INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY

STUDY TEXT

T03

Accounting
Technician
Level I

THE NATIONAL BOARD OF ACCOUNTANTS AND AUDITORS TANZANIA (NBAA)

T03

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY

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NBAA

The content writer is grateful to The National Board of Accountants and Auditors, Tanzania for permission to reproduce past examination questions. The answers to past examination questions have been prepared by National Board of Accountants and Auditors.

FOREWORD.

The National Board of Accountants and Auditors is a professional body in Tanzania, established under the Auditors and Accountancy Registration Act No 33 of 1972 (CAP 286 R.E.2002). The Board has been charged with among other things, the responsibility to promote, develop and regulate the accountancy profession in the country.

In fulfilling its statutory obligations, NBAA prepares National Accountancy Examination Scheme for students aspiring to sit for Accounting Technician and Professional Examinations. Further, for effective implementation of the examination scheme and improve examination results, the Board provides Study Guides for all subjects to assist both examination candidates and trainers in the course of learning and teaching.

The Study Guides have been prepared in the form of text books with examples and questions to enable the user to have comprehensive understanding of the topics. The Study Guides cover a wide range of topics in the NBAA syllabi and adequately cover the most comprehensive and complete knowledge base that is required by a leaner to pass the respective examination levels.

Furthermore, the Study Guides have been prepared to match with the Competency Based Syllabi to enable the learners to be exposed to practical understanding of issues rather than memorisation of concepts. In this case, the Study Guides are characterized by the following features:-

1. Focus on outcomes – The outcomes shown in every topic provides clear understanding on what to be learnt.

2. Greater workplace relevance – the guides emphasize on the importance of applying knowledge and skills necessary for effectively performance in a work place. This is different from the traditional training where much concern has been expressed in theoretical perspectives.

3. Assessments as judgments of competence – The assessment questions embedded in the Study Guides are adequate measures of understanding of the subject matter.

Study Guides are also useful to trainers specifically those who are teaching in the review classes preparing learners to sit for the professional examinations. They will make use of these Study Guides together with their additional learning materials from other sources in ensuring that the learners are getting sufficient knowledge and skills not only to enable them pass examinations but also make them competent enough to perform effectively in their respectively workplace.

NBAA believes that these standard Study Guides are about assisting candidates to acquire necessary skills and knowledge that will enable them to perform as professionals. The outcomes to be achieved are clearly stated so that learners may know exactly the skills and knowledge they are supposed to acquire in a particular topic.

NBAA wishes all the best to NBAA Examination candidates, trainers in their review classes, lecturers in the higher learning institutions and all other beneficiaries of these learning materials in making good use of the Study Guides towards promoting the accountancy profession in Tanzania.

CPA. Pius A. Maneno
EXECUTIVE DIRECTOR

JUNE, 2019

STUDY CONTENTS

T03 – Introduction to Information and Communication Technology

Features of the book

'The book covers the entire syllabus split into various chapters (referred to as Study Guides in the book). Each chapter discusses the various Learning Outcomes as mentioned in the syllabus.

Contents of each Study Guide

'Get Through Intro': explains **why** the particular Study Guide is important through real life examples.

'Learning Outcomes': on completion of a Study Guide, students will be able to understand all the learning outcomes which are listed under this icon in the Study Guide.

The Learning Outcomes include:

'Definition': explains the meaning of important terminologies discussed in the learning Outcome.

'Example': makes easy complex concepts.

'Tip': helps to understand how to deal with complicated portions.

'Important': highlights important concepts, formats, Acts, sections, standards, etc.

'Summary': highlights the key points of the Learning Outcomes.

'Figure': facilitates memory retention.

'Test Yourself': contains questions on the Learning Outcome. It enables students to check whether they have assimilated a particular Learning Outcome.

Self Examination Questions': exam standard questions relating to the learning outcomes given at the end of each Study Guide.

EXAMINATION STRUCTURE

The syllabus is assessed by a three-hour paper based examination.

The examination will consist of

Two conventional questions of 20 marks each	40 marks
Thirty objective questions of 2 marks each	60 marks
	100 marks

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY

A1

STUDY GUIDE A1: HISTORICAL DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

■ Get Through Intro

The study of the historical development of Information and Communication Technology (ICT) help connect the dots leading from the past and conveys us how this industry has changed the environment around us drastically. It has made the entire world digital.

Learning the history of its development will help us know and correlate the past and the present; will help us realise that how fortunate are we to be able to use this technology in our daily lives for our daily needs in the form of accounting software, internet, net banking, online shopping etc. As time advances, advancements in this field bring new introductions and we can now say that be stay in the 'Information Age.'

This Study Guide will acquaint you with the historical development of ICT, its impact on accounting profession and also the advancement in other areas due to ICT.

■ Learning Outcomes

a) Trace the development of information technology and its impact on accounting profession.
b) Explain changes that have occurred as a result of ICT.
c) Correlate development of ICT and other areas of economic development.

1. Trace the development of information technology and its impact on accounting profession.
[Learning Outcome a]

1.1 Meaning of information technology

Definition

Information technology (IT) can be defined as the term used to label the subject areas in which technology is used to transfer and process information quickly and efficiently to users.

Example

In business context it deals with the aspect of managing and processing information for organisations.

All organisations require information regardless of the goods or services they produce. Information is the input needed to make strategic, managerial and tactical decisions. The different departments of an organisation will require different types of information in order to fulfil their particular functions.

Example

The types of information that will be required by the four main departments of an organisation are:

(i) **Finance department:** information on the organisation's monetary resources. The department uses this information to plan how existing and proposed operations of the business are to be financed. In other words, how the organisation's money should be spent.

(ii) **Marketing department:** information on the organisation's products or services as well as on the customers who purchase them. This information allows the department to decide what should be produced and for whom.

(iii) **Human resources department:** information on all the organisation's employees with respect to their job profile and performance. This information will help the department decide on job roles.

(iv) **Production department:** information on an organisation's physical resources such as inventory and equipment, as well as, processes currently being utilised. This will help the department decide what should be produced and how.

The executives of an organisation will require all the above information in order to set the organisational strategy and its long term objectives.

Information technology (IT) is the area that deals with all aspects of **managing and processing information.** The main reason for having IT systems and software in an organisation is that important information can be **stored, retrieved and analysed** whenever needed.

There are three main components to an organisation's IT system:

(a) **Data:** the raw information that an organisation needs

(b) **Systems / software:** represents the programs that will perform the necessary calculations, analysis, processing, etc.

(c) **Hardware:** represents the physical devices such as computers, hard drives etc.

Example

Agape Plc is an organisation that has recently installed an automated payroll system for handling the monthly salary payments to its employees.

(i) **Data** would be individual employee details such as the employee's name, gross salary and number of days present at work.

(ii) Each month the **software** would make the necessary calculations on the employee's gross salary amount, for example deductions for sick leave, tax deductions etc. to arrive at the employee's net salary.

(iii) **The hardware** used would be a desktop computer in the accounting department.

Having efficient IT allows information to flow more accurately and quickly than their paper-based manual predecessors. IT has not only allowed each department to perform their function more efficiently, but has also enabled each department to nurture the role it plays in the organisation.

Example

(i) **Finance department:** through the use of spreadsheet packages and scenario planning programs can run numerous "what if" scenarios. These enable an organisation to look at and be able to choose from several financing options.

(ii) **Marketing department:** through various 'data mining' programs, marketing departments have been able to sort through an organisation's sales records and develop more detailed and accurate profiles of customers.

(iii) **Human resources department:** have used various specialised programs such as PeopleSoft that help them effectively track and monitor employee profiles and performance. This has helped the department better match and place employees to jobs.

(iv) **Production department:** through the automation of production processes and inventory tracking, organisations have been able to achieve greater efficiencies and output as well as implement advanced manufacturing systems such as JIT (just in time).

1.2 Meaning of information and communication technology

Information and communication technology (ICT) is similar to IT, but it focuses mainly on usage of data via communication mediums. It includes computers, radio, TV, internet, mobile phones, different social networking sites like facebook, twitter, video conferencing, distance learning, satellite system etc.

The use of such technologies has made the world smaller while retaining its vast geographical dimension. This makes the world 'a global village.' ICT has contributed phenomenally in transforming the world into the present digital world. ICT is also sometimes referred to as 'Info communications.'

1.3 Development of IT

Information and communication technologies have been in existence since the time human beings came into existence. Communication was possible through the mechanisms available at that time.

1. **Historic development of ICT can be depicted in four stages:**

Pre-mechanical
Mechanical
Electro-mechanical
Electronic (presently used)

(a) Pre-mechanical (between 3000BC and 1450AD)

This is the earliest age when ICT came into existence. Humans first communicated using picture drawings. Through these picture drawings different alphabets were developed. As the use of alphabets started getting popular, people started writing on clay. With time, paper was invented on which they started writing with feathers. These papers were bound together to make a book to store things permanently.

Later, during this period the numbering system of 0 to 9 was invented. The first calculator, known as 'ABACUS' was invented at this stage to facilitate the counting process and from here the basic elements of accounting like summing, subtracting etc started.

(b) Mechanical (between 1450 and 1840)

During this era a lot of machines were invented, which were to be used mechanically. Most famous invention of those times was 'Pascaline' a very popular mechanical computer of those times invented by Blaise Pascal. This was a very huge computer which could do only one work at a time and had to be operated manually.

(c) Electromechanical (between 1840 and 1940)

This was an era when telecommunication was about to start. During this time, telegraph, telephone and radio were invented. These inventions were very crucial and were big inventions of those times. Major usage and competitive advantage of using these electromechanical devices was in evidence during World Wars I and II.

Then for the very first time, large scale electromechanical computer system was invented in the United States at Harvard University in the year 1940. It was named as **Harvard Mark 1.** The programming on Mark 1 was done by using punch cards.

(d) Electronic (1940 onwards)

During this period, ENIAC (Electronic Numerical Integrator and Computer) was invented. It was the first computer capable of solving a small array of computing problems, simultaneously, at high speed. It occupied an even larger space as compared to Mark 1. It was intended for use by the US army.

