- Machine and assembly languages are classified as low level languages, and they execute faster but use lengthy and difficult coding.

- High-level languages, such as BASIC and FORTRAN, make use of programmers’ spoken language and they are classified as natural languages but they execute slowly.

- Very high-level languages, such as RPG, are non-procedural.

- Fifth generation languages will also make use of natural languages and are used in AI.
The major computer operations are Arithmetic computations, comparisons, and I/O operations.

Program flowchart, decision table, decision tree and structured English are aids to program development.

MULTIPLE CHOICE QUESTIONS

1. Sequencing, selection and Repetition are examples of..................................
   (A) Computer program instructions  
   (B) System flowchart elements  
   (C) Computer program operations  
   (D) Program flowchart elements  
   (E) Process flowchart elements

2. Which of the following is not an aid to computer program construction?
   (A) Structural Narrative Language  
   (B) Program flowchart  
   (C) Decision table  
   (D) Decision free  
   (E) Structured system Analysis and Design

3. Which one of the following is odd?
   (A) MICR  
   (B) OCR  
   (C) PRINTER  
   (D) OMR  
   (E) ATM

4. Which one of the following is odd?
   (A) Magnetic disk  
   (B) Magnetic tape  
   (C) WORM  
   (D) CD-ROM  
   (E) RAM
5. Which one of the following is odd?

(A) Printer  
(B) Graph plotter  
(C) COM  
(D) Computer Resolution  
(E) VDU

SHORT-ANSWER QUESTIONS

1. Throughput is the amount of useful................performed during a given a period of time.

2. OMR as an input device is an example of a.................document

3. START and END are......................instructions used in program flowchart.

4. Software is a generic term for all......................that run on the hardware system.

5. In program flowchart, less than operation is.................operation.

SOLUTIONS

MULTIPLE CHOICE QUESTIONS

1. A

2. E

3. C

4. E

5. D

SHORT ANSWER QUESTIONS

1. Work

2. Turnaround

3. I/O (Input/Output)

4. Programs

5. a Logical
CHAPTER 5

INFORMATION PROCESSING

5.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to learn

- The concept of computer file and file organizations
- Different date processing activities
- Types of data processing methods

5.1 Elements of a Computer File

5.1.1 An entity is something about which information is stored. Examples include Employee, Inventory items, customers e.t.c. The characteristics of interest in each entity is called an attribute, which needs to be stored. Examples

1. For Employee, possible attributes are pay rate and PIN
2. For Customer, possible attributes are Name and Address.

Generally, each type of entity possesses the same set of attributes. However, the specific data value for those attributes will differ among entities. Data values are stored in a physical space called a Field.

A Computer file consists of a number of records. Each record is made up of a number of fields and each field consists of a number of characters.

We now define these terms in details.

(a) Character is the smallest element in a file and can be alphabetic, numeric or special symbols. Each character, which is 1 byte is made of 8 bits in the EBDIC code system.

(b) Field is a collection of characters, e.g name, address, pay rate e.t.c.

(c) Record is a collection of related fields, i.e a field is an item of data within a record. Example: A customer record consists of name, address etc
(d) Data base is a combination of files containing related data.

Considering the table below, we have four fields and three records

<table>
<thead>
<tr>
<th>S/N</th>
<th>PIN</th>
<th>EMPLOYEE NAME</th>
<th>PAY RATE</th>
<th>SEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3501</td>
<td>M. O. ADE</td>
<td>5,000</td>
<td>M</td>
</tr>
<tr>
<td>2.</td>
<td>1152</td>
<td>S. A. OJO</td>
<td>7,000</td>
<td>F</td>
</tr>
<tr>
<td>3.</td>
<td>1005</td>
<td>T. J. KOFI</td>
<td>3,000</td>
<td>M</td>
</tr>
</tbody>
</table>

**Figure 5.1 Employee File**

5.1.2 There are two common ways of viewing computer files:

(a) Logical Files are viewed in terms of what data items its records contain and what processing operations may be performed upon the files. The user of the file will normally adopt such a view.

(b) Physical file is viewed in terms of how the data is stored on a storage device such as magnetic disk and how the processing operations are made possible.

Note that a logical file can usually give rise to a number of alternative physical file implementations.

5.2 Types of Files

Three basic types of files are used to store data.

5.2.1 Master file is of a fairly permanent nature and it is regularly updated to show a current position. For example, customer ledger, payroll, inventory e.t.c. are master files. Customer’s order will be processed to change the balance, but the name, address e.t.c. will be static.

5.2.2 Transaction (or movement) file is made up of the various transactions created from the source documents. For example, in a sales ledger application, the file will contain all the orders received at a particular time. This file will be used to update the master file and then discarded. Thus, it has a short life span.

5.2.3 Reference file has a reasonable amount of permanency. Examples of data used for reference purposes are price lists, tables of rates of pay, names and addresses.
5.3 Primary and Secondary Keys

**Primary Key:** is a unique identifier of a record. Examples include:

(i) Customer number is a customer ledger record

(ii) Stock code number in a stock record

(iii) Employee PIN in a payroll record.

Sometimes, the primary key is made from the combination of two fields. In this case it is called a composite key or compound key. A secondary key is another field to identify a record, although it is not unique, it is used to identify a group of records and it can be used to sort records. For example, the state of origin of the customer might be a secondary key.

Note: Not only does the key fields assist in accessing records but also the records themselves can, if required, be sorted into the sequence indicated by the keys.

5.4 Processing Activities

The major processing activities are:

(i) Updating which involves changing the master file to reflect a current position. e.g. updating a customer ledger record with new orders.

(ii) Referencing involves access to a particular record to ascertain its content e.g. access to a prize file during an invoicing run.

(iii) File maintenance involves addition and deletion of records in order to create a new file, thus updating a file with new records,

(iv) File Enquiry or Interrogation: This is similar in concept to referencing. It involves the need to ascertain a piece of information from a master file.

5.5 Characteristics of Files

We discuss four characteristics of files.

5.5.1 Hit Rate:- Is used to measure the rate of processing of master files in terms of active records. For example, if 2,000 transactions are processed each hour against a master file of 20,000 records, then hit rate is 10.
Thus, Hit rate = \[ \frac{\text{Number of records in a file}}{\text{Number of processed records}} \]

5.5.2 Volatility:- Is the frequency with which records are added or deleted from a file. If the frequency is high, the file is said to be volatile. A semi-static file has a low frequency. A static file is not altered at all.

5.5.3 The Size of a file is the amount of data stored in it and expressed in terms of characters or records.

5.5.4 Access Time on disk is the time interval between the moment the command is given to transfer data from disk to main storage and the moment the transfer is completed.

5.6 File Organisation:- We consider file organization on both tapes and disks. File organization refers to the way data are stored on the physical storage media.

5.6.1 File Organisation on Tape

Organisation of a file on tape is simply placing the records one after the other onto the tape. There are two such possible arrangements.

(i) Serial:- This is achieved when records are written onto tape without any relationship between the record keys. Unsorted transaction records would form such a file.

(ii) Sequential:- This occurs when records are written in sequence according to the record keys. Examples include:

(a) Master file

(b) Sorted transactions file

5.6.2 File Organisation on Disk

We consider four basic methods:

(i) Serial:- This is the same method as in tape

(ii) Sequential:- This is the same again as in tape

(iii) Indexed Sequential:- This is same as in sequential organization but with an important difference – an index is provided to enable individual records to be located. Thus, the index will determine the sequence.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

(iv) **Random or Direct Access:** Stores records in no particular order. Instead a mathematical algorithm is applied to the primary key to determine the physical address at which to store the record.

5.7 **Factors Determining the Method of Data Processing**

The common factors determining the methods of data processing are:

(i) Size and type of Business

(ii) Timing Aspect

(iii) Link between Application

**Size and Type of Business**

The size means the volume of transaction in the business. Business with large volume of transaction will require the use of computers, while businesses with low volume of transaction will use manual method or electro-mechanical devices like calculators.

**Timing Aspects**

The frequency of information will determine the methods and the equipment needed for processing. For example, information on payroll might be monthly while information on invoices are virtually all the time.

**Link Between Application**

Sometimes, a simple pool of data might be needed by many applications and this will determine the technique to be used. For example, the data on items sold will be needed by the price list, the stock file, the invoicing production. This can easily be done through the Data Base Management System (DBMS) unlike the manual system.

5.8 **Stages of Data Processing**

Whatever might be the method employed, the following stages will be followed during data processing (DP).

(i) Origination of data i.e the source of data (Source document)
(ii) Preparation for data entry depending on the method, whether batch, On-line or Real-time.

(iii) Input the data

(iv) Processing to get the information using appropriate software.

(v) Output through appropriate medium.

5.9 Processing Techniques

Depending on the determining factors for data processing, transaction may either be processed singly or in batches. A batch is a number of transactions accumulated together and processed at a predetermined time as a single unit.

5.9.1 Batch Processing

Updating master files periodically to reflect all transactions that occurred during a given time period is called Batch Processing. The master file is updated at predetermined times (e.g daily or weekly) or whenever a manageable number of transactions are gathered.

Note that, the transactions data can either be entered as a batch or as each transaction occurs. Data entry as each transaction occurs is called Online Batch Processing.

In Batch processing, the jobs are entered and stored on a disk in a Batch Queue before being run under the control of an operating system (OS).

Note:- The time that elapses between the submission and the return of result is called the Turn-around time.

5.9.2 Remote Job Entry (RJE) Processing

This refers to (batch) processing where jobs are entered at a terminal remote from the computer and transmitted to computer on-line (i.e through telecommunication links) or offline using external storage systems.

5.9.3 On-line Real-Time Processing

In this method, the computer captures data electronically, edits it for accuracy
and completeness and immediately processes it. The processing of data is done so quickly that the results are available to influence the activity currently taking place. Note that all real-times are On-line but not all On-lines are real-time. Since online batch processing is not real-time. Examples of real-time processing include:

(i) International Hotel Reservation

(ii) Airline reservation and

(iii) Space exploration

Note that real-time processing is used for critical systems where time delay is not allowed.

5.10 Configuration of Processing Method

There are three basic ways to configure the Processing Methods i.e to determine the arrangements and locations of the computer systems.

5.10.1 Centralised Processing Method

Here, all processings are done in a single place e.g the headquarters of the organization and results are later distributed to the various departments. In centralized processing method, all terminals and other devices are connected to a central corporate computer (called a server)

Advantages:- It provides

(i) Better control over the processing

(ii) More experienced I.T staff

(iii) Economics of scale that is cheaper to run

Disadvantages

(i) Greater complexity

(ii) Higher communication cost of results to the departments

(iii) Less flexibility in meeting the needs of individual departments.

(iv) No departmental secrecy
5.10.2  **Decentralised Processing Method**

Here each department does its own processing and I.T Staff within the department. There is no connection among the departments; and even with the Headquarters.

**Advantages**

(i) It allows the departments to meet their needs and separate users’ needs.

(ii) Less communication cost associated with distribution of information

(iii) Departmental secrecy is achieved since data is stored locally.

**Disadvantages**

(i) Complexity of coordinating data among the departments.

(ii) Increase in administrative cost

(iii) Increase in machinery/hardware costs

(iv) Greater difficulty in implementing effective control.

5.10.3  **Distributed Data Processing (DDP)**

This processing system is an hybrid of the centralized and decentralized systems approaches. Each location has its own computers to handle local processing and the departments are all linked to each other and the corporate server.

**Advantages**

(i) Since the departments are linked, they back up each other. Thus, there is less risk of catastrophic loss, since resources are in multiple locations.

(ii) Since local processings are treated as module, more modules can easily be added or deleted from the system,

**Disadvantages**

(i) The multiple locations and varying needs complicate the task of coordinating the system and maintaining hardware, software and data consistency.
(ii) Difficulty in standardizing documentation and control, since authority and responsibility are distributed.

(iii) Multiple location and communication channels hinder adequate security controls and separation of duties.

(iv) Data duplication of multiple location creates increase in data storage costs and data inconsistency

**Summary and Conclusion**

1. The smallest unit of data is the byte which is made up of 8 bits. A character can be an alphabet, numeric, or special symbols.

2. A field is a combination of characters while a record is a collection of related fields and a file is a collection of records.

3. We have primary key which is a unique identifier for record.

4. Files are organized as serial, sequential, indexed sequential and random in disks.

5. Batch processing is the updating of master files at a pre-determined time period.

6. On-line processing is a technique where data is entered as it occurs.

7. (On-line) real-time processing processes data as they occur and results are obtained immediately. It is used in critical events.
MULTIPLE CHOICE QUESTIONS

1. A WORM is different from a virus because
   (A) It is an insect, while a virus is a disease
   (B) It is a program while a virus is a disease
   (C) It is a device while a virus is a program
   (D) It is more vicious than a virus
   (E) It can be seen with the naked eye while virus is microscope

2. Which one of the following is odd?
   (A) Cracking
   (B) Hacking
   (C) Eavesdropping
   (D) Computer operation
   (E) Salami Technique

3. Which one of the following is odd?
   (A) Batch Processing
   (B) On-line processing
   (C) Independent processing
   (D) Real time processing
   (E) On-line Batch processing

4. Which one of the following is odd?
   (A) Star topology
   (B) Bus topology
   (C) Ring topology
   (D) Mesh topology
   (E) Centralised topology

5. Which one of the following is odd?
   (A) Updating
   (B) Referencing
   (C) File processing
   (D) File maintenance
   (E) File Enquiry
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

SHORT-ANSWER QUESTIONS (SAQ)

(1) A mean of signing a document with a piece of data that cannot be forged is called..................

(2) A series of characters that uniquely identifies a user and is known only to the user and the system is called..................

(3) Ethics are standard rules relating to a person’s...............conduct.

(4) Electronic mail is a hardware/software system that facilitates sending letters, memos, documents e.t.c from one.............to another.

(5) An information system intended to provide the type of advice that would normally be expected from human experts is called....................

SOLUTIONS

MULTIPLE CHOICE QUESTIONS
1. B
2. D
3. C
4. E
5. C

SHORT ANSWER QUESTIONS
1. Digital signature
2. Password
3. Moral
4. Device/System
5. Expert System (ES)
CHAPTER 6

SYSTEMS DEVELOPMENT

6.0 LEARNING OBJECTIVES

After reading this chapter you should be able to

1. Understand what is meant by the development of a computer-based system.
2. Understand the cycle of stages that the development of a typical system goes through.
3. Understand the importance of user involvement in the development of a system.
4. Appreciate the concept of prototyping and its importance.
5. Understand the application of prototyping as a tool.
6. Understand the concept and application of outsourcing.

6.1 THE SYSTEMS DEVELOPMENT LIFE CYCLE

6.1.1 Introduction

New computer systems frequently replace existing systems and this process of replacement is often organised into a series of stages. The whole process is called the systems life cycle. The system life cycle is the traditional method for developing new systems but there are newer alternative methods which attempt to improve upon the traditional approach and overcome some of its limitations.

Thus, a systems study is broken down into a number of stages that constitute a systems life cycle. After reading this chapter, you should have a good understanding of how to carry out a systems study of an organisation's information systems issues.

Our discussion in this manual will emphasize the role of the computer in information systems. Not all systems studies, however, will go through the entire set of stages we are going to discuss.

It is important to note that a number of models have been developed that can be used to develop systems. As with the models, a number of systems development
Methodologies are also available for use in developing systems. An organisation will normally decide on a particular mode or methodology when it has to study and develop a system.

Our discussion will focus particularly on the traditional method called Systems Development Life Cycle (SDLC) developed by the National Computing Centre (NCC) in the UK in 1960.

6.1.2 Stages of the systems development life cycle

The stages of the development of any system constitute the systems development life cycle (SDLC), which is shown in the diagram below.

![Diagram of SDLC stages](image)

Fig. 6.0 Stages of SDLC
6.1.3 Problem Definition

This stage involves an analysis of the system (or sub-system) in conjunction with users, so that their actual requirements can be identified, rather than their likely requirements.

6.1.4 Feasibility Study

This is a formal detailed study to decide what type of system can be developed which meets the needs of the organization. The goal of a feasibility study is to identify, as quickly as possible, whether the benefits of a proposed project appear to outweigh its expected cost and disruption based on what is already known.

Since early feasibility estimates may be overly optimistic, it is usually a good idea to conduct feasibility study at various times throughout all the phases of the Systems Development Life Cycle (SDLC) to determine whether to continue the project, revise the specification, or abandon it altogether.

6.1.5 Systems Definition (or Systems Specification)

The systems specification is the detailed documentation of the proposed new system. It serves two main purposes:

(a) Communication: It serves as a means of communicating all that is required to be known to all interested parties, such as:
   (i) Management for final approval
   (ii) Programmers to enable them to write the programs necessary for implementation
   (iii) Operating staff, detailing all necessary operating procedures.
   (iv) Users, as they will ultimately be responsible for running the new system. They must therefore be fully aware of the contents of the specification and their agreement is essential.