2. Generations of computers

When the electronic age started, different computers with different types of storage devices, memory types and other features started developing. This led to different generations of computers that are discussed below:

There are five main generations of computers as follows:

   i)   First Generation
   ii) Second Generation
   iii) Third Generation
   iv) Fourth Generation
   v)   Fifth Generation

Each of the above are explained below:

(a) First generation computers (1940 - 1956)

This generation of computers was built on the following lines:

   i)   Circuitry: vacuum tubes.
   ii)   Storage: magnetic drums.
   iii) Programming language used: machine language (lowest level language).
   iv)   Space consumed: enormous could occupy entire room.
   v)   Electricity usage: very high.
   vi)   Heat emission: very high.
   vii) Capability of solving problems: only one at a time.
   viii) Input: punched cards and paper tapes.
   ix)   Output: print outs.

ENIAC, Mark 1 are the examples of first-generation computers.

(b) Second generation computers (1956 - 1963)

This generation of computers were built on the following lines:

i)   Circuitry: transistors.
ii) Storage: magnetic core technology (where instructions were stored in memory).
iii) Programming language used: high level language (COBOL, FORTRAN)
iv) Space consumed: Less than first generation.
v)   Electricity usage: low.
vi) Heat Emission: high.
vii) Capability of solving problems: only one at a time.
viii) Input: punched cards and paper tapes.
ix) Output: print outs.

Usage of transistors made the computers compact, cost effective, energy effective.

The computers of this generation were used in atomic energy industry.

(c) Third generation computer (1964 - 1971)

This generation of computers were built on the following lines:

i)   Circuitry: transistors placed on silicon chips called semi-conductors.
ii) Storage: central program that monitored memory.
iii) Space consumed: more compact than second generation.
iv) Electricity usage: low.
v)   Heat Emission: low.
vi) Capability of solving problems: many applications at same time.
vii) Input: keyboard.
viii) Output: monitors, interfaced with operating system (OS).

(d) Fourth generation computer (1971 - present)

Such types of computers are presently used. The computers and laptops which we use today are of fourth generation.

i)   Circuitry: thousands of circuits integrated on single chip i.e. microprocessor (Intel developed such chip.)
ii) Storage: central program that monitored memory.
iii) Space consumed: compact than third generation.
iv) Electricity usage: low.
v)   Heat emission: low.
vi) Capability of solving problems: many applications at same time.
vii) Input: keyboard, mouse, handheld devices.
viii) Output: monitors

During this generation GUI was introduced on the software. Along with it, internet also was introduced.

In 1981, IBM made available a general purpose computer that could be used by the common man at home.

In 1984, Apple introduced Macintosh. These are the examples which fall under this generation computers.

(e) Fifth generation computers (present and future):

i)   Such computers use artificial intelligence.
ii) Very few devices are available presently, but majority are under development and would be available in near future.
iii) The main motive of such computers is to recognize the natural language of human beings and accept it as
iv) input, process the same and give the output.
v)   Such computers will be able to learn new things and also organizing things by themselves.

Example

Voice recognition projects have been implemented, but the other concepts like sixth sense technology, robotics etc are the examples of fifth generation computers.

1.4 Impact of development of IT on accounting profession

1.   Manual accounting

Before IT was introduced and before it became widely accepted by people, accounting was done manually.

Under the m**anual accounting system,** all work and information processing has to be done by '**hand'** and corresponding information and reports **kept as paper copies.** All accounting vouchers like payment voucher, receipt voucher, sales voucher, purchase voucher, debit notes, credit notes, etc. are manually prepared. Each transaction is then manually recorded in various day books and based on these paper records, the financial statements are prepared. Generally, such accounting systems are preferred by small scale businesses as they may not be comfortable operating a computerised accounting system. Moreover, maintaining and using computerised accounting system proves to be expensive.

Entering each vouchers detail in an excel worksheet and maintaining accounts from there is also a form of manual accounting system, because here you do have to enter each and every data in the row and then proceed just like you would with a pen and paper.

2.   Computerised accounting system

Computerised accounting system is a software based system. With an automated system, all work and processing of information is done using **technology** and corresponding information and reports would be **stored electronically.** The software enables the data relating to various transactions like sales, purchases, receipts and payments, journals etc. to be recorded. Using this database, the software generates various vouchers, day books and financial statements required by an organisation. Furthermore, the software also generates inventory records (which was earlier prepared manually) and carries out various financial analysis which facilitate the organisation in evaluating its performance. Thus, computerised accounting system involves recording, summarising, storing and analysing financial transactions.

Computerised accounting packages are of the following types:

(a) Accounting packages

An accounting package is the software designed to help an organisation record, process and summarise its financial information in prescribed formats.

Example

The Sage accounting software is extensively used by organisations in the UK.

The type of accounting package an organisation would require would depend primarily upon the scale of financial transactions and the accountancy features that it requires to manage its business.

Small organisations can buy 'off the shelf' accounting packages. Bigger organisations can get accounting software customised to suit their requirements.

Example

There is different software like, Tally for small businesses, Accounting PRO for medium size businesses and AccuFund CRM for large size businesses that are available in the market and which ease the work of the accountant.

(b) Interlocking system

In earlier days to computerise accounting, entities adopted the interlocking system of accounting. **Two sets** of accounts are maintained under the interlocking system of accounting. One set of accounts according to the financial accounting system and the other as per the cost accounting system.

(c) Integrated accounting systems

With a view to overcome the drawbacks of the interlocking system, the concept of integrated accounting system was introduced. Under an integrated system, a common input is used by the financial and cost accounting systems. It refers to a system of accounting wherein a **single set of accounts** provides data for both financial and cost accounting systems.

Note: Interlocking system and integrated accounting systems are discussed in detail in Study Guide - F4.

The advantages of using accounting packages:

(i)   Accounting packages enable accountants to enter data efficiently and in line with the requirements of financial reporting standards.

(ii)   Certain recurring calculations can be automated. For example, depreciation and amortisation calculations at the end of a period can be automated.

(iii) These packages can aid in automatic updating of related accounts. For example, if any updating is made in a supplier's account, the concerned entry in the purchases ledger too would get updated.

(iv)   Well-structured budgets can be prepared with ease.

(v)   An organisation engaged in international trade can easily convert figures related to its transactions from one currency to another.

(vi)   Management reports like inventory reports, aged debtors' reports, sales reports, purchases, payrolls and variances can be generated instantly and accurately.

(vii) Goods and services tax and value added tax returns can be calculated easily.

(viii) The tax liability of an entire organisation can be calculated accurately.

3.   Each system has its own advantages and disadvantages which are discussed below:

(a) Advantages of an automated system

(i)   They are **faster, more reliable** and less expensive in the long run.

(ii) Accounting documents like invoices, cheques and statement of account can be **automatically generated**.

(iii) **Large data storage** capacity.

(iv) Errors can be easily **rectified** as data can be easily altered.

(v)   The following manual steps are **automatically generated**:

   1. posting to ledger accounts;
   2. preparation of unadjusted trial balance;
   3. posting of adjustment entries;
   4. preparation of adjusted trial balance;
   5. journalise closing entries;
   6. posting of closing entries;
   7. prepare a post-closing trial balance;
   8. prepare financial statements.

(vi) In addition, automated systems also offer the advantage of '**scalability**'. Scalability refers to the ease at which the capacity or work load of the system can be increased in cases where an organisation goes through a process of expansion or experiences growth in sales.

(b) Disadvantages of an automated system

(i) **Set up costs** for IT systems are generally higher because they require hardware and software in addition to regular staff. Moreover, if the organisation is going to use a customised software package, a significant period of **time** has to be set aside for developing, testing and training employees in the use of the new software package.

(ii) Automated systems are more **time consuming and expensive** to implement but have much lower operating costs over a long-term horizon.

(iii) However, securing an automated system is much more **expensive and difficult, particularly** in the current scenario where virus threats are common.

(iv) In addition, organisations often find that all work comes to a halt when there is automated system breakdown.

Although automated systems are definitely more common and the future, many organisations have a **combination of both the systems.**

SUMMARY

Manual & automated financial system

manual systems

manual processing of information

information in paper form

lower speed & accuracy

easier & cheaper to implement, alter

low scalability

simple and cheap to secure

automated systems

electronic processing of information

information in electronic form

faster & more reliable

time consuming & expensive to implement

high scalability

complicated & expensive to secure

Test Yourself 1

Manual systems are _____ and _____to implement for an organisation, than automated systems.

A more time consuming, expensive
B more suitable, beneficial
C more inconvenient, difficult
D easier, cheaper

2. Explain changes that have occurred as a result of ICT.

[Learning Outcome b]

ICT has brought about changes in all walks of life. Some of the areas of changes are explained below.

1. Impact on accounting profession

Traditionally, accountants spent a considerable amount of time in book-keeping. However, with the advent of ICT in accountancy, accountants provide greater valuable services to organisations by analysing the financial statements, which in turn **facilitate** not just financial reporting but also **management accounting as well as financial management**

Traditionally auditing was a manual activity, hence time consuming and prone to errors. However, ICT has developed auditing tools like Computer assisted audit techniques (CAAT) which facilitate the identification of misrepresentations in financial statements easily and quickly.

The job description of accountants has undergone a change. Traditionally organisations used to hire accountants on the basis of knowledge and experience of candidate in the subject of financial accounting. However, with the application of computerised accounting, integrated accounting systems etc. by organisations, candidates are selected based on their accounting skills as well as their knowledge of application of accounting software.

Due to automation of many accounting processes, vacancies in entry-level positions have reduced as these responsibilities have been taken over by computers.

The expectation from accountants has increased. The software released in the markets update to newer versions every few months. Thus, an accountant is expected to be in a format of continued learning.

2. Impact on education system

The education system has also undergone changes. It has become imperative for school students to learn ICT and ICT tools from a young age. Furthermore, students are also exposed to ICT enabled learning resources like e-learning, presentations made using power point, use of internet for research etc. All of this has made the learning process fast and interesting. This has improved the quality of education and made education equitable.

3. Information technology used by business organisations for internal control

Information technology-based controls are designed, to ensure, that the objectives of the internal control system are met. There are **a variety of controls that** are **performed** to test the **accuracy, completeness** and **authorisation** of transactions in a **computerised system**. The controls are grouped under two categories: application controls and general IT-controls.

4. Impact of development in information technology and information systems on business processes

Traditionally, buying and selling was carried out, face to face or through telephones or written communication. However with the development of ICT, e-commerce has emerged. E-commerce refers to any kind of business transaction in which the parties interact electronically rather than through direct contact. E-commerce is usually associated with buying and selling over the Internet or conducting any transaction involving the transfer of ownership or rights for using goods or services through a computer-mediated network. The various developments in the field of e-commerce are discussed in detail in Study Guide - E2.

Test Yourself 2

Information technology has not only helped businesses grow and become more efficient but also to evolve:

A True
B False

Test Yourself 3

The main rationale behind the B2B model is that the internet will allow organisations to:

A Deliver their goods and services directly to customers
B Sell their goods and services directly to customers
C Eliminate the need for intermediaries
D None of the above

___

5. **Impact on communication:** ICT has brought about tremendous improvement in communication systems.

(a) Internet, intranet and extranet

The internet enables computers all over the world to connect with each other. This connectivity enables information and resource sharing between people and companies. The term intranet refers to an **internal network** that functions like a **private internet** for use by an organisation. If access to an intranet is extended to people outside the organisation, it is called an extranet. In other words, an extranet is a type of private internet that isn't entirely internal but is more like an extended intranet.

(b) Data Link

Data link consists of the various electronic equipment and accompanying rules for receiving and sending data over a network. Data link connects one location to another for transmitting and receiving signals.

Data link usually connects the following:

i) Computers in a network
ii) Personal computer with the server of the network.

(c) Cellular phone

The cellular or mobile phone is a portable device used for voice or data communication. Along with the voice function of the telephone, a mobile phone can support several additional features like SMS for text messaging, access to the internet, email and photography as well amongst many others.

6. Impact on entertainment

ICT has brought about a tremendous change in the world of entertainment. For example, huge volumes and variety of software has been developed to aid in the process of editing films, composing music, creating special effects in movie films, making animations, cartoons and much more.

3. Correlate development of ICT and other areas of economic development.
[Learning Outcome c]

Economic development refers to an increase in the real value of production and income. Economic development for a country occurs when it's real **Gross Domestic Product (GDP) rises** annually at a constant price. GDP measures the annual output (the total value of all the goods and services) that a country produces.

Economic development is therefore associated with an increase in the total value of all the goods and services that a country produces and distributes.

Correlation of ICT with other areas of economic development -

1. Increase in scope of products and services

A number of information system researchers have positioned information technology as an important ingredient of innovation development. Firms implement information technology to enhance and/or enlarge the scope of their products and services. Studies have suggested that information technology plays a fundamental role in a firm's ability to enhance business performance through innovations in products, channels and customer segments.

2. Enhancement of competitive capabilities

Most firms have adopted information technology to foster changes in the management of customer relationships, manufacturing, procurement, supply chain and all other key activities in order to enhance their competitive capabilities. The internet has opened up a new range of possibilities for enriching interactions with customers. For example, Dell Computers has succeeded in attracting customer orders and improving service by placing configuration, ordering and technical support capabilities on the web.

Example

ABB's power generation business has to link, on real time basis, its construction activities in South Korea, its design and engineering capabilities in the US and its business development efforts in the People's Republic of China. E-mail, video conferencing, phones and faxes are the most obvious ways of supporting the needed communication between these geographically remote but closely related activities.

3. Innovations in the field of ICT

Innovations in the field of ICT have led to rapid and continuous productive gains in ICT- sectors. They keep bringing to the market new hardware, software and telecommunication products and services of higher quality and better performance. It has also resulted in a huge decline in the price of ICT goods, providing investors an incentive to replace other forms of capital with ICT equipment. These productivity dynamics combined with a rapidly increasing demand for ICT products and services, have led to an expansion of output in ICT- generating sectors, thereby directly resulting in a large contribution by ICT production to the economic growth of any country. In recent years, the integration of telecommunication devices with broadband functions gave an additional boost to opportunities for investment and economic growth.

Innovations like mainframe computers and fourth generation computers led to increased productivity of such products, thus bringing about new hardware, software and communication products. There is also considerable decrease in the price of these products, thus, increasing the demand for the products which is directly affected by their productivity. This has thereby contributed to economic development.

The new technology coming up in broadband functions supplementary to internet is booming up in market. This gives push in the investment and economic growth.

Apart from the direct effect of the boost in ICT productivity on the ICT- generating sector, it also increases the rate of growth in the other sectors of the economy. Further, the declining prices of ICT have made it an attractive factor of production thus leading to even greater investments in ICT to boost efficiency and productivity.

4. Improvements in effectiveness of business

IT is an important business weapon. Through improved information availability for decision-making, faster customer response times and many other such advantages it is being used to improve the effectiveness of business processes at every step. IT has become a key component in carrying out business in innovative ways and even for transforming a business or a sector. The details of improvements made in terms of effectiveness of business processes are discussed in Study Guide- A4.

5. Improvements in efficiency of business

Now-a-days new products, services, processes and ways of working involving IT are managed to obtain business benefits. Today, availability and cost of IT are no longer major constraints on its effective application in businesses. The potential applications of IT which can be cost-justified and are technically feasible far exceed the capability of organisations to exploit these opportunities. For example, contemporary firms are making significant investments in information technology to align business strategies, enable innovative functional operations and provide extended enterprise networks.

Implementation of information technology not only enables the sharing of information across different departments but also provides flexibility to respond to changes in business strategy.

Example

In Royal Dutch Shell, worldwide technology enables planning managers and general managers to share information about their business instantly. Sharing of experiences with new techniques, information about emerging issues and discussion on topics of interest and concern are supported by this network. Internet benchmarking is greatly facilitated and strategic developments in Lausanne are immediately available to managers located in Louisiana, Lucknow and London.

6. Improvement in management of business

The IT revolution has had massive influence on the way that organisations are managed today. It can be credibly claimed that no other source of change, has had more impact than IT, on the patterns and practices underlining the management function. Although other developments such as the emergence of the global economy, increasingly knowledge-based nature of modern organisations and other factors have significantly affected the style of management in organisations, IT developments are an integral part of all these other phenomena as well which lead the change in management practice. Improvements in the practice of management will automatically affect the way in which firms are managed and this will improve the economic development.

7. Increase in employment

Higher employment is congruent with the objective of economic growth. The increase in the use of IT in all walks of life has brought about a significant increase in employment opportunities in the area of IT. For example all medium sized firms have a full-fledged IT department that handles development of software, system administration etc. which together contribute favourably to economic growth.

Test Yourself 4

Explain two areas where an information system affects business performance?

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

Manual systems are easier and cheaper to implement for an organisation, than automated systems.

Answer to TY 2

The correct option is **A**.

IT and IS have significantly changed business practices for many organisations.

Answer to TY 3

The correct option is **C**.

Answer to TY 4

Two areas where an information system affects business performance.

Changing interactions with suppliers

Due to coordinating problems with external suppliers, large firms often produce many of their required inputs in-house. General Motors is the classic example of a company whose success was facilitated by high levels of vertical integration. However, technologies such as electronic data interchange (EDI), internet-based procurement systems and other inter-organisational information systems have significantly reduced the cost, time and other difficulties of interacting with suppliers. For example, firms can place orders with suppliers and receive confirmations electronically thereby, eliminating paperwork and the delays and errors associated with manual processing of purchase orders.

Changing customer relationships

The internet has opened up a new range of possibilities for enriching interactions with customers. Dell Computers has succeeded in attracting customer orders and improving service by placing configuration, ordering and technical support capabilities on the web.

Self Examination Questions

Question 1

First digital and high-speed computer was invented by_____

. A   IBM
B   Apple
C   Microsoft
D   None

Question 2

Introduction of operating system (OS) started from which generation computer_____.

A   Fourth
B   Sixth
C   Third
D   First

Question 3

Manual accounting is considered to be faster than computerized?

A   True
B   False

Question 4

ICT has not contributed in health care services of nation.

A   True
B   False

Question 5

ICT's maximal contribution to economical development is from which of the following?

A   Internet
B   Broad band services
C   Telecommunication
D   Abacus

Question 6

The advantages that automated financial systems have over manual systems are that, they are:

A   Easier and cheaper to implement for an organisation
B   Faster, more reliable and less expensive in the long run
C   Easier and cheaper to implement for an organisation and faster, more reliable and less expensive in the long run

Question 7

Distinguish between manual accounting and computerised accounting.

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **A.**

Answer to SEQ 2

The correct option is **C.**

Answer to SEQ 3

The correct option is **B.**

Answer to SEQ 4

The correct option is **B.**

Answer to SEQ 5

The correct option is **C.**

Answer to SEQ 6

The correct option is **B.**

Automated systems are faster, more reliable and less expensive over the long run. Though these systems are more time consuming and expensive to implement, they will have a much lower operating cost in the long run and prove beneficial.

Answer to SEQ 7

Manual Accounting	Computerized Accounting
1) It is carried out on paper.	It is carried out on computer.
2) The process of accounting is slower than computerised computing.	The process of accounting is faster than manual accounting..
3) It is cost effective.	Heavy amounts are to be invested for purchase of software / software development.
4) Accounting is independent from machines, so can be carried out anytime anywhere.	Accounting is possible only if the computer containing the software is available.
5) Accountant needs no training on operating the accounting software.	Accountant needs training on operating the accounting software.
6) It is less efficient compared to computerised accounting.	It is more efficient compared to manual accounting.

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY

A2

STUDY GUIDE A2: ADVANTAGES AND DISADVANTAGES OF USING ICT

■ Get Through Intro

In study Guide A1, we have discussed the basics of ICT. ICT plays a very important role in improving the way a business is conducted and undertaken. Evolution of ICT has brought about business growth, improvement in communications, improvement in labour productivity etc.

However just as a coin has two sides, ICT also has its disadvantages and advantages. For example, use of ICT tools may be costly for small business enterprises.

Knowledge of the advantages and disadvantages of ICT will guide you to make assessments relating to application of ICT tools at your work place.

■ Learning Outcomes

a) Explain advantages of using ICT.
b) Explain disadvantages of using ICT.
c) Explain specific challenges facing developing countries like Tanzania in relation to ICT.