(b) Record: A permanent record of the system in detail is necessary for control. It will be used for evaluation, modification and training purposes.
6.1.5.1 Terms of reference

This will be set up by a steering committee or management and might comprise the following:

- investigate and report on an existing system, its procedures and cost
- define the system's requirements
- establish whether these requirements are being met by the existing system
- establish whether they could be met by an alternative system
- specify the performance criteria for the system
- recommend the most suitable system to meet the system's objectives
- prepare a detailed cost budget within a specified budget limit
- prepare a draft plan for implementation within a specified time scale
- establish whether the expected benefits could be realized
- establish a detailed design, implementation and operating budget
- compare the detailed budget with the cost of the current system
- date by which the study team must report back to the steering committee
- operational managers who may be approached by the study group.

6.1.5.2 Criteria for Project Selection

There are four (4) key areas in which a project must be feasible if it is to be selected. These areas (criteria) are

a) Technical Feasibility: The system requirements as defined in the feasibility study must be technically achievable. This means that any proposed solution must be capable of being implemented using available hardware, software and other equipment. The requirements may include
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

i) transaction volumes

ii) storage capacity

iii) response times

iv) number of users

b) **Operational Feasibility:** Any option worth considering should not lead to inefficiencies or ineffectiveness in the operation of the organization. In other words, any operational changes resulting from the option must result in enhancing business objectives otherwise it lacks operational feasibility.

c) **Social Feasibility:** An assessment of social feasibility should address issues like

i) personnel problems

ii) job enrichment

ii) threats to industrial relations

iv) expected skills requirements

v) motivation.

d) **Economic Feasibility:** A system which satisfies all the foregoing criteria must still be economically feasible; in other words it must be a good investment. It should be possible to recover the amount invested and realise some profits.

### 6.1.5.3 Cost and benefits

The cost of an Information System (IS) project may be considered under the following:

a) **one-off costs:**

- Cost of hardware, software and other equipment  
- project team costs
- cost of producing documentation
- training cost
- cost of installing the system.
b) Running (Operating) Costs:

- staff salaries
- overheads
- training
- maintenance
- utilities and consumables
- insurance and financing

The benefits will include both quantitative and non-quantitative (or qualitative) components, for instance:

i. better decision-making
ii. fewer delays
iii. better services
iv. competitive advantage

There will also be quantitative or tangible benefits, for example:

i. reduction in waste
ii. increase in revenues

6.1.5.4 Cost - Benefit Analysis

This is complicated by the fact that a number of the benefits are rather qualitative and non-quantifiable.

A number of approaches are available to do this, including:

i). Payback Period Method:- This calculates the length of time a project will take to recoup the initial investment - in other words, how long a project will take to pay for itself. The method is based on cash flows and has obvious disadvantages In particular, it does not consider the present values of future inflows. This shortcoming is resolved by the next method we are going to consider.

ii) Discounted Cash Flow (DCF1):- This method may use two approaches:

a) Net Present Value (NPV), which considers all relevant cash flows associated
with the project over its life and adjusts those occurring in future years to "present value" by discounting at a rate called the "cost of capital".

If the NPV has a positive value, the project is feasible. Where the NPV is negative, the total discounted cash outflows exceed the total discounted cash inflows and so the project is not feasible. A zero value for the NPV reflects a break-even situation and the project should not be embarked upon.

b) Internal Rate of Return (IRR), involves comparing the rate of return expected from the project calculated on the discounted cash flow basis with the rate used as the cost of capital. Projects with IRR values higher than the cost of capital are worth undertaking.

**Cost- Benefit Ratio**

Where cash is a constraint, a decision based on NPV alone may be misleading. In such circumstances, we use the cost benefit ratio, also known as the profitability index or NPV per N initial outlay, given by NPV / Initial outlay.

**6.1.5.5 The feasibility study report**

This formal report is normally written by the project manager and submitted to the project Steering Committee, asking for agreement to proceed. It will include the following as contents:

i) Executive summary - A short (possibly one-page) summary of the contents of the entire report.

ii) Terms of reference - A restatement of the terms of reference to facilitate an understanding of the report.

iii) Current system issues - All the good and bad sides of the current system that came up during the study.

iv) Evaluation of each option - Details of how each option was assessed in terms of its strengths and weaknesses.

v) Description of the options - A thorough account of the various options, showing why each was selected.
vi) Feasibility - Analysis of how each option met the selection criteria in 5.1.4.2.

vii) Conclusion - A clear statement of what the team finally arrived at, in terms of its choice

viii) Recommendation - This is to the appointing authority seeking permission to continue with the project.

### 6.1.6 Systems Investigation

This fact-finding exercise investigates the existing system to assess its problems and requirements and to obtain details of data volumes, response times and other key indications.

The steps involved are

(a) *Fact-finding*, by means of interviews, questionnaires, observation, organisation charts, etc.

(b) *Fact recording*, using flowcharts, decision tables, narrative descriptions, organisation and responsibility charts.

(c) *Evaluation*, assessing the strengths and weaknesses of the existing system.

At this point, we will consider the following main fact-finding methods:

### 6.1.5.1 Questionnaires

A questionnaire is required when collecting information from widely dispersed respondents. It may be used in advance of an interview, to save the time of the analyst and employee.

A questionnaire is used to

(a) ensure consistency of approach.

(b) achieve a logical flow of questions.

(c) avoid omissions.

(d) ensure that data are collected in a form suitable for tabulation and analysis.

A questionnaire should

(a) Not contain too many questions. This might make the intended respondents unwilling to co-operate.
(b) Be organised in a logical sequence. This is likely to attract a free flow of logical and meaningful responses.

(c) Include an occasional question to the answer which corroborates the answers to previous questions. This will enable the analyst to find out which responses are realistic and honest and could be relied upon.

(d) As much as possible, be designed with dichotomous questions. These are questions that attract only one of two answers (e.g. yes/no).

(e) Be tested independently before being issued to the actual respondents. This will reveal if the questions are simple, unambiguous and can be easily answered by the target group.

(f) Take into account the sensitivity of individuals in respect of their job security. As much as possible, the identities of respondents should not be asked for if honest responses are solicited.

6.1.5.2 Interviews

During an interview, the analyst meets face-to-face with the staff or interviewee in order that the analyst might obtain the vital information he needs.

If properly conducted, an interview should enable the analyst to break through any fears and resistance to change that may be felt by the employees, in addition to finding out essential facts about their work.

The analyst must be able to adapt his approach to suit the individual interviewee, rather than follow a standard routine.

The analyst should plan the interviews well and ask the types of questions that will attract the most useful responses.

Above all, the analyst must have ready and convincing answers to any of the questions that the interviewees may have in connection with how the project might affect them in the future.
The analyst may find the following a useful checklist of what to do and what to avoid during the conduct of interviews:

<table>
<thead>
<tr>
<th><strong>DO</strong></th>
<th><strong>DON'T</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan for the interview</td>
<td>Be late (lateness will disturb interviewee’s schedule of work)</td>
</tr>
<tr>
<td>Make appointments and be committed to meet them</td>
<td>Be too formal or too casual (in order to identify with group)</td>
</tr>
<tr>
<td>Identify the right people to answer questions</td>
<td>Interrupt (in order to help in the free flow of information)</td>
</tr>
<tr>
<td>Listen carefully since the exercise is meant to be used to learn about system in use</td>
<td>Use technical jargon (this ensures that all questions are well understood and answered)</td>
</tr>
<tr>
<td>Use the local terminology appropriate to the type of job</td>
<td>Confuse opinions with facts</td>
</tr>
<tr>
<td>Accept ideas and hints from interviewee</td>
<td>Jump to conclusions (since this is a learning process)</td>
</tr>
<tr>
<td>Hear from all people who join efforts to complete a task</td>
<td>Argue (this might offend the interviewee)</td>
</tr>
<tr>
<td>Collect documents/forms. These may be required for use in a future system</td>
<td>Criticise</td>
</tr>
<tr>
<td>Check the facts back to ensure correctness of information</td>
<td>Suggest (any suggestion might distort the real issues)</td>
</tr>
</tbody>
</table>

Part pleasantly, showing appreciation, since there might be the need for a repeat visit.

**Table 6.1 Interview guidelines**

**6.1.5.3 Observation**

Once the analyst has some understanding of the methods and procedures used in the organisation, he should be able to verify his findings and clarify any problem areas by an observation of operations. Observation is a useful way of cross checking with the
facts obtained by interviews or questionnaires.

Very reliable results will be obtained if the maximum co-operation is sought from those being observed, since staff may act differently from normal if they know they are being observed.

Long periods should also not be devoted to any particular staff since the exercise can make the person being observed nervous and may also easily make the observer feel sleepy, since the entire exercise may be very boring. A good approach will consist of shifting from person to person during the exercise in order to remain active and stay awake.

6.1.6 System Analysis

This is the stage where a thorough and detailed description of the current system is carried out in the form of a documentation showing its strengths and weaknesses and why it works the way it does. Identifying the strengths, the analyst will ascertain what role (if any) they may have in future processing activities.

This stage examines why current methods are used; what alternatives might achieve the same, or better, results; what restricts the effectiveness of the system and what performance criteria are required from the system.

6.1.7 System Design

This is a technical stage that considers both computerised and manual procedures, addressing, in particular, inputs, outputs, program design, file design and security. This leads to the detailed specification of the new system. This detailed description on paper is also referred to as the 'logical design' of the system.

It is the process of creating alternative solutions to satisfy the feasibility study goals, evaluating the choices, and then drawing up the specifications for the chosen alternative.

During the system design stage, designers must decide on how to produce an efficient
(economical) and effective (relevant and useful) system.

A number of approaches are adopted at this stage. One that is adopted by all analysts/designers to ensure they obtain a system that meets users' exact requirements is what is referred to as 'design reviews and walkthrough', or 'user validation' - described next.

**Design Reviews and Walkthroughs (or User Validation)**

This is a very crucial approach adopted by designers when they are designing systems. The analyst breaks down the process into a number of sections (called 'milestones'). At each milestone, the resulting output ('deliverable') is presented to users for their approval.

Periodic sessions are held so that interested users can 'walk through' the input and processing operations to describe the handling of data.

Users are encouraged to look for errors and to make comments. It does not serve any purpose for the designer or the users themselves if a, honest review is not done in order to ensure corrections are effected where necessary. There must be a formal sign-off on the section before work on the next can commence - this is what gives the designer the right to proceed.

At the end of this exercise, any changes that become necessary should be due to changes in user requirements which were not anticipated earlier, granted that all those involved in the process did what was expected of them.

**6.1.8 System Implementation**

This stage carries development from design to operations. It involves acquisition (or writing) of software, program testing, file conversion, file set-up, education and training, acquisition and installation of hardware, and changeover.

This stage of turning the theoretical design (logical design) into a working system (the physical design) comprises the following steps (in the form of a flow chart):
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress.
Thanks.

Fig. 6.1 Steps of Implementation
6.1.8.1 System Testing

This is aimed at ensuring that the system works accurately and efficiently before live operations commence. Tests of hardware, software and staff should be arranged in a live operating environment or a simulated one. The objective is to prove that the computer and clerical procedures are understood and produce the required results.

6.1.8.2 Education and Training

Education involves creating the right atmosphere and motivating user staff. It should be established first at the senior level and then it is more likely to be more effective with lower levels of management and other staff.

Education helps overcome the resentment that may be caused by the computer seeming to take away responsibility from individuals. It also helps to allay fears of staff being made redundant which may eventually lead to job loss.

Training should be aimed at equipping staff with the changeover procedures as well as the new system procedures. It should be noted that training at this stage is not what is required for staff to be able to operate the new system.

6.1.8.3 File Conversion

This involves the conversion of the old file data into the form required by the new system. It usually involves the conversion of live files (e.g. stock files and customer files). This poses major organisational and scheduling difficulties, since incoming data (e.g. stock issues/receipts or payments) are continually being used to update the files.

The conversion of large files may be done by first separating and converting the static data part of each record on the files and converting the dynamic contents as late as possible. These parts are then merged to make up complete records and complete new files.

6.1.8.4 File Set-Up

This is the process of creating the new computer files from the converted computer-acceptable data. Usually special programs are required to carry out some 'once-only' conversion processes.

The major problems associated with the process are the accuracy of the conversion and the error detection procedures. It is essential that at the end of file set-up, the users
should be satisfied with the new files. It is vital that the data content of master files at changeover are accurate.

Incorrect data may arise
- as errors in the original source document
- during clerical transcription
- during data entry
- from a conversion program.

6.1.8.5 Changeover

The changeover from the old to the new system may take place when

(a) the system has been proved to the satisfaction of the analyst and the other preceding implementation activities have been completed

(b) users and managers are satisfied with the results of the system test, staff training and reference manuals

(c) the operations manager is satisfied with the performance of equipment, operations staff and the timetable

(d) the target date for changeover is due. The main approaches are:

i) Direct Changeover

| OLD | NEW |

The old system is suddenly replaced with the new. This is a very bold approach that should be attempted during slack periods. Conditions under which this method may be
adopted include
- previous success of new system in a similar situation
- no basis for comparison by virtue of both systems being substantially different
- no-extra staff to oversee parallel running.

ii) Parallel Running

This method runs both the old and new systems together for a period of time, both processing current data. Results from both systems are checked for consistency. Where the results do not agree, the reasons may be attributed to

- errors in the new system, or
- errors in the old system, or
- sabotage of the new system, or
- wrong handling of the new system although it is error-free.

This method provides a degree of safety but is expensive in terms of the duplication of efforts and resources used.

The method should be properly planned to cater for

- a firm time limit on parallel running
- details of the type of results to be checked
- instructions on how errors are to be dealt with
- instructions on how to cope with major problems in the new system
- simulation of period-end processing (e.g. year-end),
iii. Pilot Operation

This is cheaper and easier to control than parallel running, and provides a greater degree of safety than does a direct changeover. There are two types:

- **Retrospective Parallel Running**, in which the new system operates on data previously processed by the old system. The existing results are available for checking with results from the new system without the problems of staffing and disruption caused by parallel running.

- **Restricted Data Running** involves a complete logical part of the system file being chosen and it is run as a unit on the new system. If that is shown to be working well, the remaining parts are then transferred. Gradually, the entire system can be transferred in this piecemeal fashion.

iv. Staged / Phased Changeover

This is best suited to very large or complex projects. The first stage is implemented using the parallel approach and, thereafter, it is a series of discrete direct changeovers.
Where this approach is adopted, care must be taken to control any systems amendments incorporated in the later stages in order to ensure that the overall system remains totally compatible.

Note carefully that the difference between this approach and the restricted data running approach discussed above is that this approach looks at implementing the entire new system in stages while the restricted data running considers the implementation of part of the entire system in a piecemeal fashion.

### 6.1.9 Post-Implementation Review

This is an investigation to review the performance of an operational system; to compare actual with planned performance; to verify that the stated objectives of the system are still valid in the present environment and to evaluate the achievement of these objectives.

The investigation also examines the level of control in the system. The initial review provides the opportunity to check whether the objectives and benefits forecast in the feasibility study have been achieved. Subsequent reviews, carried out as part of regular reviews of systems (mostly annually) will be concerned with the continued achievement of benefits, any deviations from the master system specification, and opportunities for improvement.

### 6.2 THE IMPORTANCE OF THE LIFE CYCLE

#### 6.2.1 Impact of the life cycle

The systems development life cycle has had a very positive effect on the standards of computer systems. Its systematic approach means that the quality and efficiency of the systems developed will be substantially enhanced.

The feasibility study establishes whether the new system can be justified. Proper analysis and design increase the chances that the new system will meet users' requirements. The cycle also recognises that the implemented system should be continually monitored and updated as necessary.
6.2.2 Disadvantages of the cycle approach

There are some drawbacks associated with the system development life cycle approach. It leads to very limited and restricted attitudes to the development of systems.

Users tend to be relegated to a passive role in the development process. The definition of their requirements is technical and it relies more on the abilities of the analysts. Often this has led to the information needs of managers being ignored, poorly defined user requirements, and a lack of involvement of users in the development process.

Another disadvantage is that most systems were developed independently of each other.

A number of other models are available that ensure better user participation during systems development. These models which include the waterfall model, b model, spiral model, etc are, however, not discussed in this manual.

6.2.3 Structured methodologies

The introduction of other ways of developing systems (notably the methodologies) helped to reduce the effects of many of the drawbacks of the systems development life cycle.

A system development methodology is a collection of procedures, techniques, tools and documentation aids which help system developers in their effort to develop and implement a new system.