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1. Explain advantages of using ICT.
**   Explain disadvantages of using ICT.**

                                        [Learning Outcomes, a and b]

1.1 Advantages of using ICT

ICT has the following advantages:

1. Improvements in effectiveness

ICT tools have improved effectiveness of many aspects of organisations. Some of the areas are explained below:

(a) Evolution of business processes

ICT has not only helped business enterprises grow and become more efficient but has also helped them **evolve**. In particular, the B2B (business to business) and B2C (business to consumer) models have significantly changed business practices for many organisations. Both of these processes are explained in Study Guide E2.

(b) Effective service provision

The direct service department serves as a **single point of contact** for the clients of an organisation. This department becomes particularly beneficial for organisations whose clients have to deal with multiple departments within the organisation. The direct service provision acts as an intermediary between the client and the rest of the organisation. The direct service function is effective only due to the support offered by ICT.

Example

An advertising company's client would need to interact with the following departments:

   Creative department to decide upon artwork / graphics for upcoming advertisements.
   Copywriting department to decide upon the text for the upcoming advertisements.
   Media department to decide upon what publications the advertisements should feature in.

To simplify the process for the clients, most advertising companies have a client servicing department that coordinates with these other departments on the client's behalf.

Interaction with the departments is done using ICT tools like e-mails, mobiles etc.

Effective service provision leads to increased customer satisfaction which in turn leads to increased orders and business from the client. The organisation is also in a better position to understand the customers business requirements.

2. Improvement in efficiencies

ICT has improved efficiencies in most of the aspects of business. Some of the areas where efficiencies have occurred are listed below:

(a) Development of automated processes

Traditionally manufacturing units had to employ trained engineers to operate shaping machines, lathes etc. However the advent of ICT has brought about the invention of automated machines and processes like CNC machines (Computer Numerical Control machines) which carries out operations at a faster rate (it can operate uninterrupted 24x7) and more accurately than the traditional machines. This in turn has improved efficiency of processes in organisations.

(b) Improvement of productivity of employees

The advent of ICT has improved productivity per worker which again gave organisations the ability to reduce their workforce.

Example

The CRDB Bank PLC has been able to downsize their workforce after many Branches computerised their operations and changed their customer service providing techniques, leading to a greater productivity per worker.

The arrival of the desktop publishing system allowed Mwananchi Newspaper publishing press to downsize its organisation. As this technology automates the newspaper production process, Mwananchi Newspaper did not need the same large number of employees to print its newspapers as was the case with the conventional printing and publishing method.

Therefore **technological advances typically end up being efficiency drivers or labour saving innovations. They allow organisations to automate repetitive or manual tasks thereby eliminating the need for skilled labour.**

(c) Accurate and quick exchange of information across the organisation

Having efficient IT and IS in place facilitates efficient exchange of information across the organisation. They allow information to flow more accurately and quickly than their paper based manual predecessors. Information technology has not only allowed each department to perform their function more efficiently, but has also enabled each department to nurture the role it plays in the organisation.

Example

(i) **Finance department:** through the use of spread sheet packages and scenario planning programs can run numerous "what if" scenarios. These enable an organisation to study and choose from several financing options.

(ii) **Marketing department:** through various "data mining" programs, marketing departments have been able to sort through an organisation's sales records and develop more detailed and accurate customer profiles.

(iii) **Human resource department:** have used various specialised programs such as PeopleSoft that help them track and monitor employee profiles and performance more effectively. This has helped the department in more appropriate job placement of the employees.

(iv) **Production department:** through automation of production processes and inventory tracking, organisations have been able to achieve greater efficiencies and output as well as implement advanced manufacturing systems such as JIT (just in time).

(d) Improves efficiency of business processes

(i) B2B activities occur when organisations buy / sell goods and services, amongst themselves, over the internet. This improves e**fficiency** as it integrates buyers and sellers. Moreover, IT systems are effective in making transactions more efficient because manual processing requirements get substantially reduced.

(ii) The manufacturing process of an organisation continually works towards improving the efficiency of the production process with upgraded technology.

Example

One of the main reasons why Toyota has become one of the 10 largest companies in the world, is its strength in the area of production. The Toyota Production System (TPS) is both, a framework and a philosophy used by the company throughout its manufacturing facilities.

TPS is based on two fundamental premises:

'**Jidoka**' (automation with a human touch), a system that allows any employee to halt production when a problem or defect is noticed and
'**Just in time**' where inventory is produced in exact quantities and made available at the exact time when needed thereby eliminating waste and storage costs.

These philosophies and systems have enabled Toyota to consistently produce quality vehicles at relatively economic prices.

3. Becoming environment friendly

Electronically maintaining and transferring data can reduce consumption of paper and facilitate sustainable development and also reduce costs. This will make business processes cost effective and environment friendly.

Example

Customers of banks can get their account summary via electronic mail, thus enabling banks to reduce paper consumption and consequently reduce costs.

4. Making timely strategic and operational decisions

Management accounting reports are prepared by organisations, using various ICT tools like database management, integrated accounting systems, Microsoft word, excel, power point, etc. These reports are extensively used within the organisations for setting performance targets, monitoring performance and controlling various other aspects of operating entities. This enables organisations to also make strategic decisions like whether the entity should enter new markets, whether it should plan for a particular level of production etc. Hence, this is a very important tool used by managements for making strategic and operational decisions.

5. Computerised accounting systems

Traditionally, organisations adopted manual accounting processes. However, with the advent of ICT most organisations have adopted computerised accounting. This has improved the efficiency of accounting function since it not only speeds up the accounting process but also increases accuracy as compared to manual accounting.

An organisation can reap the following benefits by using accounting packages:

(a) Accounting packages enable accountants to enter data efficiently and in line with the requirements of financial reporting standards.

(b) Certain recurring calculations can be automated. For example, depreciation and amortisation calculations at the end of a period can be automated.

(c) These packages can aid in automatic updating of related accounts. For example, if any updating is made in a supplier's account, the concerned entry in the purchases ledger too would get updated.

(d) Well-structured budgets can be prepared with ease.

(e) An organisation engaged in international trade can easily convert figures related to its transactions from one currency to another.

(f) Management reports like inventory reports, aged debtors' reports, sales and purchases report, payrolls and variances can be generated instantly and accurately.

6. Improves personal effectiveness

There are numerous devices in existence today that helps an individual **perform his work** more **accurately** or **efficiently**. It helps them perform their tasks **faster** and / or more accurately, thereby helping them **increase** their **personal effectiveness**.

Example

a) Ordinary everyday devices such as calculators have become so common they are no longer thought of as technology.
b) Computers and various software programs such as word processors and spreadsheets that enable people to perform various office functions more quickly and efficiently.
c) The internet which allow individuals immediate access to wide sources of information and data thereby quickening and improving the decision making process.
d) Email and mobile phones that allow individuals to interact with others instantaneously.
e) Personal planners and programs that help individuals map out, plan and schedule their daily activities.
f) Specialised software programs like payroll accounting, materials management help individuals to perform a specific function.

7. Advantages of input devices:

This is explained in Study Guide B2.

8. Advantages of data communication systems

This is explained in Study Guide D1.

9. Advantages of e-commerce

This is explained in Study Guide E2.

Test Yourself 1

Information technology is used:

A   To transfer information quickly and on time to users.
B   To decrease personal effectiveness at work.
C   To help individuals perform their work more accurately and / or efficiently.
D   Both A and C

1.2 The disadvantages of ICT are as follows:

1. Limitations of an automated system

(a)   Set up costs for IT systems are generally higher because they require hardware, software and also staff. In addition, if the organisation is going to use a customised software package, a significant period of time has to be set aside for developing, testing and training employees in the use of new software package.
(b)   Automated systems are more time consuming and expensive to implement, but over the long term have a much lower operating cost.
(c)   Securing an automated system is much more expensive and difficult, particularly in the current scenario where virus threats are common.
(d)   In addition, organisations often find that all work comes to a halt when a system breakdown occurs.

2. Inherent limitations of ICT tools

(i)   For ICT to be effective, speed of hardware and connectivity of the communication systems should be at par with the requirements of the customer. For example, an entity which sells goods online should have internet connectivity (24 x7) and sufficient speed of the internet to carry out the operations efficiently. Therefore having inappropriate hardware or connectivity is a limitation of ICT.

(ii)   Software which is used by organisations can be effectively used only if it meets the needs of the user and furthermore, the user has the hardware that is compatible with the software. For example, an entity which develops an integrated accounting package should ensure that the specific operations and transactions carried out by the entity are taken into account in the development of the accounting software. Additionally, if the software is programmed to develop board reports which contain coloured graphs, the entity must have coloured printers which will generate the required reports.

3. Inappropriate use of generic software

Smaller organisations generally go in for off-the-shelf generic software because they are cost effective. However, the use of generic software causes the following limitations for an organisation:

(a)   Generic software is not designed for a specific industry or organisation. The business processes covered in a generic software is meant for generalised use. If an industry involves processes which are very specific to that industry, adoption of generic software solution is likely to make business processes difficult and ineffective. Also, the adoption of generic software could be risky if used without a trial version.

If a company is using different systems for different functional areas, it is not economically possible to integrate the processes across multiple operational areas. The company will not obtain a complete, integrated view of its operations through these different systems. It will require pooling of data from those multiple systems which integration will be prohibitively expensive for small and medium-sized companies.

(b) As integration of such systems is expensive, it is not desirable for fast growing or fast changing business organisations. It may cause interruptions and bottlenecks.

(c) Although there have been substantial developments in generic software, they are generally not scalable and there is a lack of focus on business intelligence. Most generic software is designed for transaction and data processing.

(d) The development of generic software is handled by large business houses which do not respond promptly to service needs. This creates greater dependability on the organisation's own employees to preserve critical knowledge. In spite of claims of best processes by many well-known brands of generic software, they have been found to be, in reality, average processes.

4.   Limitations of dash board reports

Many reports in the organisation are intelligently combined and presented as a single report using a digital dashboard. For example, in a board meeting where details of performance of various departments may be required, instead of presenting multiple reports, important points from various reports are captured intelligently and presented as a single report using a dashboard.

The disadvantages of presenting information using dashboards are as follows:

(a) The dashboard is totally dependent on the computer system as reports generated are entirely based on the data fed into the system.

(b)   The digital dashboard can be effective only if it is designed to suit the needs of its users. For example, information relating to sales trends may not be useful to the materials department. Instead, the materials department may need information relating to trends of consumption patterns of various raw materials. Therefore, digital dashboards need to be tailored to suit its users.

(c)   If digital dashboards are not tailored to suit the specific needs of its users, it can cause information overload for some users i.e. managers.

(d)   As digital dashboards are customised to suit the needs of its users, they involve high implementation costs.

(e)   A large amount of data is required to be assimilated resulting in the computer system becoming slow and difficult to use.

(f)   As various kinds of data are used, it becomes important to develop good internal processes for data management e.g. data back-up should be taken regularly, data access must be personalised, etc. This will ensure that the reports are reliable.

(g)   As the effectiveness of a dashboard relies on the comprehensiveness of its data, many applications are at a disadvantage. They simply cannot consolidate data from all the various sources necessary to get a comprehensive view of enterprise performance.

5.   Not error free

Computerised systems are prone to fraud and error as they are not totally automated i.e. they require human intervention at the development stage and the operation stage where humans can override controls and cause fraud.

Example

Pluto Plc has an integrated accounting software in which the sales invoicing programme has an error due to which arithmetical accuracies of sales invoices are not ensured. This may cause errors in sales invoices generated by the entity.

Further, while the systems give access to different levels of personnel to specified modules of the package, the staff share passwords with each other and security is lost because the whole staff can access all the various modules. This makes it easier for frauds to happen because people get access to those modules also which they were not authorised to view.

6. Disadvantages of input devices

This is explained in Study Guide B2.

7. Disadvantages of data communication systems

This is explained in Study Guide D1.

8. Limitations of e-commerce

This is explained in Study Guide E2.

> **Tip**
>
> The limitations explained in the next Learning Outcome are also disadvantages of ICT.

2. Explain specific challenges that face developing countries like Tanzania in relation to ICT.
[Learning Outcome c]

As discussed in Learning Outcome 1, ICT improves efficiency and effectiveness of businesses, provides access to new markets and thereby brings about business growth. Thus, investment in ICT by developing countries, can act as a vital tool to bring about economic development. However, the advantages of ICT can be realised only if the limitations of ICT discussed in the second Learning Outcome are overcome.

Developing countries like Tanzania face the following challenges in relation to ICT:

1. Insufficient infrastructure

As discussed in Learning Outcome 2, ICT can be effective only if it is supported with hardware, software and communication tools.

ICT can be used only if electricity is available. However, the rural areas of the country are not equipped with power supply, thus the economy faces the challenge of **providing uninterrupted electricity across the country**.

Internet access, which is used widely for communication, depends wholly on the availability of broadband services. However, most of the country is not equipped with broadband services, therefore **providing broadband services across the country is a challenge.**

The content on the internet is mostly international; furthermore, the content is not frequently updated and hence has limited local content. In order to encourage locals to use the internet, **the quantum of local content must be increased and also regularly updated.**

2. Manpower

Tanzania has **inadequate staff who are not capable of applying ICT tools** at the work place; in fact many Tanzanians, especially located in rural areas are not aware of operating ICT equipment.

Tanzania has **limited capacity to produce ICT tools** since its software industry is presently on a small scale.

The decision makers in the organisations, private as well as government sectors mostly belong to the older generation and thus often **lack** the **knowledge ICT and its importance** in organisational growth.

3. Labour Vs ICT

Developed economies have abundant capital but face labour scarcity. Therefore, they sometimes use ICT to substitute labour or to save labour. Furthermore, developed economies also substitute labour with ICT to enhance processes, not primarily to substitute labour.

However, this strategy is not always suitable in developing nations which have abundant labour but limited funds to afford ICT tools. This does not mean that developing economies must not invest in ICT, instead a careful cost benefit analysis should be made by entities before investing in ICT. Therefore, **maintaining the balance between utilisation of labour and ICT** is a challenge faced by developing countries.

4. Consumption of foreign exchange

The production of ICT tools takes place majorly in developed countries and developing countries mainly import ICT tools. This involves utilisation of foreign exchange causing a deficit balance of payments for the country (a balance of payments or international payments disequilibrium occurs when the value of a country's imports does not equal the value of its exports. If the value of imports is greater the country has a deficit). Furthermore, higher economic growth and balance of payment equilibrium are contradictory goals. When an economy is growing fast, consumer spending tends to be high. Hence, import growth picks up at a relatively higher rate as compared to exports, leading to a worsening trade deficit. In such circumstances, the government has to deflate the economy, implying a low rate of growth.

Therefore, developing economies face a challenge on **deciding the quantum of foreign exchange which can be utilise**d for this purpose.

Test Yourself 2

There is _____ relationship between economic growth and balance of payment equilibrium.

A   a positive
B   an inverse
C   no

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

Information technology is used to transfer information quickly, on time and efficiently to users as well as to help them perform work more accurately and / or efficiently.

Answer to TY 2

The correct option is **B**.

Higher economic growth and balance of payment equilibrium are contradictory goals. When an economy is growing fast, consumer spending tends to be high. Hence, import growth picks up at a relatively higher rate as compared to exports, leading to a worsening trade deficit. In such circumstances, the government has to deflate the economy, implying a low rate of growth

Self Examination Questions

Question 1

The following IT device can be used to perform work more accurately and efficiently.

A   Television Set
B   Computer
C   DVD player
D   None of the above

Question 2

Which of the following tools help in preparing single reports in the organisation by intelligently combining and presenting several reports?

A   Digital dashboards
B   Power point presentations
C   Online analytical processing
D   Spreadsheets

Question 3

Until 30 June 20X9, Harry & Co recorded all its accounting data manually. From July 20Y0, the company started recording its transactions through the new accounting software it purchased.

Required:

Explain whether the financial statements generated by the new accounting software will be free from error and fraud.

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **B.**

Computers and various software programs such as word processors and spreadsheets enable people to perform various office functions more quickly and efficiently.

Answer to SEQ 2

The correct option is **A.**

Many reports in the organisation are intelligently combined and presented as a single report using a digital dashboard.

Answer to SEQ 3

Computerised systems are prone to fraud and error as they are not totally automated i.e. they require human intervention at the development stage and at the operation stage when humans can override controls and cause fraud.

For example

(i)   Internal accounting software would be developed to handle daily transactions of a routine nature under normal circumstances. However, they are not set out to handle unusual circumstances and unusual transactions. Therefore, the possibility of fraud and errors in these transactions can occur.

(ii)   Authorised persons may take advantage of their positions to manipulate records. The manipulation of records may be done for personal gains or to ensure that third parties are benefited. This can lead to fraud and errors.

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY

A3

STUDY GUIDE A3: STRATEGIC RELEVANCE OF ICT

■ Get Through Intro

ICT stands for Information Communication Technology. It is all about accessing and sharing information through the telecommunication mode.

Information is accessed through various mediums such as internet, mobile phones, wired network, wireless networks, etc. With the advancement in telecommunication technology, using instant messaging and video conferencing, people can communicate in real time. Being similar to IT (Information Technology), ICT emphasises on communication technology.

ICT in modern world has not only made the world smaller in terms of connectivity, but has also made communication more fast and effective.

This study guide will enable you to know how ICT can be integrated in a business model and used in an effective way. You will also know about the tools of ICT and the methods to improve efficiency by using ICT. You will learn how the evolution of ICT has helped to improve the way we live, and why ICT has become an indispensable resource for any organisation to achieve success.
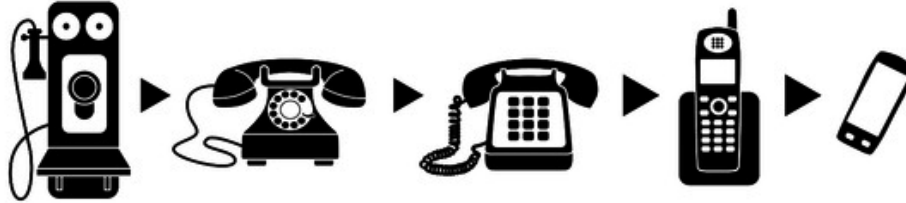
■ Learning Outcomes

a) Explain how ICT improves effectiveness.
b) Explain how ICT improves efficiency.
c) Explain how ICT improves life standards.

1. Explain how ICT improves effectiveness.
[Learning Outcome a]

1.1 Evolution of ICT Figure

1: Evolution of ICT

Humans have always communicated with each other. They started communicating with signs and with further inventions, used drums, various sounds and melody to communicate. Then they started using material to write, draw and paint to communicate with each other, trying to make communication more informative and effective. With the growth in technology, people started communicating and sharing information through means such as phones, which itself transformed drastically with time. The size of the phones reduced but the impact and features got better and better.

Rapid development in technology has changed the face of ICT and the way information is being shared and communicated. In the modern world, with technology revolution, people communicate with advanced technology such as phones, video conferencing, wireless technology, etc. Information is communicated at a fast pace and in real time.

1.2 Effectiveness of ICT

ICT has come a long way in improving all the facets of communication. It has drastically changed the way a business operates. ICT provides a great amount of leverage with its convenience and flexibility. An effective ICT ensures risk management keeping in mind the privacy and security of the information. It is a key factor which enables sharing of information and communicating anywhere in the world at a fast pace, resulting in effectiveness in the communication process.

1. Mobile Communication

Development in technology has ensured that communication is made simple and easy. Sharing information and communicating is not restricted to a definite workplace. You can talk to people anywhere within and outside the organisation. This has resulted in multitasking, as mobility in communication has opened the gates of being connected with each other on the move.

Example

James is heading the marketing team of Fortune Pack LLC. He has to make an important client visit. However, just before he leaves, the operator transfers a call which is for James from another prospective client. The client wants someone from James' department to visit them to discuss a business matter on an urgent basis.

As James cannot attend both the clients at the same time, he instructs his subordinate Frank to make the other visit. As the other client visit was not planned in advance, Frank is not aware of the client and about the meeting. They both leave the office at the same time, taking a different route. On the way, James uses his mobile phone to communicate with Frank and explains to him how to go about the meeting with the client to be effective.