The methodologies help in the following ways:

They

- involve users more closely in the development process;
- analyse user needs in a more fundamental way;
- allow flexibility of systems
- produce easily understood documentation;
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

6.2.4 Advantages of methodologies

The advantages of these methodologies include the following:

a) detailed documentation is produced;
b) standardised methods make it easier and cheaper to apply;
c) leads to improved system specifications;
d) systems developed in this way are easier to maintain and improve;
e) users are involved with development work from an early stage and are required to sign off each stage;
f) use of diagrams makes it easier for relevant parties, including users, to understand the system than if it were merely descriptive;
g) a logical design is produced that is independent of hardware and software.

6.2.5 Disadvantages of methodologies

a) it may be inappropriate for information of a strategic nature that is collected on ad-hoc basis;

b) some methodologies may be limited in scope, being too concerned with systems design and not with their impact on actual work processes or the social context of the systems;

c) it may encourage excessive documentation and bureaucracy and may be just as suitable for documenting bad design as good.

As our example, we shall consider the Structured Systems Analysis and Design Methodology (SSADM), which is a very popular type. It is discussed in the following block diagram.
6.2.6 Stages of SSADM

STRUCTURED SYSTEMS ANALYSIS AND DESIGN
METHODOLOGY (SSADM)

Fig: 6.2 Overline of the stages of the structured Systems Analysis and Design Methodology
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

SSADM is a structured methodology with the following features:

a) it describes how a system is to be developed;

b) it reduces development into phases, with each phase reduced into stages (sub-phases). Each stage contains a number of steps which contain tasks, inputs and outputs;

c) it is self-checking and can be tailored to a number of applications.

- **PHASE 1 – FEASIBILITY STUDY**

The feasibility study phase, although not mandatory in many SSADM projects, is meant to examine the 'case' for undertaking a particular project in terms of its technical feasibility and cost benefit.

**FS1:** The basic requirements and terms of reference are set out and initial investigations carried out.

**FS2:** A number of ways of satisfying the requirements of the system are identified and costed.

- **PHASE 2 – SYSTEM ANALYSIS** covers stages 1 to 3

**STAGE 1:** The current situation is investigated by the Analyst, who will identify and document the current processes, data flows and any problems currently encountered or anticipated.

**STAGE 2:** User needs are identified and laid down in detail. If there are a number of different needs which may be conflicting or compete for resources, priorities will be established.

**STAGE 3:** The information should now be available to specify a number of hardware and software options. The best option is recommended by the Analyst and agreed to by management.

- **PHASE 2 – SYSTEM DESIGN** covers stages 4 to 6

**STAGE-4:** A relational data analysis is carried out, with the data being normalised, if required. (Normalisation of data is beyond our scope and so is not treated in this study manual).

**STAGE 5:** The different processes that are required to produce a relevant output are specified and crosschecked with the data design in stage 4 above.
STAGE 6: The logical data and process designs are combined together into a definition of how the system will be written and implemented.

6.3 PROTOTYPING

6.3.1 Introduction

During the development of a new system, there is the need to ensure that the exact needs of users are developed and that developers just do not 'dump' on users what they think is appropriate. Thus, it is necessary to ensure that end-user inputs are solicited for during the development of a system.

Prototyping is meant to afford users the opportunity to play this vital role in the development process.

6.3.2 Definition

Prototyping is a fourth generation language (4GL) development tool that is used to allow users to quickly produce a simulation of the output required from a completed system. The prototype of a system or program is a smaller version of the system or program and is supposed to have the appearance of the final completed working system/program. It may be tested and subjected to experimentation by users on the way to reaching what they desire.

Users are better able to clarify their requirements, which may be refined through the subsequent evolution of the prototype. The prototype may become part of the specification of the system.

The following sketch describes the various steps involved in prototyping:

6.3.3 Stages of prototyping

Based on the knowledge of the form of the final product, a prototype of it is created.

This is subjected to reviews, tests and amendments. As long as users indicate that the current product is not exactly what is required, there has to be an amendment, followed by further tests and amendments, where necessary, for user’s approval.

This iterative process ensures that user’s needs are exactly catered for and avoids the possibility of handing over a failed system to users. User ownership of the system developed is also ensured.

When the prototype is agreed on as representing the final outcome, prototyping software may then be used to develop the final application.

The stages may be summarised using the following sketch:
It is important to note that the prototype
a) is a live working application which can perform actual work;
b) may eventually become the actual application or be replaced by another
c) is used to test out assumptions about users' requirements and about system design;

When the final version is ready, prototyping software may then be used to develop the final system.

6.3.4 Advantages of prototyping

- The user is able to judge the prototype before things get too far to be changed.
- It makes it more economical for users to get custom-built application software.
- A prototype does not necessarily have to be written in the language of
what it is prototyping.

6.3.5 Disadvantages of prototyping

- Many prototyping software tools assume that the user is only about to computerise an application for the first time. This might not be the case.
- Programs produced may be tied to a particular hardware platform or database system.
- Prototyping tools may be inefficient in the programs they produce.
- Not all prototyping tools allow programmers to insert hand-written codes into a program when this becomes necessary.

6.4 JOINT APPLICATIONS DEVELOPMENT (JAD)

6.4.1 Introduction

Just as prototyping affords end-users the opportunity to ensure that their exact system requirements are met, JAD seeks to bring users and the systems team together so that they collaborate during the process of developing the new system. This will obviously also ensure that the required system is produced.

6.4.2 What JAD is all about

Joint Applications Development (JAD) describes the partnership between users and systems developers during the process of developing a system.

6.4.3 Benefits of JAD

JAD has the following potential benefits:

- It creates a pool of expertise made up of interested parties from all relevant functions.
- Reduces risk of systems being imposed on users.
- Increases user ownership and responsibility for systems solution.
- Emphasises the information needs of users and their relationships to business needs and decision-making.

This shift of emphasis to application development by end users needs to be well managed and controlled, and one approved means of having this done well is by the establishment of an information centre, with a help desk.
6.5 RAPID APPLICATIONS DEVELOPMENT (RAD)

6.5.1 Introduction

There are certain situations when a particular system needs to be developed very quickly because end-users and, by and large, the organisation itself, cannot afford to wait unduly for the completion of the development of the system. Such situations call for the use of novel approaches to the development process. RAD is one such approach.

6.5.2 Definition of RAD

Rapid Applications Development (RAD) is a quick way of developing software, and combines a managed approach to systems development with the use of (modern) software tools such as prototyping and modelling. RAD involves end-users heavily in the development process. The RAD team should be made up of highly motivated people with at least one person very skilled in the use of advanced tools. This will ensure that any such tools employed will eventually be used effectively.

6.5.3 When is RAD appropriate?

RAD is especially appropriate for the following situations:

a) If users are not clear about their requirements, RAD can quickly help them find out.

b) If there is the culture of user involvement in systems development, the RAD team can work productively.

c) Where there is a need for faster delivery than conventional development can provide.

d) Where the target system is limited in scope.

e) Where the target system is not expected to be implemented on a new platform.

6.6 OUTSOURCING

6.6.1 Introduction

Owing to the ever increasing competition amongst organisations, managements often device means by which they can carry out their functions more efficiently. Outsourcing is one way by which certain non-key functions of an organisation could be offloaded to
other external expert firms to manage for a fee.

6.6.2 What outsourcing is all about

Outsourcing involves purchasing from outside the organization, the services required to perform certain business functions. Outsourcing covers facilities management, types of services and a range of contracts with more intangible benefits. It is the ultimate expression of a buyer's attitude to a supplier as an extension of in-house resources. Facilities or functions that were provided in-house are instead performed by external contractors working very closely with the buying organisation. It includes such services as computer centre operations, network operations and applications management as well as systems integration. Outsourcing is often closely related to downsizing and/or divesting in order to concentrate on key business competencies. The management logic of outsourcing comes from lowering costs, reducing the dilution of management attention or covering temporary skill gaps.

A company is not expected to outsource any of its key operational functions. The reason for this is that the company stands the chance of losing any competitive advantage it enjoys if the outsourcing vendor is also a vendor to any of the company's competitors.

6.6.3 Types of Outsourcing

There are a number of types of outsourcing, they include the following:

i) Body Shop Outsourcing: This is where management uses outsourcing to meet short term IS/IT demand. For example, getting outside assistance in the area of programming, where the expertise required is temporarily not available within the firm.

ii) Project Management Outsourcing: This is used for all or part of a particular IS project, for example the development of a new system,

iii) Total Outsourcing: This is where an organization chooses to outsource more than 70% of its IS capability to a single outsourcing vendor.
6.6.4 Ensuring the success of outsourcing

Gary J Zenz provides a worthwhile analysis of steps which managers should take to ensure the success of outsourcing. These are

- Managers should establish a strategy for the proper balancing of management, contracting and consulting.
- Managers should establish a strategy to deal with possible reductions in staff.
- Managers should closely integrate the external suppliers.
- Managers should provide appropriate communication channels.

6.7 CHAPTER SUMMARY

The systems development life cycle is a comprehensive tool for solving organizational problems, especially those that relate to the flow of computer-based information. It is essential for an organization to select a particular approach to use in the development of its systems in order to avoid adopting any ad-hoc methods or trial-and-error approaches that may not work well and are very likely to result in failed systems.

Prototyping is a typical fourth-generation language (4GL) tool that is used to develop good working systems. It entails the early definition of a system, the creation of a prototype of it, and the continued test and review in conjunction with users. The resulting iteration enables refinements to be made until the final working system is attained. Through this approach, users are assured of a good working system and the chance of just any solution being thrown at users is far remote.

Using JAD and RAD, it is possible to fully engage users in the development of systems. User ownership of the systems developed is therefore assured.

Outsourcing is a way of an organization engaging its management capabilities in critical (or key) areas of competence and giving out other activities which are not key to its operations to other experts to undertake on its behalf. This means that management can now focus more on the organization’s core activities and perform better, while it pays for expert services from outside vendors. It should be noted that an organization is not expected to outsource a core activity because doing so will easily result in leaks in the organization's operational information and may open it to attack from its competitors.

6.8 SELF-ASSESSMENT QUESTIONS

6.8.1 What is the difference between the parallel approach and the retrospective parallel approach as applied to a system changeover?
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

6.8.2 In the development of a new system, why is prototyping important?

6.8.3 Explain briefly the term 'outsourcing'.

6.8.4 What is the relevance of 'Joint Applications Development' (JAD) to the organization?

6.8.5 Define the concept of Rapid Application Development' (RAD).

6.9 ANSWERS TO SELF-ASSESSMENT QUESTIONS

6.9.1 Whereas the parallel approach uses current transaction data to compare the old and new systems, the retrospective parallel approach uses old transaction data that would have been run already in the old system. This makes the latter approach faster than the former in its application.

6.9.2 Prototyping is important because it affords the eventual users of the system the opportunity to ensure that the final product meets their exact needs. The iteration process allows users to suggest any changes they deem necessary on their way to arriving at the final product.

6.9.3 Outsourcing involves an organisation's management giving out certain non-key functions to other companies to perform on its behalf in order that the organisation can focus better on its core business functions. Outsourcing covers such services as computer centre operations, network operations and applications management as well as systems integration. It is often closely related to downsizing and/or divesting in order to concentrate on key business competencies.

6.9.4 Joint application development describes the process by which an organization allows its system developers the opportunity of working in close collaboration with users of these systems. The participation of users in system development ensures that users get precisely what they require and eventually this goes to benefit the organisation itself.

6.9.5 Rapid application development is a quick way of building software, and it combines a managed approach to systems development with the use of (modern) software tools such as prototyping and modeling.

RAD involves end users heavily in the development process. It has to be so because users' needs must be fully covered and this is best done with their full commitment and participation.
CHAPTER 7

COMPUTER SERVICES

7.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to

1. Understand the role which microcomputer plays in the accounting environment.

2. Understand the nature and role of user departments.

3. Understand the concept and structure of an Information Centre.

4. Appreciate the function of an Information Centre.

5. Understand the concept and services available from a Computer Service Bureau.

6. Understand the concept of Facilities Management.

7.1 THE ROLE OF MICROCOMPUTERS IN THE ACCOUNTING ENVIRONMENT.

7.1.1 Introduction

The user-friendliness of the microcomputer and its associated software, accompanied by the low cost and ready availability of the microcomputer software make the microcomputer the preferred type in most organisations. The activities that take place in the typical accounting environment lend themselves well to the use of personal computers (microcomputers).

7.1.2 The use of microcomputers in the accounting environment

A number of personal computer (PC) accounting packages are currently available for use by the Accountant.

A number of general accounting software products such as spreadsheet or database programs exist that can be used to process accounting transactions. There are also integrated accounting packages that may be used for features like

- creation of chart of accounts,

- recurring journal entries,

- variance analysis reports,
- payroll,
- accounts payable,
- accounts receivable, etc.

### 7.1.3 Microcomputer business applications

The typical business applications facilitated by the microcomputer include payroll, stock control, purchases, invoicing, sales ledger, general ledger, etc.

The various ways in which a microcomputer will be utilised in an organisation will vary depending, among others, on the nature of the business, its organisation, management style, geographical dispersion of its operating units, and volume of work.

However, it is amply evident that the computer has taken over a lot of what the accountant previously used to handle manually, especially in the areas of management reports of all kinds, forecasting and modelling.

### 7.2 THE INFORMATION CENTRE

#### 7.2.1 Introduction

The widespread dependence on computer-based information systems means that many individuals and organizations will have to use computers.

However, some of these individuals may not be very knowledgeable in the use of the computer and so must necessarily depend on others for assistance. The Information Centre is there to play this part in the organisation.

#### 7.2.2 Definition of Information Centre

An information centre (IC) is a department or office that is manned by technically skilled staff that assists the Information System (IS) department staff with regards to user requests and complaints.

A help desk is an office or a desk with staff using a number of telephones and hot lines to receive various user staff complaints and requests. These are eventually passed on to information centre for solution. This is very important because not all the user staff are likely to be IT literate and there will always be issues that they will need assistance in.

The arrangement ensures that Information Systems (IS) staff have sufficient time to
focus on their routine functions, thus avoiding any backlog of work. The IC staff, however, are not supposed to be usurping the powers and functions of the IS staff.

![Diagram showing Information System Department, Information Centre, Working in Collaboration With Help Desk, and Users]

**Fig. 7.1** Information Centre Arrangement

### 7.3 COMPUTER SERVICE BUREAUX

#### 7.3.1 Introduction

Under certain circumstances, an organisation may not be ready to acquire the
computers it requires or may not have the relevant skills to pursue its stated objectives using the computer. In such situations, it may have to depend on some form of consultancy services or engage the services of a Computer Service Bureau.

7.3.2 Definition of Computer Service Bureau

A computer service bureau is a firm that operates to offer computing services to individuals and other firms that require the services but either do not have the facilities needed or just do not find it worthwhile or economically justifiable to do so.

7.3.3 Types of computer service bureaux

Three types of bureaux are available and may be classified as

- Independent companies formed specifically to render computing services to clients.
- Computer manufacturers with separate departments set up for the purpose.
- Computer users who are prepared to sell spare capacity to other firms and individuals.

7.3.4 Services available from computer service bureaux

In general, the range of services offered by these bureaux include

a) Data preparation or conversion - this may be required when changing from one system of operation to another.

b) Systems investigation - this service will be needed when studying a system in operation with a view to finding out how it works and evaluating it prior to having it replaced.

c) Systems analysis and design - this entails a thorough study of an existing system to ascertain how it works, the reasons why it works the way it does, and preparing a document that details the specifications of a proposed new system.

d) Programming - coding a program to answer user needs and testing it to ensure it works as desired.

e) Hiring out computer time - entails the running of jobs for clients using clients' own data and programs.
f) Do-It-Yourself service - where clients' staff use the bureau's facilities themselves, usually during peak periods.

g) Time sharing - where communications links are provided for a number of clients, using specific time slots, to share the resources of the bureau's computer system as if they were using their own in-house computers.

### 7.3.5 Reasons for using computer service bureaux

Any particular individual or company will have good reasons for using a bureau but in general the following reasons may be cited as common:

- to obtain valuable initial experience of computer processing prior to acquiring own computer;
- to use as a stand-by arrangement in case of breakdown of in-house computer;
- for use during peak processing periods;
- to avoid the financial and administrative implications of owning and operating an in-house computer;
- insufficient workload to justify the installation of in-house computer;
- to obtain the benefit of computer power at reasonable cost;

### 7.3.6 Disadvantages of using computer service bureaux

These may be stated as follows:

- loss of control over time taken to process data (turn-round time);
- inability of client staff to gain experience in computing;
- possible loss of competitive advantage where client depends solely on bureau;
- secrecy of the company may be impaired.

### 7.3.7 Selection criteria for computer service bureaux

The following are some of the factors that may be used to select a bureau from among a number for the purposes of efficiency and reliability:

i) reputation of the bureau on the market;

ii) integrity of the bureau;
iii) efficiency of the bureau;
iv) how competitive the bureau is;
v) financial standing of the bureau - an indication of ability to invest and take useful business risks;
vi) ability to render quick services to clients;
vii) calibre of staff employed;
viii) bureau's approach to technological developments.

7.4 FACILITIES MANAGEMENT

7.4.1 Introduction

Occasionally, an organisation may find itself owning its Information Systems (IS) facilities and most often, the full complement of IS staff as well. Depending on the type of system used and the level of complexity associated with it, the organisation may be compelled to engage an outside firm to manage its IS facilities on its behalf. This is what we refer to as Facilities Management.

7.4.2 Definition of Facilities Management

Facilities Management (FM) is defined as the management and operation of part or all of an organisation's Information Systems (IS) services by an external source at an agreed service level and an agreed time period.

The facilities management contract may further include IT consultancy, the management of IT services, the provision of new services and ownership of hardware and software.

7.4.3 Scope of Facilities Management

Computing facilities that could be taken over by FM will include

- project management assistance
- complete control of systems development
- running an entire IS function.

The FM company usually takes over the employment contracts of the organisation's IT staff. The terms and conditions of employment are protected by legislation in the form of the Transfer of Undertakings, Protection of Employment (TUPE), regulations. This
implies that even in the event of the FM contract being terminated, the IT staff hired by the FM company still maintain their jobs.

### 7.4.4 Reasons for using Facilities Management

The reasons for using facilities management include:

a) The organisation may not have the staff, management time or expertise to organize its substantial IS requirements.

b) Controlling cost; the contract for services may specify the cost in advance and extra costs may be borne by the FM company.

c) Economies of scale may exist where a number of organisations employ the same FM company; any research carried out by the FM company can be shared between them.

d) The FM company may employ staff with specific expertise that can be shared between several customers. Once a company has handed over its IS function to another company, it is locked into the arrangement, the decision being difficult to reverse.

Should the FM company's services be unsatisfactory, the effort and expense of the company re-building its own IS facility will be enormous.

### 7.5 CHAPTER SUMMARY

The computer, especially the microcomputer, has become an invaluable tool for the accountant in the workplace and elsewhere. There is currently so much dependence on the computer by organisations that no matter what it costs, organisations are prepared to commit resources to get their work done by the use of the computer.

In a number of cases, firms will choose the path of acquiring their own computers and engaging qualified personnel to manage their Information Systems (IS) requirements.

Some firms will also seek the services of consultants in many diverse forms, including the use of computer service bureaux.

Currently, however, there are some organisations that prefer to outsource certain aspects of the IS functions, including their payroll or some aspects of it.
In all these, firms are advised to ensure that their vital corporate resources, especially information, are not leaked to their competitors.

7.6 **SELF-ASSESSMENT QUESTIONS**

7.6.1 Describe the purpose an information centre serves in the Organisation.

7.6.2 What is a computer service bureau?

7.6.3 Give any two reasons to show why facilities management is beneficial to the organisation.

7.6.4 What is meant by the term 'help desk’?

7.6.5 Give any two reasons why the accountant finds the microcomputer quite invaluable.

7.7 **ANSWERS TO SELF-ASSESSMENT QUESTIONS**

7.7.1 In the organisation, an information centre gives the end-users of information systems the opportunity to interact with experts in order to get their work done, without putting undue pressure on the Information

7.7.2 A computer service bureau is an organisation that is set up to offer computing services to individuals or other organisations that require such facilities but are not in any position to help themselves.

7.7.3 An organisation might find out that it needs to get into a facilities management contract because of reasons that include the following:

i) The organisation might not have staff with the requisite skills or the management competence to help itself.

ii) The organisation may require the needed solution more cheaply and with the highest level of expertise.

7.7.4 A help desk is an office established with at least two staff members equipped with very reliable telephone facilities. These are used to receive complaints and problems from end-users of the system and find appropriate solutions to these problems from among the staff of the information centre.

7.7.5 The accountant finds the microcomputer very invaluable because of reasons that
include the following:

i) The microcomputer is very user-friendly and can also be carried over to any place where the accountant may find himself working.

ii) There are numerous microcomputer-based software products that the accountant can use for any job that he has to perform with a computer and these products are quite inexpensive and very user-friendly.
CHAPTER 8

MODERN TRENDS

8.0 LEARNING OBJECTIVES

After reading this chapter, you should be able to

1. Understand what networks are.
2. Distinguish among the three major types of network (LANs, MANs and WANs).
3. Understand the issues concerned with network security.
4. Understand the issues concerned with developments in office automation.
5. Understand what is meant by computer crimes and how these can be managed.
6. Understand what computer viruses and worms are and how to deal with them.

8.1 COMPUTER NETWORKS

8.1.1 Introduction

A computer network may be defined as an interconnection of a number of computers, telephones, and other shared devices in various ways so that users can process and share information.

Networks make it possible for users to share peripheral devices, programs and data; to be engaged in better communication; to have more secure information; and to have access to databases.

8.1.2 Types of Networks

Computer networks may be categorised as follows:

- **Wide area network**: A wide area network (WAN) is a communications network covering a wide geographical area such as a region of a country or entire country. The Internet, for example, links together several computer WANs. Most
telephone networks are typical examples of WANs.

- **Metropolitan area network:** A metropolitan area network (MAN) is a communications network that covers a geographical area such as the size of a town, suburb of a city, or an entire city.

- **Local network:** A local network is a privately owned communications network that operates in a confined geographical area, usually within a kilometre. It could be operated within a building, a number of buildings close together, or on the campus of an educational institution. Local networks are either private branch exchanges (PABXs) which is Private Automatic Branch Exchanges) or local area networks (LANs).

A private branch exchange is a private or leased telephone switching system that connects telephone extensions in-house, and often also to the outside telephone system. Apart from analog telephones, PABXs can also handle digital equipment, including computers. They often share existing telephone lines with the telephone system.

Local networks, on the other hand, require installation of their own communication channels, whether by the use of wires or wireless. A local area network consists of a communications link, network operating system, PCs, servers, and other shared hardware devices like printers, scanners, and storage devices all connected up within a small geographical area.

### 8.1.3 Network topology and Protocol

*The topology* (or configuration) of a network refers to the logical layout or shape of the network. It describes the manner in which the various component computers are physically connected,

On the other hand, the protocol consists of the set of rules that governs the way information is carried over the network.

Our focus from this point on will be on local area networks.
8.1.4 Components of a LAN

Local area networks are made up of several standard components. They include the following:

- **Connection or cabling** - LANs are either wired or wireless. Wired networks may use twisted-pair wires, coaxial cables, or fibre-optic cables. The wired networks use infra-red or radio waves.

- **Network interface cards** – Each computer on the network requires a network interface card in order to send and receive messages on the LAN.

- **Network operating system** - This software manages the activities on the network.

- **Other shared devices** - Other devices like printers, fax machines, scanners, and storage devices may be added to the network as necessary and shared by all users.

- **Bridges, Routers and Gateways** - A LAN may stand alone or be connected to other networks. Various hardware and software devices may be used as interfaces for these connections.

A bridge or router will facilitate communication between similar networks, while a gateway makes it possible for dissimilar networks to communicate (e.g. a LAN with a WAN).

8.1.5 Types of LANs

LANs are of two basic types - Client/server and Peer-to-peer.

- A Client/server LAN consists of requesting PCs, called clients, and devices that provide a service, called servers. The various devices are connected to the file server, A file server is a powerful computer that stores the programs and data shared by all users on a LAN. A data base server is a computer on a LAN that stores data (but not programs) for use on the LAN. A print server is a computer on a LAN that controls one or more printers. It stores the print-image output from all the PCs on the network and sends the output to the printer(s) one document at a time.
A Peer-to-peer LAN is one in which all the PCs on the network communicate directly with each other and there is no server. This is less expensive than the Client/server type and is quite effective for up to 25 (twenty-five) PCs; beyond this number, the network tends to be slow and quite ineffective.

8.1.6 LAN Topologies

At this point, we shall consider some key LAN topologies.

8.1.6.1 Star network

On the star network, all the PCs and other communications devices are connected to a central server. This is a typical example of a Client/server LAN. No client is allowed to communicate directly with other clients. Electronic messages are routed through the server to their various destinations. The server monitors the flow of traffic. The advantages are that the server prevents collisions of messages and also if a connection is broken between any communications device and the server, the rest of the devices on the network will continue to function. The main disadvantage is that a breakdown of the server renders the network inoperative.

A PBX system is an example of a star network.

![Star Local Area Network Diagram](image-url)
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

8.1.7 Ring (or Loop) network

In a ring network, all the PCs and other communications devices are connected in a continuous loop. This is a typical peer-to-peer LAN; there is no server. Messages flow in only one direction and there is, therefore no danger of collisions. However, if a connection is broken, the entire network may stop working. A user, who intends to send information, is required to be allocated a "bit token" (0 or 1) indicating permission to send or otherwise.

**Fig. 8.2** Ring Local Area Network

8.1.8 Bus network

In a bus LAN, all the communications devices are connected to a common channel. If a connection is broken, the network may stop working. This type of network structure may be organised as a client/server or peer-to-peer network. A signal from any communications device moves in both directions to the ends of the bus. Any imminent collisions of messages are detected by the protocol, Carrier Sense Multiple Access/Collision Detection (CSMA/CD), which delays the messages and later allows the devices concerned to retransmit.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

Fig. 8.3  Bus Local Area Network

8.2  LAN SECURITY ISSUES

8.2.1  Introduction

The complexity of LANs makes it possible for a number of breaches to be committed. We shall now consider the following areas of concern:

i. passwords and unauthorised access

ii. computer viruses (discussed in section 8.4)

iii. encryption

8.2.2  Passwords and unauthorised access

A password may be defined as a sequence of characters to be entered into a computer system in order to gain access to the system or some other parts of it.

The use of passwords should be properly monitored and controlled to ensure that passwords are not leaked to or copied by other people. Passwords should also be changed regularly (possibly monthly).

The use of passwords has the objective of restricting access to the LAN or any resources on it to only authorised users; that is, unauthorised access is prevented.
8.2.3 Encryption

Encryption is the technique of disguising information stored or in transmission in order to preserve its confidentiality.

The process of encryption and decryption involves the use of an algorithm - the operation by which the information may be put into cipher form - and a key, which controls the algorithm.

Using appropriate software, the sending computer encrypts the message and, at the receiving end, the computer decrypts the message. Anyone intercepting the message will not have the key to decipher it and thus will not find it meaningful.

8.2.4 Advantages of networks

The following are key advantages of networks:

- Sharing of peripheral devices: Several users on the network are able to share printers, scanners and disk drives connected to the network in order to keep cost down.

- Sharing of programs and data: Network users are able to share a common database on a shared storage device, as well as common software. It is much easier to update files when these are stored on a server than when they are stored on separate computers.

- Better communications: On the network, information may be shared in real time, Electronic mailing is facilitated.

- Security of information: Information is more readily backed up on networked storage media just as data integrity is easily ensured when a central database is used. An item of data is easily updated with a single input.

- Access to databases: It is possible to tap into other external databases, whether private or public
8.3 OFFICE AUTOMATION (OA)

8.3.1 Introduction

Office automation involves the use of computers, micro-electronics and telecommunications technology to manage information resources automatically.

The whole purpose of office automation is to integrate some, if not all, of the departmental functions in the organisation. The difference between today's office and that of the previous decade or so arise in the channel of communications and the flow of transmission. The terms 'electronic office' or 'paperless office' are often used to describe the modern office environment.

The implication is that more use is now made of varied office equipment in the office than used to be the case in the past, leading to the minimal, if at all, use of paper. For example, organisations now use electronic mail for both internal and external communication. The computer is used in many different ways to handle almost all office routines. We now consider some of the computer and telecommunication resources used in OA.

8.3.2 Word Processing

Word processing packages have facilities to assist various people, including accountants, in the creation and editing of text and graphics in letters, reports, Web pages or e-mail messages while performing a number of functions including the following:

- Text manipulation. The user is given the ability to insert, delete, move, edit, retrieve text, etc.
- Production of standard letters. A standard letter can be typed and stored and then be used over a period of time.
- Mail-merging. This gives the facility for standard letters to be personalised by the use of details stored on a mailing list.
- File merging. It is possible to have standard details stored on a file and then incorporated into other letters or documents.
• Document checking. A dictionary and a thesaurus are available to be used to check spelling and grammar.

8.3.3 Desktop publishing (DTP)

Desktop publishing packages have become very popular now and may be used to present reports and various documents in an exceptionally professional way. These are applications software that use the PC, mouse, scanner and usually a laser printer to mix text and graphics, including photos, to produce high-quality printed output.

Text is usually composed first on a word processor, artwork created with drawing and painting software, and photographs scanned in using a scanner. Prefabricated art and photos may also be obtained from clip art.

Often the laser printer is used to get an advanced look before the completed job is sent to a typesetter for higher-quality output. Desktop publishing has had a major impact on the computing world and a wide range of DTP applications are currently available, including, Aldus PageMaker, Ventura Publisher, First Publisher and Microsoft Publisher.

Desktop publishing has the following features:

• Mix of text with graphics: The package allows user to manage and manage text with graphics. While laying out a page on screen, one can make the text flow like a liquid around graphics such as photographs.

• Varied type and layout styles: The package provides a variety of fonts or typestyles and one can create different rules, borders, columns, and page numbering. A style sheet in the package makes it possible to choose and record the settings that determine the appearance of the pages.

• Use of files from other programs: The DTP package can be used to integrate a number of files from different programs, including prefabricated art obtainable from disks containing clip art, or images that can be used to illustrate DTP documents.

• Page description language: Much of the shaping of text characters and graphics is done within the printer rather than in the computer. Software called a 'page description language' is used to describe to the printer the shape and position of letters and graphics. An example of a page description language is Adobe's PostScript, used with Aldus PageMaker.
8.3.4 Facsimile (Fax)

A fax machine - or facsimile transmission machine - scans a document or an image and sends it as electronic signals over telephone lines to a receiving fax machine, that recreates the document or image on paper.

There are two types of fax machines - dedicated fax machines and fax modems.

The dedicated fax machine is a device that is meant only to send and receive fax documents.

The fax modem is installed as a circuit board inside the system unit of the computer. It is a modem with fax capability that facilitates the sending of signals directly from one computer to another fax machine or computer fax modem.

The main shortcoming with the fax modem is that one requires an image scanner or graphics scanner to scan in external documents.

8.3.5 Audio Teleconferencing and Videoconferencing

Present day telephone systems allow users to connect together a number of callers (usually more than two) in different geographical locations. This makes it possible to hold a conference by telephone. This is referred to as audio teleconferencing (or conference call). A variation of this meeting format is called videoconferencing, in which use is made of television video and sound technology together with computers to enable people in different geographical locations to see, hear, and talk with each other. The use of 'Web camera' (Webcam) technology on PCs has made videoconferencing via the Internet a cheaper option than investing in special equipment and facilities.

Videoconferencing has led to video mail (V-mail) in which video messages can be sent, stored, and retrieved just like e-mail.

Audio teleconferencing and videoconferencing have the following advantages:

- Information and views can be shared by the participants simultaneously.
- It enables people to conduct business meetings without the need to travel.
- It eliminates the time and expense involved in travelling to attend a meeting.
8.4 COMPUTER VIRUSES AND WORMS

8.4.1 Introduction

A computer virus is a small program which has the ability to infect a whole computer system.

8.4.2 Definition of computer viruses

A computer virus may also be referred to as infectious coding or malicious coding. It is any software designed to damage or compromise computer systems.

The coding is parasitic in nature. Once it finds a host (which might be a PC), it is released and replicates itself very quickly, possibly infecting memory and backing storage media.

The commonest way that viruses are spread is through e-mail, usually in the form of attachments. Viruses can also be carried by diskettes, flash disks, networks, CD's and in software downloaded from the Internet. It is even possible to pick up a virus by chatting on-line, visiting a website, or playing computer games.

Many viruses are designed to exploit vulnerabilities in commercial software and to sneak in through unprotected "back doors" (digital holes in commercial software). Reports indicate that there are more than 57,000 individual viruses around that could infect computers and networks. Some of these are merely mischievous (that is, they may just drop a cheeky message onto your screen) but others are designed to infiltrate sophisticated computer systems.

8.4.3 Examples of viruses

Examples of viruses include:

a) The Jerusalem virus, which slows down the operation of the computer so much that it becomes virtually unusable; and it deletes files.

b) Cascade causes characters on the screen to fall to the bottom of the screen and may even reformat the hard disc, an action that results in the deletion of everything on the hard disk.

c) Casino displays a one-armed bandit game on the screen; if the user fails to win the jackpot, the hard disc is wiped clean.

d) Love Bug attacks the operating system.
e) **The Boot Sector virus** replaces boot instructions with some of its own; once the system is turned on, the virus is loaded into main memory before the operating system - from there it is in a position to infect files.

f) **Time bomb** is a piece of software that is executed at a specific date/time.

g) A logic bomb will be triggered into action on the occurrence of an event.