Communicate on the move with mobile phones
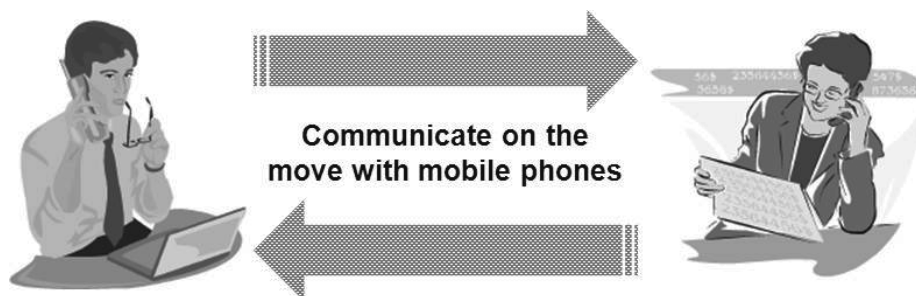
Mobile phone has enabled James to prepare Frank for the other meeting and make both the client visits simultaneously, which has not only been time saving but effective as well.

2.   Correspond & share information

Revolution in technology has largely impacted computers and the way they are being used to share information and communicate. Computers have not only made information sharing look more aesthetic, but also enhanced productivity. Mobiles and laptops have ensured that even if a person is out of office or workplace, it does not prove to be an obstacle from performing their tasks effectively.

Technology not only helps to easily work on complex data at a fast pace, but also enables to retain and manipulate data for multiple re-use, making communication and information sharing easy. With the help of the internet, emails, office processing programs, chat applications, video conferencing and many such web-based applications, time management has become more effective.

Example

Communication has become fast and easy with technology. Information can be stored and shared across various locations using computers, laptops, mobile phones etc.

3.   Business Growth

In the modern world, businesses cannot grow without ICT. Enterprise Resource Planning (ERP) is an example of this fact. It is an integrated system which incorporates multiple functions of a business such as finance, manufacturing, HR, etc. This minimises paper work, saves time, reduces data redundancy & duplication, data security, and most importantly, it enables easy access to appropriate data.

ICT connects business with business and helps to grow. This interacting protocol helps meeting people across the locations with the help of virtual technology such as instant messaging, and video conferencing saves time and money, eventually proving to be more effective.

Buying, selling and accounting have been made easy with the help of technology. All the functions of a business such as Production, Sales, Logistics, Procurement, Marketing, HR, Finance, etc. are knit together with ICT, integrating the operations and ensuring parallel development and an overall growth of the business.

Example

Companies are investing in technology wherein a system is developed as a resource for various departments to maintain the database pertaining to that process. Every such process is then integrated centrally so that the data is accessed easily and cross functioning is possible.

For example, the marketing department would have electronic data of their customers, price list, product range, marketing plan, sales forecast etc. Each staff in the marketing department would access, share and work on this data. However, since it is an integrated process, the data is available to others in the company, with relevant authorisation wherever needed.
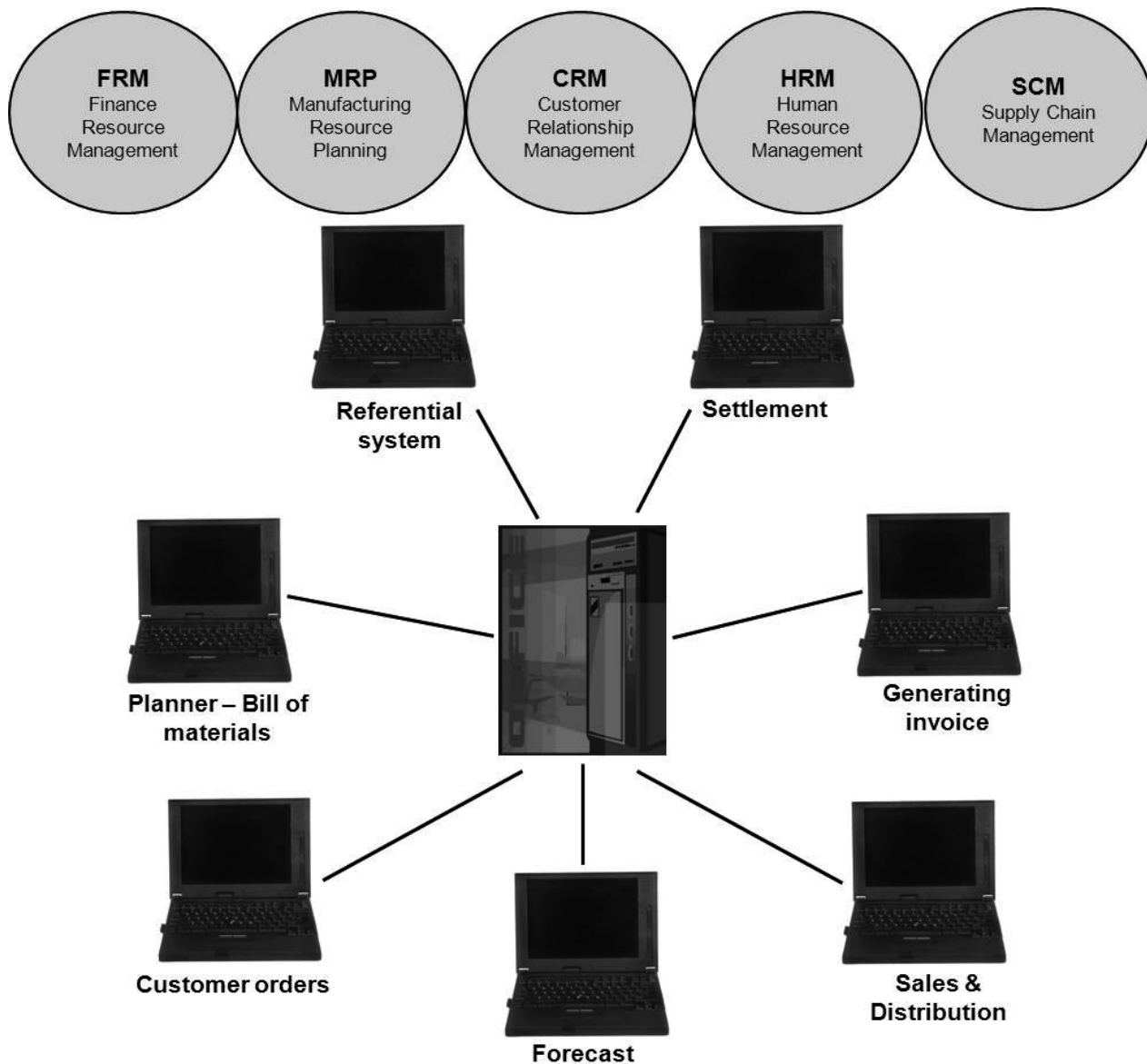
Figure 1

4. Global connect

Unlike earlier days, business is not limited to certain boundaries. With the help of ICT, it has surpassed the limits and has grown in leaps and bounds across regions and territories touching all corners of the world. People and businesses across the world are getting connected easily and effectively with the help of the internet, emails, etc.

ICT helps businesses to market and sell products and services and use technology to be more effective even from a distant location. ICT has mostly minimised the requirement of travelling to distant locations to market and establish business across the globe. This has not only saved time and money but has also ensured growth of business at a fast pace.

Example

Companies now days designed websites in their name wherein the information regarding company profile, its vision, mission, product & services, location & contacts are provided. Any other company or individual can get connected to the internet and access the website of the required company to obtain relevant information which would be useful for business.

E-mails and other web applications are being used to communicate and share information between companies at a distant location for carrying out business transactions on a regular basis. This is possible from one place with the help of computer and internet without travelling to distant locations, spending time and money to acquire the information and do business.

5. Collaborations using Network & Channels

Nowadays, businesses are using social media networks to get connected globally to develop collaboration and maximise reach for services, and for problem solving. The new generation effectively uses forums to communicate and share information. Such channels can be used to launch new products, discuss strategies and issues, make presentations, acknowledge achievements and also for regular business activities.

Test Yourself 1

ICT has enabled the automation of the integrated process of business wherein each function communicates with the other at a common ground.

How does a business benefit from this?

A   Speedy communication
B   Effective time management
C   Cost effectiveness
D   All the above

---

2. Explain how ICT improves efficiency.
[Learning Outcome b]

2.1 Tools of ICT

Adapting to the change in technology is of great essence and hence, keeping abreast with the changing technology would enable you to utilise the power of ICT, which is being associated with its development. Digital revolution has taken ICT at a different level wherein communicating and sharing information is more engaging and exciting. Using ICT to a great effect would require some tools to represent the ability of ICT in the business world. Some of the tools are listed below:

Figure 2: Tools of ICT

Document Processors   Computers   Internet   E-mail / Chatting

Networking   Social Networking   Video Conferencing   Fax Machine

Mobile Phones   Knowledge Base   Bluetooth   Web Applications
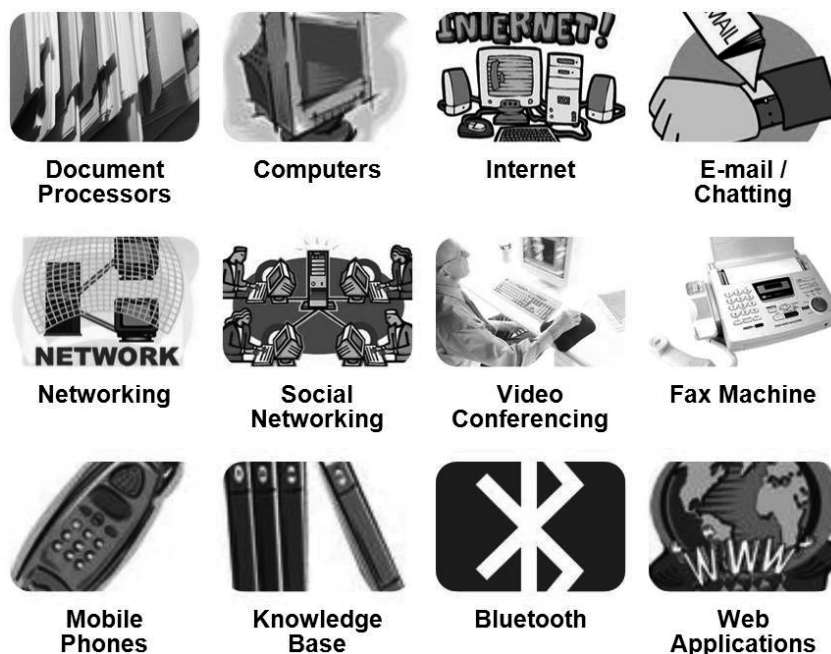
As you can see, all the above tools play a vital role in ICT performance. Computers are the basic hardware needed wherein the Document Processors are the applications that are used to present the information, enhancing the aesthetic value, and still being informative. Internet is the tool for getting connected to share information and communicate with others.

Knowledge Base is the dictionaries and libraries available on the internet to enhance knowledge. Bluetooth is a technology making communication wireless. On the other hand, Mobile phones are no more a luxury product but have become a necessity of our daily life. E-mails, Chats, etc. are the tools to interact with anyone and anywhere with the help of technology. It is not limited to written interaction but also visual interaction is made possible with video conferencing.

There are numerous Web Applications which have their own features are used to communicate and share information. Network is all about linking the hardware connections so that they can interact with each other. Social Networking is the trend of the hour and is being used to communicate and share information within groups and forums. It can also be used to share information in an open forum.

Fax Machine is the last but not the least and is one of the best sources to photocopy at a distance location. While the usage has reduced, it still has its effectiveness and is being used in many organisations.

2.2 Efficiency with ICT

Each business entity desires to enhance its performance and keep up its growth rate. ICT plays a key role in the development of the business. Hence, companies invest in ICT as it has become evident that ICT is becoming an integrated player in the market. Having said this, it is imperative that the efficiency of ICT has to be known to justify the investment. Let us see what role ICT plays in improving efficiency.

1. Enhanced speed

The speed in which data is processed, shared and communicated is unimaginable. While it seems that technology has reached its maximum processing speed, some new inventions make it even faster. The speed at which people communicate and share information has changed drastically. The enhanced speed of ICT has enabled people to perform several multiple activities within a small time frame. Speedy work assures speedy results.
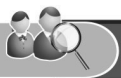
Example

Earlier: A letter had to be typed or written, made copies and then posted to all the intended recipients which would take some time (even days) to reach the recipient. Not to forget the time taken to make corrections in drafting letters in case of errors.

Now: Type a letter or correspondence using email and just write the email address of the recipient and press a button to send it to the recipient, which would reach within seconds anywhere in the world. Instead of carbon copies, type the other recipients' email addresses and send it simultaneously. It is easy to make corrections even when errors happen. The software does a spell check which ensures less errors.

2. Reduction in processing time

In a business environment, time is of a great essence and when a particular activity is completed within or before the stipulated time, it not only reflects efficiency but also provides additional time to take up other tasks. ICT not only saves time but also ensures that integrated activities are performed effectively at a fast pace, managing the time very well.

Example

A marketing department has to make company profile presentations quite often to prospective clients. Most of the information in the presentation is similar, with only a few changes to be made according to the need. With the help of technology, the data used for the presentation is stored and accessed multiple times to make a new presentation by only making minimal and relevant changes. The storing of data saves a great deal of time as repeated work can be eliminated.

3. Quick decision making

Enhanced speed would mostly ensure quick results and which in turn helps in quick decision making. For example, getting connected to the internet and using the resources and getting the required information would ensure that you have sought the desired information to make quick decisions. Business growth would need quick decision making as decisions made in a slow pace would hamper the performance and result in slow growth of the business.

Example

Jonathan is the Finance Manager of Prolific Trading PLC. He has been given to understand that due to some reasons there is a shortage of funds in the business bank account. However, there are several cheques which have been issued as payments. He will be receiving some funds, but it will take a day or two.

He immediately connects to the internet and checks the bank balance and confirms shortage of funds. He makes a decision and instantly writes a mail to the Bank Manager requesting stoppage of payment for all the cheques issued yesterday and today. He follows this up with a phone call. He calls and sends mail to all the parties and requests to hold the cheques for a couple of days.

Technology assisted him to make a fast decision and save embarrassment.

4. Enhanced communication

Sharing knowledge and information is a part of communication. Emails, chat applications and video conferencing make communication quick and also helps in sharing information between team members in an efficient manner. As information is visible to all at the same time, it can be used by various team members effectively.

Using technology with different presentation tools and document processors, organisations share the information in a very presentable manner. ICT enables you to communicate and share information in such a way that it is being understood and comprehended efficiently.

Example

The Figure below will display how communication has enhanced with time and evolution of ICT

a) Telephone had no mobility and had limited features, while cellular phones are mobile and have numerous features in it.

b) Typewriters were used to type data, and storing data for repeated use was not possible. Computers, laptops enabled communication to look more aesthetic. Storing data for repeated use and making copies became easily possible with computers.

c) Blackboards were used to present data to a group of people for discussion with limitation of presenting complex data in a simple form. Information presented could not be reused for future purpose. However, with the development of technology, computers, projectors, screens enabled data to be shown in a more presentable form and illustrations, Figures, pictures and videos can be used to present complex data in a simpler form to understand. It enabled catering to a large audience with visual effects, and data could be stored for future reference.

d) Communicating effectively with far away clients and peers was not possible in earlier days. ICT has empowered people to effectively communicate with far off people with the help of video conferencing wherein visual impact enhanced the communication to a great extent.
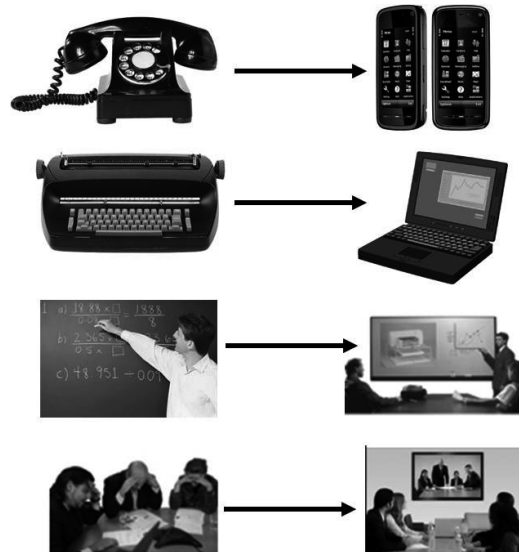
5. Integration

Businesses, whether big or small, have their own processes and sub-processes. ICT ensures efficiency by integrating various functions and automating the process to perform in a better way. Enterprise Resource Planning (ERP) is an integration model. For example, in a Human Resource department, along with Payroll, other sub-activities such as leave details, employee details, attendance and monthly MIS are integrated to perform the overall HR role efficiently.
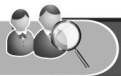
Example
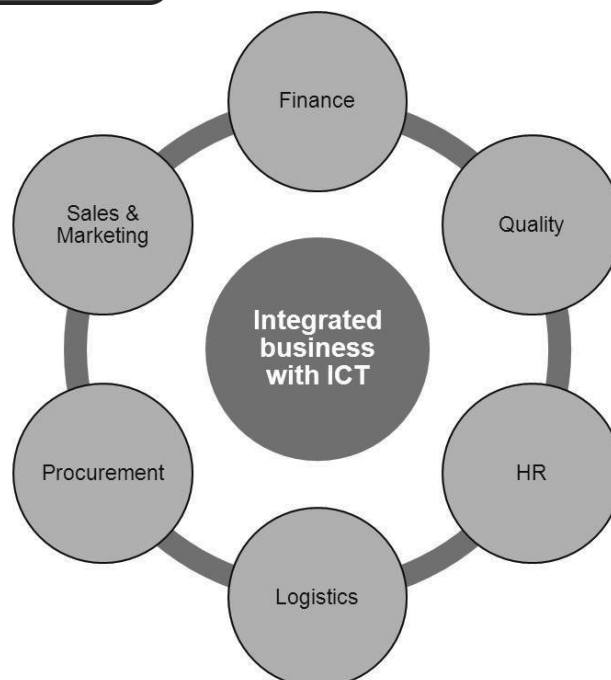
Figure 2 : Business Functions

Companies sync technology with the process to streamline the operations. The various processes and sub-processes of a business were connected well with each other. Each function performed independently, however the systems enabled to store the data centrally making it accessible to all the other functions as per the need. The integration of the processes made it easy as the work became more of a system driven activity. Data storage, availability and un-interrupted work flow was easily possible with the integrated systems.

For example, the finance department can use the integrated technology to find out the information on a particular employee's attendance to confirm the details if needed before providing leave encashment. The finance staff need not go to the HR department to get the physical files. With relevant authorisation, integrated systems enable effective data handling which is electronically stored and managed.

6. **Easy data sharing**

Data is being shared in an organisation at various levels and for various purposes. ICT has brought with it the power of sharing data which is not only easy but also stored safely. Various system applications and resources are available which ensure that the data is stored at one place or centrally and it is being shared within different functions. Such technology ensures that data is managed by the system more than by the people. This helps to avoid data redundancy and duplication, and above all, enable sharing it easily.

Example

Earlier data was physical and in written form; handling and maintenance was difficult and a lot of space was also required. The security of certain confidential data needed efforts. Data accessibility had its limitations as locked cabinets and drawers hampered the sharing ability.

Test Yourself 2

Carl has been the owner of Power Tools PLC for the last 17 years and the company has been operating with old fashioned technology. He wants to enlarge his business and wishes a global presence. He is being joined by his two friends, James and Jessica. They have brought with them some expert professional experience and have also contributed to the capital of the business to take it forward.

Carl now has a bigger vision and has more funds to invest on hiring skilled people, spending on marketing, good infrastructure, increased purchasing power and more stocking. Which investment has Carl missed out considering the vision to reach out globally?