### 8.4.4 Computer Worms

A **worm** is that type of high-tech maliciousness, program that copies itself repeatedly into memory or a selected medium, until no more space is left. Most worms, having made copies of themselves, release a "pay load", an action designed to disrupt your system e.g. the Magistrate worm hides itself in the hard disc, moving around in your main address book and then mailing itself to people you interact electronically with.

Examples of worms include

(i) Blaster
(ii) Slammer

A worm is like a virus except that it is a program rather than a code segment, hidden in a host program. It usually does not live very long, but it is quite destructive while it is alive.

### 8.4.5 Detection and Prevention of Viruses and Worms

Viruses and worms may be detected by the use of effective anti-virus software installed on the network or stand-alone computer. Examples of these are:

- Norton Anti-Virus
- Dr Solomon's
- AVG Anti-virus
- Kaspersky Anti-virus Personal
- PC-Cilli
- Windows Live onecare
- McAfee Virus scan
- Panda

The software scans the computer's main memory and media to detect viruses and, if possible, destroy them.

You need to note that, depending on the type of worm or virus, a particular anti-virus software may be ineffective. In such a situation, there is the need for a more effective
(powerful) type of anti-virus.

8.4.6 How to avoid Viruses and Worms

The following steps may be taken to avoid viruses and worms.

- Go for the right anti-virus software and ensure regular backups.
- Update the anti-virus software regularly (through the internet).
- Guard your e-mail in-box, especially attachments.
- Download material from well-known and reputable sources only.
- Contact your ISP about virus scanning.
- Establish rules on media that may be used on the network or PC.

8.5 ISSUES IN THE MANAGEMENT OF INFORMATION TECHNOLOGY

8.5.1 Introduction

An information technology crime may be an illegal act carried out on computers or telecommunications or it may be the use of computers or telecommunications to accomplish an illegal act.

These crimes could include hardware or software theft, stealing of computer time and stealing of information or money.

8.5.2 Theft of Hardware

This may be associated with the smaller PCs and is usually rampant at airports and hotels as well as on campuses. With the desk-tops, thieves may often decide to steal the system unit and leave the peripheral devices.

In the organisation, these hardware devices must be properly documented in the stock registers and labelled with specific codes that indicate their sites and other identification marks to discourage people from taking them out.

8.5.3 Theft of Software
A number of ways could be devised to make this unrewarding. For instance, the software developers may decide that before the program runs on any computer, there must be a valid key (or code) on the computer. This key should include the serial number of the computer’s processor. This ensures that the same program will not run on a different computer, thus making it not the while to pirate the program.

8.5.4 Crimes of Malice and Destruction

Sometimes, criminals are more interested in abusing or vandalising computers and telecommunications systems than in profiting from them.

There are a number of devices, principally involving programming tools, for entering into computer systems and wreaking havoc. Some of these computer crimes are:

- **Warez trading**: Exchanging or selling pirated software.
- **Superzapping**: Bypassing all security systems by means of specialized software tools.
- **Data leakage**: Removing copies of confidential information within a system without any trace.
- **Carding**: Obtaining, using, or selling other people’s credit card numbers.

We now give more computer crimes and abuse techniques:

1. **Cracking** is an unauthorised access to and use of computer systems, usually by means of a PC and a telecommunication network. Crackers are hackers with malicious intentions.

2. **Data dialling** is changing data before, during, or after it is entered into the system in order to delete, alter or add key system data.

3. **Data leakage** is unauthorised copying of company data such as computer files.

4. **Denial of service attack**: Attacker sends e-mail bombs (hundreds of messages per second) from randomly generated false addresses. Internal service provider’s e-mail server is overloaded and shuts down.

5. **Eavesdropping** is listening to private voice or data transmission, often using a wiretap.

6. **E-mail forgery** is sending an e-mail message that looks as if it were sent by someone else.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

(7) E-mail threats involve sending a threatening message to try and get recipient to do something that would make it possible to defraud him.

(8) Hacking is unauthorised access to and use of computer systems, usually by means of a PC and a telecommunications network. Hackers do not intend to cause any damage but to access for the sake of doing it.

(9) Internet misinformation involves using the internet to spread false or misleading information about companies.

(10) Internet Terrorism is using the internet to disrupt electronic commerce and to destroy company and individual communications.

(11) Logic Time Bomb is a program that lies idle until some special circumstances or a particular time triggers it. Once triggered, the bomb sabotages the system by destroying programs and/or data.

(12) Masquerading or Impersonation involves a perpetrator gaining access to the system by pretending to be an authorised user; enjoys same privileges as the legitimate user.

(13) Password cracking involves an intruder penetrating a system’s defences, steals the file containing valid passwords, decrypts them, and then uses them to gain access to system resources such as programs, files and data.

(14) Piggybacking involves tapping into a telecommunication line and latching on to a legitimate user before he logs into the system. Legitimate user unknowingly carries perpetrator into the system.

(15) Round-down involves computer rounding down all interest calculations to two decimal places. Remaining fractions of a cent is placed in an account controlled by perpetrator.

(16) Salami Technique: Here tiny slices of money are stolen over a period of time (Expenses are increased by a fraction of a per cent; increments are placed in a dummy account and later pocketed by the perpetrator).

(17) Scavenging involving gaining access to confidential information by searching corporate records. Scavenging methods range from searching trash cans for printouts or carbon copies of confidential information to scanning the contents of computer memory.

(18) Social Engineering. Here perpetrator tricks an employee into giving out the information needed to get into a system.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

(19) Software piracy is copying computer software without the publisher’s permission.

(20) Spamming involves e-mailing the same message to everyone on one or more usenet newsgroup or LISTSERV lists.

(21) Superzapping involves unauthorised use of special system programs to bypass regular system controls and perform illegal acts.

(22) Trap Door. Here perpetrator enters the system using a backdoor that bypasses normal system controls and perpetrates fraud.

(23) Trojan Horse involves unauthorised computer instructions in an authorised and properly functioning program.

(24) Virus as stated before.

(25) War dialling involves programming a computer to search for an idle modem by dialling thousands of phone lines. Perpetrator enters the system through the idle modem, captures the personal computer attached to the modem and gains access to the network to which the PC is attached.

8.5.5 Privacy and Security

Information privacy includes the rights of individuals to know that recorded personal information about them is accurate, pertinent, complete, up-to-date and reasonably secured from unauthorised access. The concept of information privacy includes the right of the individual to influence the kind, quantity and quality of information contained in the system which is readily identifiable to the individual. Regardless of whether this information is open to the view of the general public or specifically required to be confidential by law, these privacy guidelines should be observed by all operators and users of information systems.

Data security is neither a social nor a legal issue; rather it is a procedural matter which involves the way organizations protect their information from unauthorized or accidental modification, destruction and disclosure. There is no such thing as perfect security and most organizations can achieve a level of protection appropriate to their needs. The objective of a data security program is to cut the risk and probability of loss to the lowest affordable level and also to be capable of implementing a full recovery program if a loss occurs.

The first step in providing an effective security program is that, all levels of management must become aware of the importance of information management and its consequences. Once management has made the commitment to security procedures
a plan must then be developed and put into action.

IT requires vigilance in security. Four areas of concern are:

- Identification and access
- Encryption
- Protection of software and data
- Disaster recovery planning

a) Identification and access

Computer systems try to authenticate user’s identity by determining

i. what the user has e.g. card, key, signature, badge etc

ii. what the user knows e.g. PIN, password, digital signature

iii. who the user is e.g. by the use of biometrics

A digital signature is a string of characters and numbers that a user signs to an electronic document being sent by his or her computer.

The receiving computer performs mathematical operations on the alphanumeric string to verify its validity.

b) Encryption

This is the technique of disguising information in order to preserve its confidentiality during transmission and when stored. The process of encryption and decryption comprises an algorithm and a key.

The algorithm is the operation itself which transforms the data into cipher and the key controls the algorithm. Changing the value of the key can alter the effect of the algorithm so that the conversion for each key value is completely different.

c) Protection of software and data

Measures taken will include educating staff on back-up procedures, protection against viruses etc. Other security procedures include

i. Control of access, using physical and logical access control.
ii. Audit controls: These track the programs and servers used, the files opened etc. and create audit trails.

iii. Staff controls: These include screening of job applicants, segregation of duty, manual and automated controls and the destruction of all printouts, printer ribbons and other waste that may yield passwords and trade secrets to outsiders.

d) Disaster recovery plans

These are methods used to restore information processing operations that have been halted by destruction or accident. It includes arrangements for alternative locations, which may be Hot or Cold sites.

A Hot site is a fully equipped computer centre with everything needed to quickly resume functions. This does not necessarily have to be owned by the company that needs it.

A Cold site is a building or other suitable environment where a company can install its own computer systems. An installation will take place where there is a mishap that renders continued operations impossible.

8.5.6 System security

A Computer System is said to be secured against a particular threat (e.g. fire), if counter-measures have been taken to reduce to an acceptably low level the amount of loss, which the threat may be expected to cause over a given period of time.

There are three types of loss, from which an organization will not want its computer system to suffer. These are

- Loss of availability - this means that for some reasons, the system is not available for use.
- Loss of integrity (accuracy) - a virus attack, for instance, may bring this about.
- Loss of confidentiality - this occurs when the system can be easily accessed by unauthorised people.

A threat to a computer system is any event whose occurrence will adversely affect one or more of the assets or resources (hardware, software, network, media and data etc.), which make up the system.

Threats may be grouped into two broad types:
a) Physical Threats; comprising fire, water, the weather and the physical environment.

b) Human Threats; made up of damage, theft, strike actions etc.

8.6 STANDARD HEALTH ISSUES

8.6.1 Introduction

The use of computers and communications technology can have some adverse effects on our health. It is important to have some knowledge about some of these health issues in order to protect yourself adequately against them.

8.6.2 Repetitive strain injuries

Repetitive strain injuries (RSIs) consist of wrist, hand, arm, and neck injuries resulting when muscle groups are forced through fast, repetitive motions. These often affect people such as journalists, data-entry staff, postal workers, pianists, etc.

RSIs may cover a number of disorders, some of which may be easily curable, and others that may be very damaging. Included in the latter is the carpal tunnel syndrome (CIS), which is a debilitating condition caused by pressure on the median nerve in the wrist, producing damage and pain to nerves and tendons in the hands. This may require surgery.

8.6.3 Eyestrain and headaches

In most instances, users of computers are compelled to read from the screen at very short distances and this affects the eyesight.

Computer vision syndrome (CVS) presents with eyestrain, headaches, double vision, and other problems caused by improper use of computer monitor screens. This could be reduced by keeping the screen at a good distance, using a screen with good resolution and installing screen shields.

8.6.4 Back and neck pains

These result from using improper furniture or positioning keyboards and display screens
in improper ways. Users have to adapt to the right type of furniture and equipment in order to avoid or minimise this. Also users are expected to sit straight-up when using the system.

8.7 CHAPTER SUMMARY

In this chapter we dealt with the issues of computer networks, office automation, and computer crime.

We began the chapter with the concepts of computer networks, and looked at some major network configurations, while discussing the various protocols that go with these configurations.

Office automation was also discussed, with references made to a few key applications.

There has been a discussion on computer crime that includes virus and worm.

The chapter ended with some issues in the management of Information Technology, including certain health issues.

8.8 SELF-ASSESSMENT QUESTIONS

8.8.1 What is a 'computer network?'

8.8.2 Distinguish between a computer network topology and a computer network protocol.

8.8.3 Explain briefly the term 'office automation'.

8.8.4 What is videoconferencing?

8.8.5 Define the term 'computer virus

8.9 ANSWERS TO SELF-ASSESSMENT QUESTIONS

8.9.1 A computer network is an interconnection of a number of computers and other shared devices such as printers, scanners and disc controllers for the purposes of information processing and dissemination.

Depending on the geographical dispersion of the devices making up the network, we may have a wide area network (WAN), where the devices are spread over a wide area such as a country or continent. We may also have a metropolitan area network (MAN), where the devices are spread over a smaller area like a suburb
of a city, or a local network, where the devices are spread over a limited area such as a building or a small campus of an institution.

(Note that a local-area network, LAN, is one type of a local network).

8.9.2 The topology (or configuration) of a network is determined by the manner in which the devices making up the network are physically connected together. The physical connection is very important because it is possible to have a visual picture of a type of topology whereas the actual one is entirely different.

However, a network protocol consists of the set of rules and guidelines that govern the manner in which messages are passed round on the network.

8.9.3 Office automation involves the use of computers, micro-electronics and telecommunications technology to manage information resources automatically.

The whole purpose of office automation is to integrate some, if not all, of the departmental functions in the organisation. The terms 'electronic office' or 'paperless office' are often used to describe the modern office environment.

The implication is that more use is now made of varied office equipment in the office than used to be the case in the past, leading to the minimal, if at all, use of paper. For example, organisations now use electronic mail for both internal and external communication. The computer is used in many different ways to handle almost all office routines.

8.9.4 Videoconferencing makes use of television video and sound technology together with computers to enable people in different geographical locations to see, hear, and talk with each other. The use of 'Web camera' (Webcam) technology on PCs has made videoconferencing via the Internet a cheaper option than investing in special equipment and facilities.

Videoconferencing has led to video mail (V-mail) in which video messages can be sent, stored, and retrieved just like e-mail.

8.9.5 A computer virus is a type of infectious coding or malicious coding designed to damage or compromise computer systems.
The coding is parasitic in nature. Once it finds a host (which might be a PC), it is released and replicates itself very quickly.

A virus will typically infect the memory and/or backing storage. Some viruses may cause no visible harm to a computer system but others are such that they cause extreme havoc immediately they get onto the computer.
CHAPTER 9

THE INTERNET AND RELATED APPLICATIONS

9.0 LEARNING OBJECTIVES

After reading this chapter you should be able to

1. Understand the nature of the Internet and its uses, problems, and benefits.
2. Appreciate the related applications of the Internet, intranets, and extranets.
3. Understand the concept of electronic commerce, electronic data interchange, electronic banking, teleconferencing, and similar applications.
4. Understand the concept of the virtual office.
5. Understand the nature and uses of information stored on cards.

9.1 THE INTERNET

9.1.1 Introduction

The internet is a network of networks; a series of networks using very precise rules that allow any user to connect to, and use, any available network or computer connected to it.

Created by the US Department of Defense in 1969 under the name ARPAnet (ARPA stands for Advanced Research Project Agency). The Internet was built to serve two purposes:

The first was to share research among military, industry and university scholars.

The second was to provide a system for sustaining communication among military units in the event of nuclear attack.

9.1.2 The Internet protocol

The Internet Protocol, the standard language of the Internet, Transmission Control Protocol/Internet Protocol (TCP/IP), has been available since 1983. It is the standardised set of guidelines (protocol) that allows different computers on different networks to communicate with each other efficiently, no matter how they gained access to the Net.
9.1.3 Using the Internet

There are no formalised rules about how to behave on using the Internet. Over the years, however, a code of conduct, sometimes referred to as network ethics has evolved.

Rules that govern the Internet rest with the Internet Society (a voluntary organisation) that, through the Internet Architecture Board (IAB), sets the standards as well as the rules for accessing and using addresses.

The addressing system for the Internet uses a process called the 'Domain Name System' (DNS). Internet addresses are numerical and are called 'IP Addresses' (e.g. 128.116.24.3). However, most users never see or use IP addresses directly because the DNS provides a more meaningful and easier-to-remember name. The host computer converts a DNS to an IP address in the background, so the user doesn't need to know or remember the numbers.

A DNS name is made up of a domain and one or more sub-domains. For example, www.ed.ati.edu uses the domain edu (educational institution) and has three sub-domains, ati, ed, and www. Each sub-domain identifies a particular computer or network. Reading the address backwards, it is the educational institution Accountancy Training Institute (ati), using the education (ed) computer, which is available on the web (www).

The DNS is specific to a computer.

Popular domains are:

- .com or .co commercial
- .edu or .ac educational (university)
- .gov governmental
- .mil military
- .org organisation
- .net network

Because the Internet is worldwide, some addresses include the country in addition to the network type, e.g. .ng (for Nigeria) .us(for the US), .uk (for the UK), and .gh (for Ghana).

The web consists of an interconnected system of sites, or places, all over the world that
can store information in multimedia form - sounds, photos, video, as well as text. The sites share a form consisting of a hypertext series of links that connect similar words and phrases.

'Hypertext' is a system in which documents scattered across many Internet sites are directly linked, so that a word or phrase in one document becomes a connection to an entirely different document.

In particular, the format used on the web is called 'hypertext mark-up language' (HTML) and swaps information using 'hypertext transfer protocol' (HTTP).

To find a particular web site, one needs its URL (Uniform Resource Locator), which is an address that points to a specific resource on the web.

To get to this address, one needs a web browser software that helps one get information required by clicking on words or pictures on the screen.

Popular web browsers include Netscape Navigator, and Microsoft Internet Explorer.

Searching the Internet is done by the use of a search engine such as Google, Yahoo, etc. The user simply types in a word or phrase to find a list of related websites.

The Wireless Application Protocol (WAP) allows the use of mobile phones for a wide range of interactions with the web.

**9.1.4 Current Uses of the Internet**

The scope and potential of the Internet are immense, and they include the following:

- Dissemination of information.
- Product/service development.
- Transaction processing - both business-to-business and business-to-consumer.
- Relationship enhancement.
- Recruitment and job search.
- Entertainment.
- Education.
9.1.5 Internet Security Issues

Establishing organisational links to the Internet brings numerous security risks. Some of these risks are listed below:

(a) A virus on a single computer can easily spread through the network to all the organisation's computers.

(b) Disaffected employees can deliberately cause damage to valuable corporate data or systems because the network could give them access to parts of the system that they are not really authorised to use.

(c) Where the organisation is linked to an external network, outsiders may be able to gain access to the company's network, either to steal information or damage the system.

(d) Employees may download inaccurate information or imperfect or virus-ridden software from external networks.

(e) Information transmitted from one part of the organisation to another may be intercepted.

(Encryption may be used to check this. Encryption involves scrambling the data at one end of the line, transmitting the scrambled data, and unscrambling it at the receiver's end of the line).

(f) The communication link itself may break down or distort data.

9.2 INTRANET

9.2.1 Introduction

An intranet is an internal corporate network that uses the infrastructure and standards of the Internet and the World Wide Web. An intranet can connect all types of computers.

9.2.2 Intranet security

One of the greatest considerations of an intranet is security.

The fact that the network is connected to other external networks means that outsiders without access rights may easily gain access to the corporate network, and this must be
The means of doing this is the installation of a security software called a 'firewall'.

A firewall is a security program that connects the intranet to external networks, such as the internet. It blocks unauthorised traffic (including unauthorised employees) from entering the intranet.

9.3 EXTRANET

An extranet is a type of intranet that is accessible to outsiders, but limited to only those with valid user identification numbers.

9.3.1 Accessing the extranet

In order for outsiders to gain access to the extranet, there is the need for some form of identification. Any prospective user is therefore required to enter a valid identification number before access can be granted.

9.4 OTHER APPLICATIONS OF THE INTERNET

9.4.1 Electronic Mail (e-mail)

Electronic mail systems are intended to replace the movement of paper messages with the electronic transmission of coded, graphic or textual information. A mail can be sent to or received by several people at different locations and within different time zones, using computers or telephones.

Typically, the information is 'posted' by the sender to a central computer which allocates disk storage as a 'mailbox' to each user. The information is subsequently 'collected' by the receiver from the mailbox using e-mail software. Each person - the sender and receiver(s) - will require an e-mail address like mustapha@yahoo.com that must be used to send or receive the mail.

Each user will typically have a password-protected access to his own inbox, outbox and filing system.

9.4.1.1 Advantages of e-mail

E-mail has the following advantages:

(a) Speed - Since transmission is electronic, it is almost instantaneous, barring any delays over the Internet.
(b) Economy - e-mail is reckoned to be several times cheaper than fax or the ordinary post.

(c) Efficiency - A message is prepared once but can be transmitted to several different people at different locations and time zones.

(d) Security - Access is generally restricted by the use of passwords.

(e) Attachments can be used to send documents and reports as well as memoranda.

9.4.1.2 Shortcomings of e-mail

In spite of its advantages, e-mail may not always be the best medium for communication. Possible shortcomings are:

(a) The nature of the medium is such that the full import of a message may not be felt. Users tend to be very informal and casual.

(b) The nature of a message may demand detailed discussion of a problem but e-mail is best suited to short messages.

(c) There is the likelihood of information overload. People easily become obsessed with the idea of using the facility, thereby sending information when this is even not required.

(d) E-mails over the Internet may be unduly delayed while virus infection is very common.

9.4.2 Electronic Commerce (e-Commerce)

Electronic commerce may be defined as 'trading on the Internet', that is, the 'use of the Internet and Websites in the sale of products or services'.

It is the application of advanced technology to increase the effectiveness of commercial practices.

The use of the Internet allows businesses to reach potentially millions of consumers worldwide and extends trading time to seven days, around the clock.
For established companies, e-commerce reduces expensive sales and distribution workforces, and offers new marketing opportunities.

The Internet can be used to get certain products directly into people's homes. Anything that can be converted into digital form can simply be placed into the seller's site and then downloaded onto the customer's PC at home. The Internet thus offers huge opportunities to producers of text, graphics/video, and sound-based products. A large number of computer software products are now distributed this way.

Besides its usefulness for tapping into worldwide information resources, businesses are also using it to provide information about their own products and services.

For customers, the Internet offers a speedy and impersonal way of getting to know about the services that a company provides.

For businesses, the advantage is that it is much cheaper to provide the information in electronic form than it would be to employ staff to man the phone on an enquiry desk.

Websites can provide sound and movement and allow interactivity so that the user has the opportunity to drill down to obtain further information, watch a video of the product in use, or get a virtual reality experience of the product or service.

There is the need to collect information about customers. Customers who visit a site for the first time are asked to register, which typically involves giving a name, physical address, e-mail address and possibly other demographic data such as age, job title and income bracket.

When customers come to the site on subsequent occasions they either type their (self chosen) username and password or more usually now, if they are using the same computer, the website recognises them using a 'cookie', which is a small file containing a string of characters that uniquely identifies the computer.

As users visit the site more often, more is learned about them by recording what they click on, since this shows what they are interested in. These are known as 'klickstreams',

**9.4.3 Electronic Banking**

Electronic banking (or e-banking) describes the technique of engaging in banking activities by means of computers and telecommunications. A bank may provide its customers with software and telecommunications facilities, including modems, and special codes to be used to identify themselves online.
Without moving to the premises of the bank, customers can request the balances on their accounts, advise on transfers to be made from their accounts to others, and discuss account status online. The feature is available on cellular phones, making it possible to have online information on one’s account wherever one finds oneself.

### 9.4.4 Electronic Data Interchange (EDI)

EDI is the direct electronic exchange of standard business documents such as purchase orders, invoices and shipping documents between organisations' computer systems.

To use EDI, organisations must have compatible computer systems between them. EDI may be used in situations where a firm engages in business activities like purchases and sales with other companies and engages in electronic communication rather than communicating using paper documents.

EDI places a great burden on auditors because electronic transactions are difficult to verify.

### 9.4.5 Telecommuting

Telecommuting involves employees working from their homes or other locations outside their offices.

The disadvantages to employers include

- difficulty in controlling employees;
- less security of data and confidential information;
- higher communication costs.

For the employees, advantages include

- less time and expense travelling to and from work;
- more flexibility in working times;
- spending less on office space and furniture
- depending on the home environment, there may be fewer Interruptions.
- the opportunities to engage workers who may not find full time employment feasible
Disadvantages to the employees include the following:

- comfort in the home is compromised;
- some social rewards available from the office setting may be lost.

### 9.4.6 The virtual office

The virtual office is a non-permanent and mobile office run with computer and communications technology. Using pocket pagers, portable computers, fax machines, and various phone and network services, employees work from their homes, cars, and other new work sites rather than a central office.

### 9.4.7 Teleconferencing

Using teleconferencing, employees or business associates at different locations hold joint meetings by means of video, audio, and data communications.

One application of teleconferencing of interest is teaching, in which lecturers are able to both lecture and answer questions from remote locations.

Teleconferencing enables companies to save on transportation costs and reduce lost productivity. It also enables a manager to interact with different branches simultaneously.

Major drawbacks include set-up costs and the increased risks of electronic eavesdropping.

### 9.5 STORAGE ON CARDS

#### 9.5.1 Magnetic-Stripe Cards

A magnetic-stripe card has stripes of magnetically encoded data on its reverse side and is encoded with data specific to a particular use.

Examples are ATM cards and credit cards. The information they contain may be name, account number, personal identification number (PIN), etc. of the holder.
The conventional magnetic-stripe card has a capacity for about half an A4 page of data.

### 9.5.2 Smart Cards

A smart card is a wallet-type card that contains a microprocessor and memory chip that can be used to input data. As a common use, users may buy telephone debit cards that can then be used to make telephone calls. The duration of a call is automatically calculated on the chip inside the card and the cost deducted from the balance.

In some countries, the smart card may also be used as bank cards and as medical history cards that patients may carry about.

The smart card can conveniently hold the equivalent of about thirty (30) A4 pages of information.

### 9.5.3 Optical Cards

The optical card is a plastic, laser-recordable, wallet-type card used with an optical-card reader. The optical card has capacity for about 2000 M pages of data.

An optical card may be used as a health card for an individual and may hold not only the person's medical history and health-insurance information, but also digital images such as X-rays, electrocardiograms, etc.

The volume of details on the card means that adequate backups must be ensured otherwise the loss of the card will result in incalculable loss of information.

### 9.6 CHAPTER SUMMARY

In this chapter we have looked at the Internet and its related issues. We learnt that the Internet (often referred to as the Net) has been of tremendous benefit to individuals, organisations and other institutions.

Despite the benefits it affords its users, the Net has a number of drawbacks, especially with regards to security issues.
Arising from the Internet and its uses are the Intranets and extranets, and various applications geared towards communication over the Net

Some of the cards that are used to facilitate business transactions have also been discussed in the chapter.

9.7 SELF-ASSESSMENT QUESTIONS

9.7.1 Explain briefly the term 'Internet protocol'.

9.7.2 What is an extranet?

9.7.3 Define the term 'telecommuting'.

9.7.4 Describe two uses of a smart card.

9.7.5 What is an electronic mail (e-mail)?

9.8 ANSWERS TO SELF-ASSESSMENT QUESTIONS

9.8.1 By 'Internet protocol' is meant the standard language of the Internet, Transmission Control Protocol / Internet Protocol (TCP/IP), which has been available since 1983. It is the standardised set of guidelines (protocol) that allow different computers on different networks to communicate with each other efficiently, no matter how they gained access to the Net.

9.8.2 An extranet is a type of intranet that is accessible to outsiders, but limited to only those with valid user identification numbers. Any prospective user is required to enter a valid identification number before access can be granted.

9.8.3 Telecommuting involves employees working from their homes or other locations outside their offices.

The advantages of telecommuting include the opportunities to engage workers who may not find full-time employment feasible as well as spending less on office space and
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

furniture.

9.8.4 A smart card is a wallet-type card that contains a microprocessor and memory chip and can be used to input data.

One of its uses is that of a telephone card, where users buy telephone debit cards that are used to make telephone calls. The duration of a call is automatically calculated on the chip inside the card and the cost deducted from the balance.

The smart card may also be used as medical history cards that contain patients' medical information that the patients may carry about.

9.8.5 An electronic mail is intended to replace the movement of paper messages with the electronic transmission of coded, graphic or textual information. An electronic mail can be sent to or received by several people at different locations and within different time zones, using computers or telephones.

Typically, the information is 'posted' by the sender to a central computer which allocates disk storage as a 'mailbox' to each user. The information is subsequently 'collected' by the receiver from the mailbox using e-mail software. Each person - the sender and receiver(s) - will require an e-mail address.
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EXAMINATION TYPE QUESTIONS
(A) SECTION A

SHORT-ANSWER QUESTIONS

1. What is meant by the term Tile conversion?

2. Give the definition of 'facilities management'.

3. Who is an Internet service provider?

4. Two types of fax hardware are ___ and

5. Software that allows users to use their microcomputers to simulate a mainframe or minicomputer terminal is called ____

6. A worker at home can communicate with the office, using hardware and software, with the aid of ....................

7. What is a firewall?

8. Define the term connectivity'.

9. What is meant by' encryption?

10. Define the term "disaster-recovery plan".
MULTIPLE-CHOICE QUESTIONS

1. The technology that merges computing with high-speed communications links carrying data, sound, and video is known as............
   a) computer technology  b) information technology  c) communications technology  
   d) technological convergence  e) digital convergence.

2. At what stage of the SDLC are software and hardware obtained?
   a) problem definition  b) systems analysis  c) systems design  d) systems maintenance  
   e) systems implementation.

3. Which of the following changeover methods employed during system implementation is the riskiest?
   a) direct method  b) parallel method  c) phased method  d) pilot method  
   e) one by one method.

4. The following involves building a model or experimental version of all or part of a system so that it can be quickly tested and evaluated.
   a) modeling  b) testing  c) prototyping  d) system evaluation  
   e) system development.

5. The following tool(s) is (are) used during the system maintenance stage of the SDLC:
   i. testing  ii. auditing  iii. modeling  iv. evaluation  
   a) i and ii  b) ii only  c) i and iv  d) ii and iv  e) iii only

6. Which of following approaches describes the partnership between users and systems developers during the process of developing a system? a) systems design  b) rapid application development  c) joint application development  d) parallel changeover  e) modeling

7. For a typical commercial bank, which of the following activities may not be outsourced?
   a) security  b) transport services  c) canteen services  d) teller duties  e) health services.

8. Which of the following allows different computers on different networks to
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1. communicate?
   a) telecommuting  b) e-mail  c) LAN  d) WAN  e) TCP/IP.

9. Either a PABX or LAN is a .................
   a) local network  b) WAN  c) MAN  d) internet-based network  e) private network.

10. A network in which all communications devices are connected to a common channel is called a ___ network.
    a) ring  b) bus  c) tree  d) star  e) hybrid

11. You must have access to ................. before you can use your computer to communicate over the telephone lines.
    a) internet  b) data compression software  c) terminal emulation software  d) modem  e) TCP/IP.

12. Which of the following is an example of an information technology crime? a) hardware theft  b) software theft  c) theft of time and services  d) theft of information  e) computer theft.

13. One of the following groups operates over 80% of information technology crime, a) hackers  b) crackers  c) professional criminals  d) employees  e) internet service providers.

14. Which of the following is the science of measuring individual body characteristics? a) encryption  b) cryptography  c) biometrics  d) neuralistics  e) enciphering.

15. At which stage of the SDLC are data gathered and analysed? a) systems analysis  b) problem definition  c) systems design  d) systems implementation  e) data analysis.

16. Which of the following is not a type of modeling tool used in the SDLC? a) data flow diagram  b) systems flowchart  c) connectivity diagram  d) decision table  e) spreadsheet program.

17. Which of the following would you use if you wanted to copy files for free from a remote computer? a) Archie  b) Usenet  c) World wide web  d) FTP  e) copy.

18. A communications ___ is used in a communications network to govern the exchange of data between hardware and/or software.
   a) multiplexer  b) protocol  c) channel  d) information service  e) datplex.

19. Before you can communicate over the phone lines, your computer requires
communications_.

a) hardware  b) software  c) links  d) interface  e) network.

20. Which one of the following provides information in multimedia form?  a) FTP  b) Archie  c) Usenet  d) World wide web  e) router.

21. The term _____ refers to retrieving a file from another computer and copying it onto your computer.  
   a) transfer  b) copy  c) download  d) save  e) upload.

22. An interface that enables dissimilar networks to communicate is called ..............
   a) bridge  b) router  c) modem  d) multiplexer  e) gateway.

23. Which of the following copies itself into memory or a disk until no more space is left?
   a) antiviral agent  b) worm  c) virus  d) dirty data  e) test data.

24. A string of characters and numbers that a user adds to an electronic document being sent by his or her computer is known as a(n).
   a) password  b) authority code  c) digital signature  d) PIN  e) character string.

25. Which of the following is not typically part of a desktop-publishing system?  a) scanner  b) laser printer  c) mouse  d) desktop-publishing software  e) software suite.

26. Which of the following is used in Help systems to allow users to go to related helpful information.
   a) Hypertext  b) HTTP  c) HTML  d) World wide web  e) Web browser.

27. Which of the following is used on a network and serves multiple users working on a common project?
   a) integrated software  b) groupware  c) shareware  d) software suite  e) firmware.

28. Which of the following is not a feature of word processing software?  a) headers and footers  b) table insertion  c) spell-checker  d) thesaurus  e) what-if analysis.

29. Which of the following is not used to connect computers?
   a) coaxial cable  b) fibre-optic cable  c) radio waves  d) copper wire  e) all of the above.

30. A utility that is supposed to prevent a monitor's display screen from being etched by an unchanging image is known as ..................  
   a) virus protector  b) screen saver  c) operating system  d) data recovery program  e) browser.
31. What name is given to the main page or first screen you see when you access a Web site?
   a) Uniform Resource Locator b) home page c) Web page d) FAQ e) HTML.
32. A computer that stores the data shared by users on a LAN is called a(n).__ a) file server b) data manager c) mail server d) server e) database server.
33. Workgroup computing uses a type of software called ____. a) shareware b) workgroup software c) groupware d) operating software e) gopher.
34. What name is given to the communications network that covers a geographical area the size of a city or suburb?
   a) wide area network b) metropolitan area network c) local area network d) privatised network e) suburban network.
35. What is the name given to a program that destroys or corrupts data? a) corrupt software b) worm c) firewall d) virus e) cracker.
36. Which of the following describes the types of tasks performed by a systems analyst?
   a) systems analysis b) systems design c) systems implementation d) systems investigation e) all of the above.
37. Which of the following services is not available from a computer services bureau? a) data preparation b) system investigation c) system design d) programming e) text editing.
38. During ____, use is made of television, video and sound technology together with computers to enable people in different geographical locations to see, hear, and talk with each other.
   a) audio teleconferencing b) conference call c) telecommuting d) videoconferencing e) on-line chatting.
39. Which of the following is not a health issue associated with the use of computers?
   a) carpal tunnel syndrome b) eyestrain c) brain injury d) double vision e) back pains.
40. Which of these does not form a component of a LAN?
   a) connection or cabling b) network interface cards c) network operating software d) bridge e) duplicator.

ANSWERS TO EXAMINATION TYPE QUESTIONS
SECTION A

SHORT ANSWER QUESTIONS

1. 'Tile conversion' is the step in system implementation during which the old file data from the old system are transferred into a form suitable for the new system.

2. 'Facilities management' is the management of an organisation's information systems facilities by an external company.

3. An Internet service provider is a local or national company that provides unlimited public access to the Internet and the Web for a fee.

4. The two types are dedicated fax machine and fax modem.

5. Terminal emulation software.

6. Telecommuting.

7. A firewall is software used in internal networks (intranets) to prevent unauthorised people from accessing the network.

8. This is the state of being able to connect devices by communications technology to other devices and sources of information.

9. 'Encryption' is the altering of data so that it is not usable unless the changes are undone.

10. This is the method of restoring information processing operations that have been halted by destruction or some accident.

MULTIPLE-CHOICE QUESTIONS
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1. (b)  2. (e)  3. (a)  4. (c)  5. (d)  6. (c)  7. (d)  8. (e)  9. (a)

10. (b)  (ll. (d)  12. (e)  13. (d)  14. (c)  15. (a)  16. (e).  17. (d)  18. (b)

19. (b)  20. (d)  21. (c)  22. (e)  23. (b)  24. (c)  25. (e)  26. (a)  27. (b)

28. (e)  29. (d)  30. (b)  31. (b)  32. (e)  33. (c)  34. (b)  35. (d)  36. (e)

37. (e)  38. (d)  39. (c)  40. (e)
EXAMINATION TYPE QUESTIONS (A)

Answer any FIVE of the following questions. Time: 3 Hours

1. a) During the design of a system, end-user involvement is considered essential. Explain the technique of 'user validation' as used in system design.
   b) Give any two (2) benefits associated with the parallel running approach to system changeover.

2. Most organisations prefer to set up personal computer (PC) networks for use. One of the popular configurations used is the star. You are required to:
   a) explain the mode of operation of the star network;
   b) state any four (4) benefits of a local-area network.

3. a) What is meant by a 'computer virus?
   b) Give any five (5) types of intervention meant to protect a computer from a virus attack.

4. An initial investment of N2 million in a project yields cash inflows of:
   N500,000; N500,000; N600,000; N600,000; N440,000
   at 12 months intervals. There is no scrap value and funds are available to finance the project at 12%. You are required to determine whether the project is feasible, using the NPV approach.

5. a) Describe the smart card and explain its suitability as a means of storing information.
   b) K. Sam Ltd, a large newspaper firm, uses the Internet extensively for its purchases.
      Give any three (3) possible inherent disadvantages the company is likely to encounter.

6. For a typical Information System project:
   a) explain the term 'feasibility study';
   b) describe the sections of a typical feasibility study report.
7. a) Explain the term 'outsourcing'.

   b) Explain any three (3) steps that managers should take to ensure the success of outsourcing

   **ANSWERS TO EXAMINATION TYPE QUESTIONS (A)**

1. a) 'User validation' is the technique used by system designers to ensure that the eventual users of a system participate in the design process. The end result of the design process is the full specification of the system and it is believed that if users are ignored at this stage, the final delivery may not match their expectations.

   In user validation, the analyst breaks down the process into a number of sections (called 'milestones'). At each milestone, the resulting output (deliverable) is presented to users for their approval.

   Periodic sessions are held so that interested users can 'walk through' the input and processing operations to describe the handling of data.

   Users are encouraged to look for errors and to make comments. It does not serve any purpose for the designer or the users themselves if an honest review is not done in order to ensure corrections are effected where necessary. There must be a formal sign-off on the section before work on the next can commence.

   b) The parallel running approach affords a number of benefits, including:

   - allowing all interested parties to satisfy themselves that the new system actually works well before the old is abandoned;
   - giving the eventual users of the system sufficient training in its operation before it takes off.

2. a) In the star network all the PCs and other communications devices are connected to a central server. This is a typical example of a Client/server LAN. No client is allowed to communicate directly with other clients. Electronic messages are routed through the server to their various destinations. The server monitors the flow of traffic, thereby preventing collisions of messages. If a connection is broken between any
communications device and the server, the rest of the devices on the network will continue to function. The main disadvantage is that a breakdown of the server renders the network inoperative.

b) The advantages of a local-area network include the following:

- Data can be shared among all users,
- Users can share expensive resources such as high quality printers and scanners.
- If one machine breaks down, the others can continue working (provided the faulty one is not the server).
- It is cost effective for large numbers of users.
- The network can be systematically extended as the organisation grows.

3. a) A 'computer virus' may be defined as infectious coding or malicious coding. It is any software designed to damage or compromise computer systems. The coding is parasitic in nature. Once it finds a host (such as a PC) it is released and replicates itself very quickly, possibly infecting memory and backing storage media.

The commonest way that viruses are spread is through e-mail, usually in the form of attachments. Viruses can also be carried by diskettes, flash disks, networks, CD's and in software downloaded from the Internet. It is even possible to pick up a virus by chatting on-line or by visiting a website.

b) The following interventions may be adopted to protect a computer from a virus attack:

- Go for the right anti-virus software and ensure regular backups.
- Update the anti-virus software regularly (through the internet),
- Guard your e-mail in-box, especially attachments,
- Download material from well-known and reputable sources only.
- Establish rules on media that may be used on the network or PC.
4. 

<table>
<thead>
<tr>
<th>N</th>
<th>Discount Factor @ 12%</th>
<th>Present Value (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>2,000,000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**Cash Inflows**

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
<th>Discount Factor</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500,000</td>
<td>0.893</td>
<td>446,500</td>
</tr>
<tr>
<td>2</td>
<td>500,000</td>
<td>0.797</td>
<td>398,500</td>
</tr>
<tr>
<td>3</td>
<td>600,000</td>
<td>0.712</td>
<td>427,200</td>
</tr>
<tr>
<td>4</td>
<td>600,000</td>
<td>0.636</td>
<td>381,600</td>
</tr>
<tr>
<td>5</td>
<td>440,000</td>
<td>0.568</td>
<td>249,920</td>
</tr>
</tbody>
</table>

Net Present Value (NPV) \( \text{N}(96,280) \)

The negative value for the NPV means that the project is not feasible.

5. a) A smart card is a wallet-type card that contains a microprocessor and memory chip that can be used to input data. As a common use, users may buy telephone debit cards that can then be used to make telephone calls. The duration of a call is automatically calculated on the chip, inside the card and the cost deducted from the balance.

The smart card may also be used as bank cards and as medical history cards that patients may carry about.

The smart card can conveniently hold the equivalent of about thirty (30) A4 pages of information.

b) Despite the benefits associated with Internet access, a number disadvantages also present themselves, including:

- Possible transmission of viruses over the Internet.
- Frauds may be perpetrated over the Net. Fraudulent sites may be set up by certain hackers to deceive and swindle unsuspecting businesses.
6. a) Feasibility study is a formal detailed study to decide what type of system can be developed which meets the needs of an organization. The goal of a feasibility study is to identify, as quickly as possible, whether the benefits of a proposed project appear to outweigh its expected cost and disruption based on what is already known.

Since early feasibility estimates may be overly optimistic, it is usually a good idea to conduct feasibility study at various times throughout all the phases of the System Development Life Cycle (SDLC) to determine whether to continue the project, revise the specification, or abandon it altogether.

b) The feasibility study report includes the following as contents:

- Executive summary - A short (possibly one-page) summary of the contents of the entire report.

- Terms of reference - A restatement of the terms of reference to facilitate an understanding of the report.

- Current system issues - All the good and bad sides of the current system that came up during the study.

- Evaluation of each option - Details of how each option was assessed in terms of its strengths and weaknesses.

- Description of the options - A thorough account of the various options, showing why each was selected.

- Feasibility - Analysis of how each option met the selection Criteria.

- Conclusion - A clear statement of what the team finally arrived at, in terms of their choice.

- Recommendation - This is to the appointing authority seeking permission to continue with the project.

7. a) 'Outsourcing' involves purchasing from outside the organization, the services required to perform certain business functions. Outsourcing covers facilities
management, types of services and a range of contracts with more intangible benefits. It includes such services as computer centre operations, network operations and applications management as well as systems integration. Outsourcing is often closely related to downsizing and/or divesting in order to concentrate on key business competencies. The main reason for outsourcing comes from lowering costs, reducing the dilution of management attention or covering temporary skill gaps.

A company is not expected to outsource any of its key operational functions. The reason for this is that the company stands the chance of losing any competitive advantage it enjoys if the outsourcing vendor is also a vendor to any of the company's competitors.

b) In order to ensure the success of outsourcing, managers should take the following steps:

- Establish a strategy to deal with possible reductions in staff.
- Closely integrate the external suppliers.
- Provide appropriate communication channels.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

EXAMINATION TYPE QUESTIONS (B2)

Answer any FIVE of the following questions. Time: 3 Hours

1. a) Explain any two (2) breaches associated with the use of a PC local-area network (LAN) and how they may be averted,
b) How may different computer networks be linked together?

2. In the System Development Life Cycle (SDLC)
a) Why is the 'problem definition' stage very important?
b) Explain the need for the 'post implementation review'.

3. a) What is telecommuting?
b) Give any four (4) reasons for telecommuting.
c) Explain the concept of 'the virtual office'.

4. Kofi Adeyemi & Sons Ltd is into bolts and nuts production and selling and has been experiencing a marked improvement in its business operations in the past year.

Management is contemplating to use the services of a computer service bureau for some of the firm's operations.

a) What is a computer service bureau?
b) Explain any five (5) factors the firm's management may have to take into consideration in their selection of an appropriate computer service bureau.

5. a) What is 'facilities management'?
b) Explain any three (3) reasons why a firm may decide to engage in facilities management.
6. A company which has been facing liquidity problems plans to embark on a project and has four (4) options open to it. An initial study has revealed the following details about all four alternative projects:

<table>
<thead>
<tr>
<th>Project</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment (N'm)</td>
<td>20</td>
<td>30</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>NPV (N'm x 100)</td>
<td>4.90</td>
<td>5.10</td>
<td>3.95</td>
<td>2.50</td>
</tr>
</tbody>
</table>

You are required to advise on the option that the company should embark upon.

7. Write brief notes on EACH of the following:
   a) Network topology
   b) Internet protocol
   c) World Wide Web (WWW)
   d) Web site
1. a) The complexity of LANs makes it possible for a number of breaches to be committed. Included in these are the following:

   i) passwords and unauthorised access

   ii) computer viruses

- Passwords and unauthorised access

A password may be defined as a sequence of characters to be entered into a computer system in order to gain access to the system or some other parts of it.

The use of passwords should be properly monitored and controlled to ensure that passwords are not leaked to or copied by other people. Passwords should also be changed regularly (possibly monthly).

The use of passwords has the objective of restricting access to the LAN or any resources on it to only authorised users; that is, unauthorised access is prevented.

- Computer viruses

A computer virus is a small program which has the ability to infect a whole computer system. A virus may be passed from one computer to another by means of a storage medium like a floppy or hard disk or flash disk, and also through networks.

Preventive steps may include the following:

- Use of effective antivirus software on network. This software must be updated regularly from the Internet.

- Control over the use of external software, especially those downloaded from the Internet.

- Use of only tested, marked disks within the organisation.

- Guarding against one's e-mail inbox, especially with regards to e-mail attachments.
b) Local-area networks (LANs) of similar infrastructure may be connected together by means of an interface which may be a router or bridge. However, a LAN may be connected with a network of dissimilar infrastructure (e.g. a wide area network) by means of a gateway, another type of interface.

2. a) The problem definition stage is important because it makes it possible to analyse the system or sub-system with user in order to ascertain their actual needs. Unless the users' actual needs are identified, any attempt at developing any new system will be an exercise in futility.

b) The post implementation stage is essential because it is used to investigate and to review the performance of an operational system; to compare actual with planned performance; to verify that the stated objectives of the system are still valid in the present environment and to evaluate the achievement of these objectives.

The investigation also examines the level of control in the system. It is also used to carry out regular reviews of systems concerned with the continued achievement of benefits, any deviations from the master system specification, and opportunities for improvement.

A system may be seen as excellent when implemented but, because business needs and operations are very dynamic, there is always the need to review systems that have been operated for a period of time and have attained equilibrium to ensure their continued benefit to the organisation. If there is the need for amendment these can then be carried out.

3. a) Telecommuting involves employees working from their homes or other locations outside their offices. It makes it possible for employees to work effectively without always having to commute to their offices and back.

b) Reasons for telecommuting include the following:

- The opportunities to engage workers who may not find full-time employment feasible.

- The urge to spend less on office space and furniture.
- Less time and expense travelling to and from work.

- More flexibility in working times.

c) The virtual office is a non-permanent and mobile office run with computer and communications technology. Using pocket pagers, portable computers, fax machines, and various phone and network services, employees work from their homes, cars, and other new work sites rather than a central office.

This makes it possible for the organisation to expand its services to customers without necessarily spending heavily on office buildings and furniture as well as staff.

4. a) A computer service bureau is a firm that operates to offer computing services to individuals and other firms that require the services but either do not have the facilities needed or just do not find it worthwhile or economically justifiable to do so,

b) In order to select an appropriate bureau from the market, the firm's management have to consider factors such as:

  o Reputation of the bureau on the market - this is important for the purpose of trying to do business with a bureau that has already made a name and can thus be trusted to render good services.

  o Integrity of the bureau - Management will be interested in a bureau with honest and committed management and staff.

  o Efficiency of the bureau - the bureau's throughput should be high and should be using methods that will render their charges quite low.

  o Competitiveness of the bureau - the standard of work must be high and rates charged must be lower or compare favourably with others,

  o Bureau's approach to technological developments - this will reveal the preparedness or otherwise of the bureau's attitude to innovation.

5. a) Facilities Management (FM) is defined as the management and operation of part or all of an organisation's Information Systems (IS) services by an external source at an agreed service level, cost, and an agreed time period.
The facilities management contract may further include IT consultancy, the management of IT services, the provision of new services and ownership of hardware and software.

Computing facilities that could be taken over by FM will include:

- project management assistance
- complete control of systems development
- running an entire IS function.

b) The reasons for using facilities management include:

i) the organisation may not have the staff, management time or expertise to organize their substantial IS requirements;

ii) controlling cost; the contract for services may specify the cost in advance and extra costs may be borne by the FM company;

iii) economies of scale may exist where a number of organisations employ the same FM company; any research carried out by the FM company can be shared between them.

6. a) Since our company has problems with cash, we need to apply the cost-benefit ratio approach;

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV (N'm) *100</td>
<td>490</td>
<td>510</td>
<td>395</td>
<td>250</td>
</tr>
<tr>
<td>Investment (N'm)</td>
<td>20</td>
<td>30</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Cost-benefit ratio</td>
<td>24.5%</td>
<td>17%</td>
<td>15.8%</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

From the figures, it is noted that project B costs more than project A by 50% but contributes a less than proportionate NPV compared with project A. Since there is a
problem of cash availability, there will be no justification for investing that much for that small additional return.

From the figures available, project A returns the most attractive cost-benefit ratio and is, accordingly, the best option.

7. a) The term 'network topology' (also called network configuration or network structure) refers to the manner in which the devices making up the network are physically connected together. There is a clear difference between what arrangement one sees 'on the ground' and the actual topology of the network.

b) The Internet Protocol is the standard language of the Internet, Transmission Control Protocol / Internet Protocol (TCP/IP) and has been available since 1983. It is the standardised set of rules and guidelines (protocol) that allows different computers on different networks to communicate with each other efficiently, no matter how they gained access to the Net.

c) The World Wide Web (WWW), or simply 'the Web', consists of an interconnected system of sites, or places, all over the world that can store information in multimedia form - sounds, photos, video, as well as text. The sites share a form consisting of a hypertext series of links that connect similar words and phrases. The Web is the fastest-growing part of the Internet and also happens to be the most graphically inviting and easily navigable section of the Internet.

d) The term 'Web site' refers to a file stored on a computer (server or host computer). Each Web site focuses on a particular topic. The information on a site is stored on 'pages', with the starting page called the 'home page'.

The terms 'Web site' and 'home page' tend to be used interchangeably, although a site may have several pages.

To find a particular Web site, you need its URL (Uniform Resource Locator), an address that points to a specific resource on the Web.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

To get to this address, you need a Web browser - software that helps you get information you want by clicking on words or pictures on the screen.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

QUESTIONS

AND

ANSWERS
MULTIPLE-CHOICE QUESTIONS

Pick the most appropriate alternative

1. Identify the odd term
   (A) MHerts  (B) MIps  (C) MByte  (D) MFlops  (E) Mbits

2. An example of a fifth Generation language is
   (A) High-level Language  (B) Assembly Language
   (C) Natural Language  (D) Query Language  (E) Modern Language

3. Which one of the following words best connotes the meaning of the word system
   (A) Conformity  (B) Consistency  (C) Connection  (D) Competence  (E) Limitation

4. Data is transformed into information through
   (A) Sorting  (B) Processing  (C) Aggregation  (D) Integration  (E) Control

5. In developing an information strategy, opportunities can be identified through
   (A) Negotiation  (B) Creative thinking  (C) Interdepartmental collaboration  (D) Technology  (E) Debate

6. Which one of the following is not an essential attribute of information?  (A) Problem solving  (B) Relevance  (C) Accuracy  (D) Control  (E) Timeliness

7. Which of these is not an attribute of I.J.I
   (A) It can help one to work smarter  
   (B) It allows one to work away from one office  
   (C) It allows one to rely on technical specifications  
   (D) It keeps one informed even on the move  
   (E) It can get one closer to the customers.

8. A system that interacts with other systems is referred to as
   (A) Adaptive  (B) Closed  (C) Subsystem  (D) Open  (E) Cybernetic
To maintain a permanent record of data and programs when not being used by the CPU, one requires the use of

(A) Peripheral device
(B) Primary Memory
(C) Secondary storage
(D) RAM
(E) Magnetic floppy diskette

Convert the binary number 10110111 to hexadecimal directly

(A) 171 (B) 167 (C) 16F (D) 137 (E) 13F

Solution to Multiple Choice Questions

1. C
2. C
3. C
4. B
5. B
6. D
7. C
8. D
9. C
10. C

SHORT ANSWER QUESTIONS

Complete the following questions with appropriate words or phrases:

1. The binary system representation of the decimal number 428 is -----

2. A computer program is an algorithm written in a particular computer -----

3. The four classes of digital computers are microcomputer, minicomputer, Mainframe
and ........................

4. A computer technique that allows two or more programs to be executed concurrently on the same computer is known as............................

5. Programs developed to meet particular user's need are called............

6. The two different modes of accounting transaction processing are on-line processing and .

7. The processes of reviewing transaction details for accuracy and completeness during the input stage are verification and -----

8. Intruder, wine tapper, eavesdropper and hacker are examples of

9. A piece of computer code which attaches itself to another program on a system in order to spread itself to other programs and to have undesirable effect on the program is known as............................

10. Computer machine language is an object code while assembly language is a -----.

11. An authorization code or character, which is verified before access to some system resources is permitted is known as ..........................

12. A computer system that processes input data immediately after they are input and provides immediate output to users is known as..........................

13. MHertz,MIPS, MFlops are measures of--------

14. Slave is a --------- with dedicated tasks such as speeding up computations or providing better graphics.

Solutions to Short Answer Questions

1. 110101100

2. language

3. Super machine
4. Multiprogramming
5. Application packages (i.e. Bespoke software)
6. off-line processing
7. validation
8. Computer criminals
9. Computer virus
10. Source code
11. Password
12. Real-time
13. Processor's speed
14. Specialized processor

QUESTION 1

Low-level and high-level languages are major programming languages used (probably) in the immediate past; itemize five main features of these languages.

Solution

i. Features of a low-level language are

* It is machine oriented;
* It runs (i.e. (executes) very fast;
* It is tedious to write and it is time consuming
* It is written in mnemonics (i.e. symbols)
* It is written by experts;
* It conserves internal memory space;
* It has complex coding details.
Main features of a high-level language are

- It is problem oriented;
- It is a procedural language i.e. it needs the instructions to execute a process.
- It runs very slowly compared to a low-level language
- It is very easy to write
- It is written in the programmer's spoken language
- It can be written by non-expert enduser
- It uses more internal memory space compared to the low-level language
- It has less coding details

**QUESTION 2:**

What is a computer virus? Give five ways of preventing a computer virus in your environment

**Solution**

A computer virus is a segment of computer code which once introduced maliciously by an attacker into a host program is able to gain control of the system and replicates itself onto other programs in the and external media inserted into the infected PC. After a of dormancy, the virus activates Itself to destroy the host program and data.

**Ways of Prevention**

Computer virus can be in a CBIS (computer based information system environment by

- using original storage media
- not copying software from the internet;
- not using Games diskettes;
- regularly using antivirus software during system’s booting
- not allowing to bring into the computer environment any external storage media

**QUESTION 3:**

a. Explain the following data elements: file, field, bit, byte, record, database and arrange them in an ascending order.

b. Given the table

<table>
<thead>
<tr>
<th>Customer Number</th>
<th>Customer Name</th>
<th>State Code</th>
<th>Credit Limit</th>
<th>Credit Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>10568</td>
<td>AJETCo</td>
<td>Lagos</td>
<td>40,000</td>
<td>10,000</td>
</tr>
<tr>
<td>23795</td>
<td>Tosa Co.</td>
<td>Oyo</td>
<td>20,000</td>
<td>5,000</td>
</tr>
<tr>
<td>38697</td>
<td>Willy Co.</td>
<td>Ogun</td>
<td>10,000</td>
<td>50,000</td>
</tr>
<tr>
<td>56696</td>
<td>Best Co.</td>
<td>Benue</td>
<td>50,000</td>
<td>20,000</td>
</tr>
</tbody>
</table>

**Identify the following**

i. File
ii. Field
iii. Byte
iv. Record

**Solution**

a. * bit is the smallest unit of data.
A bit stands for binary digit and is represented by a 1 (one) or a 0 (zero).

* byte: is a string of bits. A character is represented by a byte. In the ASCII coding system 7 bits = 1 byte while in the EBCDIC coding system 1 byte = 8 bits.

- field: A field is sequence of characters that stores information.

There are four types of fields:
- Character field which contains text
- Numeric fields which store numbers
- Date fields for storing dates
- Logical fields for testing if a condition is true or false
  • Record: A record consists of a group of related fields.
  • File: A file is a collection of related records
  • Database: A database is an integrated collection of data flies

Ascending order is

Bit → byte → field → record → file → database

(b) i. The whole table is a file being a collection of records (i.e. a collection of all the rows)

ii. Each column is a field e.g. customer number, customer name, code, credit limit and credit balance

iii A byte is just a character e.g. any alphabet like C, any numeric number like 1 or any other symbols like W or any punctuation (e.g. comma)

iv. A record is any row in the table

**QUESTION 4**

a. Give two differences between a hardcopy and a softcopy.

b. Mention four characteristics that determine the choice of a printer

c. Name and describe briefly the two classifications of printers

d. Give three examples of each classification.
Solutions

a. The differences between a hardcopy and a softcopy are

<table>
<thead>
<tr>
<th>Hardcopy</th>
<th>Softcopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>* It can be touched</td>
<td>* It cannot be touched</td>
</tr>
<tr>
<td>* It persists</td>
<td>* It is transient</td>
</tr>
<tr>
<td>* It may not be used as classified document</td>
<td>* It can be used as a classified document i.e.</td>
</tr>
<tr>
<td></td>
<td>as confidential Information</td>
</tr>
<tr>
<td>* It can be distributed</td>
<td>* It cannot be distributed</td>
</tr>
<tr>
<td>* Page size can be as large as possible</td>
<td>* Page size is restricted to the screen size</td>
</tr>
<tr>
<td>* It takes sometime to produce</td>
<td>* It is generated instantly</td>
</tr>
</tbody>
</table>

b. The characteristics that determine the choice of a printer are:

i. Speed of producing output

ii. Quality of output

iii. Cost of purchase of printer

iv. Graphics abilities

v. Associated noise levels

vi. Multiple colour output,

c. The two classifications of printers are impact and non-impact printers

i. Impact printers make contact with paper and sound (noise) is produced during printing

ii. Non-impact printers do not make contact with paper and are relatively noiseless during printing.

d. Examples of Impact printers are:

* Dot-matrix
* Daisy wheel
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

* Chain or barrel printers
* Band printers

Examples of non-impact printers are

* LASER printers
* InkJet printers
* Thermal printers
* Xerographic printers.

**QUESTION 5**

(a)  
  i. What is an application package?
  ii. State five sources of an application package
  iii. List five criteria used in the selection of an application package

(b) You have been appointed as an accounting staff in a newly computerized company. Recommend five different application packages for your office computer.

**Solution**

(a)  
  i. An application package is a suite of programs designed to solve a particular problem. It includes documentation of details of how to setup the program and run it on the computer and relevant media on which the program is stored which is usually magnetic floppy diskette or optical disk.

  Application packages rationalize programming efforts,

  ii. Sources of application packages are:

  - Mail order as advertised in computer magazine
  - Over the counter from retail shops or stores i.e. off-the-shelf
  - Dealers (i.e. vendors) in micro computers.
  - Manufacturers of computers, who also develop software.
  - Computer bureau and information centres with expanded activities
  - Specialised organizations known as "software-houses"
• From the Internet.
• In-house by programmers (i.e. tailor made programs)

iii. Criteria used in the selection of application packages include:
• Purchase price of the package
• Primary memory capacity required.
• Availability of installed security facilities.
• After sales maintenance
• Ability to users' need
• User's friendliness
• Flexibility of the package
• The technology version of the

(b) The types of packages include:
• Electronic spreadsheet e.g Excel, Multiplan, PC-Focal, Professional Plan, Quaitro, Supercale, Lotus 1-2-3.
• Word processing package e.g. WordStar, WordPerfect, Display write, MS word, Multimate, Professional write
• File manager and Database Management system (DBMS) e.g. Dbase, Rbase, Reflexive, Access, Oracle
• Graphics e.g. free lance graphics, Adobe Pagemaker, Power point
• Statistical package e.g. SPSS (Statistical Package for social sciences)
• Accounting package e.g. SUN, Accounting saga, Dac Easy, Peach Tree.
• Stock/Inventory control package
• Payroll package
• General ledger package.
QUESTION 6

LAD company has 50 employees and plans to give 20% of basic salary as anniversary bonus. Draw a flowchart to depict the process.

Solution

```
START

READ employee’s record
For name and basic salary

Computer Bonus
= 2/10 x salary

Write name and Bonus

EOF

END.
```

Note EOF means End of file.
Question 7

Describe briefly describe four main methods of interconnecting networks or independent computers.

Solutions

The four main methods if interconnecting networks or independent computers are through

- MODEM connection
- ISDN connection
- Bridge or Router and
- Gateway

The explanations are as follows

i. A MODEM connection. MODEM is an acronym for Modulation Demodulation. A modem connection is It converts signals into analogue and vice-versa.

ii. An ISDN connection ISDN is an acronym for Integrated Service Digital Network. ISDN Connection uses the public telephone services and the data sent is in a form. All connections to the ISDN require network terminal equipment (NTE).

iii. Bridge or and Routers normally connect the type of networks,

iv. Gateway: A Gateway connects one type of network to another type.

Question 8:

Cables used in networks and interconnecting independent computers include; twisted-pair, coaxial and fibre optic. Give five parameters used in determining the selection of any one type
Solution:

The parameters used in the selection of cables include:

- The data bit rate;
- The reliability of the cable;
- The maximum length between nodes
- The possibility of electrical hazards;
- Power loss (noise) in the cable;
- Tolerance to harsh conditions;
- Expenses and general availability of the cable;
- Ease of connection and maintenance;
- Ease of running cables

Question 9:

(a) Explain briefly what is meant by an office automation system.

(b) Enumerate and discuss three application areas of office automation system

(c) List two adverse effects of office automation system on office workers.

Solution:

(a) An Office Automation System is a conglomerate of various technologies intended to improve the efficiency of office work by replacing the routine clerical, secretariat and paper-based tasks with computer-based devices.

(b) Some of the application areas of Office Automation System are:

(i) Word Processing
This involves hardware and software tools that allow the computer to behave like a typewriting device giving excellent face presentation of prepared document.
(ii) Desk top Publishing
This involves the use of computer systems equipped with special features to produce documents that look professionally printed. Such systems combine texts, art and a variety of fonts.

(iii) Electronic Mail
This refers to technologies used to send messages and documents from one electronic work station to another. Its use in business include facsimile, voice mail and electronic mail box.

(iv) Teleconferencing
This refers to the holding of meetings among people who are at physically different sites. Types of teleconferencing are video and audio teleconferencing. This system work can be done from home or other physical sites different from the office.

(v) Desktop Organizers
These are software packages that provide users with electronic equivalent of organizing and coordinating tools likely to be found on an office desk. Such tools include: Calendar, Card file, notepad, clock and calculator.

(vi) Archival Storage
This refers to off-line storage system used for historical and longtime storage of material. Such common technologies used to store archival material include magnetic tape, and computer output on microfilm/microfiche (COM).

(c) Some adverse effect of Office Automation on Office workers include:

(i) Possible harmful effects and danger of display devices (e.g. monitor) to users’ eyes.

(ii) Strain on the body (e.g. pain on backbone) due to long sitting to operate the computer system.

(iii) Reduction in number of office workers. (iv) Reduction in retirement age.

Question 10:

(a) The following are some of the common units that can be used in a computing environment: Byte, Hertz, Band and MIPS. Explain each of these units and what they are used to quantify.

(b) Briefly describe the operation of a public key encryption.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

(c) (i) What is a Website?

(ii) Give any two reasons why a business organisation may choose to develop and maintain a website.

Solution:

(a) A byte represents a sequence of bits (i.e. binary digits) which forms a character. In the ASCII coding system, 1 byte = 7 bits. In the EBCDIC Coding System, 1 byte = 8 bits; this is the usual definition of a byte. It is a unit of measurement of computer main memory or any storage medium.

*A hertz is the number of pulses or cycles per second. It is a measure of processor speed.

*Baud is the number of bits of data that can be transmitted along a communication line in one second. Baud is a unit of measurement used to specify data transmission speed.

*MIPS is an acronym for millions instructions per second. It is used to measure the number of instructions processed per second for a given processor type.

(b) Public Key encryption uses two different keys - one private and the other public.

The public key is used by the sender to encode the message while the private (or secret) key is used by the recipient to unscramble the message. The sender locates the public key of the recipient and encrypts a message with it. Upon receiving the message, the recipient uses his private key to decrypt it.

(c) (i) A website is a place on the internet where an individual, company or organization has information about itself.

(ii) Reasons why a business organization may choose to develop and maintain a website are to

* sell or market products and services;

* advertise products and services;

* promote corporate image;

* provide information about itself;
*reach out to several people simultaneously.

**Question 11**

The keyboard is the most widely used input device for the microcomputer. Give other input devices and state one advantage of each over the keyboard.

**Solution:**

The keyboard is the most widely used input device for the microcomputer. Give other input devices together with one advantage of each over the keyboard are discussed as follows.

(1) The mouse is used in a windows environment on the VDU. It is a better means of controlling a cursor, than a keyboard and the spreadsheet.

(2) Voice data entry involves the use of a voice recognition unit, which recognizes a limited number of keyboards. It is advantageous to blind people who cannot operate the keyboard. Other applications include home banking systems and air traffic control systems.

(3) Touch screens are touch-sensitive screens which are built onto a normal VDU and which transit messages depending which part of the screen is touched. Applications include manufacturing and stock control operations.

(4) Magnetic stripe cards can be used for input by the use of magnetic card reader. Application areas include the banking system where ATM is in use.

(5) Document readers with technologies including MICR, OMR and OCR. Application areas include the banking system for cheques clearing where MICR is used. Other areas include Examination Bodies making use of Multiple choice questions where OMR is used. OCR input system is used on turnaround documents such as credit card invoices.
NOTE: This is a work in progress. All topics in the syllabus are covered but editing for necessary corrections is in progress. Thanks.

REFERENCES


2. **ICAN:** Management Information Systems Professional Examination 1 Study Pack. V Publishing LTD.

3. **ICSAN** Information Systems (Foundation) for Study Text. BBP Publishing LTD. 1993