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3. **Explain how ICT improves life standards.**

[Learning Outcome c]

3.1 Merits and De-merits of ICT

ICT plays a vital role in enriching our lives. It has come a long way in improving the standard of life in terms of quantity and quality. Having said this, ICT has its own merits and de-merits, which have been mentioned below:

1. **Merits**

(a) **Communication Ease:** ICT has made it easy to communicate with clients and colleagues using internet and instant messaging. With mobile phones in place, you can communicate with any one even if you are on the move.

(b) **Speed & Time:** use of e-mail, internet and other applications has ensured that information is shared and communicated at a great speed. People get connected with each other with a click of the mouse. Various applications are used to process simple to complex data at a great speed maintaining the accuracy and relevance thereby saving time. ICT has proved its worth with its increased speed and time saving ability.

(c) **Cultural Gap:** knowing someone from a different country and doing business with someone from another culture was difficult in earlier days. ICT has made this process seamless as it has the needed advanced tools in its kitty such as internet and video conferencing wherein you not only talk to people across but also see them and present yourself. Internet, on the other hand, is a world of encyclopaedia wherein you can learn and understand about any person, country, culture or business before communicating with them. It also allows you to market your business over the web wherein your business scope is exposed globally. Use of language translator on the internet eliminates language barrier which proves a boon in a business scenario.

(d) **Data storage & accessibility:** data is the key to information processing. ICT enables a large amount of data to be stored and accessed easily whenever needed. It also ensures the safety of the data as reliability is assured with its safety. Data can not only be saved on the computer hard disk but also on various external data saving devices. Specific systems and technology makes sharing and accessing data even from a distant location which helps businesses to perform in an effective manner. With checks at relevant level, it is ensured that the stored data is accessed by an authorised or relevant person for appropriate purpose.

(e) **Cost effective:** if typing a letter and posting it to someone would cost some amount of money, sending an email to someone is almost free. Various integrated and automated processes have made business process efficient, thereby making it cost effective. It eventually boosts productivity and increases profitability of the business. Automated process uses minimal resources, saving major cost factors.

(f) **New Jobs: a**s ICT evolves, the need to operate advanced technology always arises. Specialist jobs such as Computer Programmers, Software Engineers, Hardware Engineers, Analysts, System Analysts and Designers, Web Designers and many such skilled job opportunities arise.

2. De-merits

(a) **Evading Privacy & Data Theft:** ICT has transformed drastically and has increased the speed of communication making it easier. However, with this, comes the major concern of privacy. The power of technology is also used to intercept mobile signals, hack mail and websites. Private and personal information can be accessed and such information is made public which is a major concern. The passwords are cracked, systems are hacked and valuable information is stolen and misused, posing a threat to the safety of the information.

(b) **Unemployment and lack of Job Security:** business benefits with constant upgradation and regular change in technology. However, people working on the technology may not always be upgraded with changing technology. Lack of required skill set triggers the threat of losing jobs. Moreover, technology has advanced and has automated most of the processes, reducing manpower to a good extent.

(c) **Maintenance Cost:** with every new technology the cost of upgrading the system is involved. The cost of employing specific skilled staff adds to the cost burden as people with upgraded skills are rare resources and costs more. It also calls for change in the hardware and software being currently used. In the pursuit of effective performance, companies spend a lot on new technology and integrated systems and the cost of training the staff also adds up.

(d) **Digital Divide:** while most of the business entities have the required technology and systems in place, there are still people who cannot make optimum use of the technology due to lack of knowledge or funds. The optimum use of technology varies between developed and less developed countries and locations. This creates a digital divide as a common ground cannot be arrived at as few of them are still away from the technology tool.

(e) **Information Reliability:** internet is an open forum wherein any one can post something or upload some information to be shared. However, reliability of the data and information being shared cannot be ensured. Many such pieces of information and data are not authorised and approved and hence such resources may be risky. Other elements such as unknown identity and virus threats make the reliability of the information unsure.

(f) **Over dependence on technology:** technology has advanced to an extent, wherein people use less of their memory and skills and more of the technology. Word processors with auto spell checks and a spread sheet with formulated calculations avoids human interventions to a great extent. Hence, we are getting away from these skills gradually.

3.2 Better life with ICT

ICT has changed rapidly and has provided us the most efficient resources and tools making our lives much more comfortable. The list is very vast, but some points have been briefed below.

1. Easy Reach

Gone are the days when reaching out to a relative or friend staying far away was difficult. You had to either write to them or book a long distance call to speak to them which involved a lot of time. Now with e-mails, video conferencing and mobile phones, you cannot only reach out to anyone you wish but also see them while you communicate with them.

Now you can share pictures and videos with anyone anywhere just with a few clicks on the computer. With the help of mobile phones, you can get connected to people wherever they are and from wherever you are even though you both are on the move. ICT has eliminated the distance barrier and made reaching out to people very easy.

2. Speedy Communication

Speed has been one of the most life changing aspects of ICT. People used to write to someone and post the documents and wait for the other person to receive it and then wait to receive a reply. Now, a click on the e-mail or an online chat or messaging application makes communication not only superfast but also real time. Documents are scanned and attached to e-mails which reach the recipient instantly.

You can connect with people and talk to each other at the same time. The communication speed has also helped save enormous amount of time.

Example

An important document has to be shared with someone at a distant location. Rather than making a copy and posting it, just scan the document and send as an email attachment. This would be super-fast.

3. Cost Effective

If you need to send some documents across to someone, you need to make copies, travel to the post office or courier office, pay for the services and still wait for the documents to be delivered. While all this happens you are anxious till the documents are actually delivered.

Now with all the technology in place, scanning the documents, making any number of copies and sending the documents through e-mail and other applications has not only eliminated the time but also reduced the cost drastically and over all ensures that the information has been transmitted instantly. Earlier, communicating and making calls was a costly affair, however; with advanced technology the cost of making phone calls has also reduced and communication has been made very affordable to the common man.

Example

Pinda works as a Legal Advisor for various corporates. She often needs to travel to meet and discuss things with the clients. Of late, she realises that quite some money is being spent on her travel to various clients and most of the time either the meeting would get cancelled or very little would be discussed leaving the matter for the next meeting. Cost becomes an important factor especially when the clients are located at a distant place.

Merlyn has found an effective way out. She has got a web camera attached to her computer and now she gets connected to the internet to attend video meeting/conferences and even if the meeting gets cancelled, she just needs to switch the computer off. This helps her to save a great deal of time and money.

4. Shopping made exciting and easy

While you had to look for items from one shop to other making this fun activity more tiring and boring, ICT has made a breakthrough in technology which has also impacted shopping in a great way. Shopping can be done online using internet, wherein you have various options to shop by checking the item, its specifications, rates, etc. You can look for the items of different brands and options and you have ample time to check them again and again before you decide to buy them.

Once you decide to buy something, you have to pay for it online and the delivery would be made at your door step. All this is done by sitting in one place and is especially useful if you are unable to go out for some reason.

Example

Shop sitting at home and get the required products of your choice delivered at your doorstep. Pay them by electronic or fund transfers, avoiding cash transactions.

5. Easy monetary transactions

Paying bills and making payments have become the easiest task in today's life compared to earlier days. The process of standing in long queue for making utility payments, premiums, etc. has been eliminated to a great extent. While you shop you need not carry physical cash, you just need to swipe your debit or credit card for making payments instantly. You can use ATMs to withdraw money rather than waiting in long queues at the bank. Transferring money from one bank account to another is easier than ever.

Moreover, payments can be made using debit card, credit card and electronic fund transfer through bank websites. Government and banks encourage people to use more of this technology rather than physically crowding the counters which is not only time consuming but unsafe as well.

6. Travel options

You might travel for a personal need or business requirement; but in both cases, you have to prepare a lot. You have to interact with the travel agent, get the tickets booked which requires frequent visits and investing lot of time. Moreover, if you are travelling to a new place, you need advice and tips from an expert or an experienced person before you travel. ICT has made life easy with its availability at your disposal. You have to get connected to the internet to select your mode of travel, book your tickets (many times seating options) and make payment for it instantly. Moreover, internet allows you to know about the place you plan to visit and understand anything and everything about it.
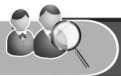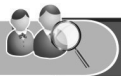
Example

You can check blogs where people pen their experience about that place which eases the travelling experience. ICT has made travelling more fun and hassle free.

7. Entertainment at a click

If you are waiting for someone, you might either read the newspaper or a book or else keep looking around. Breakthrough in technology would keep you excitingly engaged even in your free time. Your mobile is the biggest entertainment gadget. You can play games, watch movies, connect to the internet and read the news, chat to someone, talk to someone. Your computer turns into an idiot box, cinema hall or a play station.
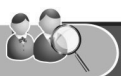
Example

You can watch movies of your choice and taste. You can upload or download movies, games, pictures and share it with others. ICT ensures that even your spare time is utilised efficiently with ease.

8. Health Care Remedies

Health care sector always needed technology to perform effectively and reach out to maximum people.

ICT enables the health care sector to have computer-based patient information records, data imaging technology to store patient health information for discussion and reference, internet tools to provide online help and information and tips to be healthy. Videos on health issue diagnosis can be shared with people making it informative. Awareness can be increased with the internet and the training of the medical professionals has become easier with it. The technology has made medical reach and development of health care possible making life safer.

Example

Janet has been visiting an Orthopedic for her father in the city where she used to stay. Due to work she has moved to a different place far away. One day her father experiences severe pain in the knee. She phones the doctor and seeks help. The doctor wants to see him before prescribing any medicine.

However, her father has acute knee pain and cannot travel so much. The Doctor scans all the documents that are with him such as diagnosis, test reports etc., emails them to Janet and asks her to visit a local Orthopedic and seek assistance. She downloads all the reports and visits the local doctor to seek temporary relief.

9. E-Governance

Dealing with government agencies and sub agencies has always been a tedious task as the process involved is time consuming. Informative documents, evidence and other paper work make it a pile of documents for any activity; be it a complaint, registration, information retrieval, membership addition, cancellation etc. With the revolution of ICT, E-Governance has emerged and almost every transaction is done online, thereby avoiding paperwork and time and eventually getting fast results. E-Governance has made a great difference in the way the government activities are being performed and now seem to be more effective and quick and result oriented.

Example

Taxes are paid online avoiding:

a) Standing in the queue at the government office and other agencies to submit documents.
b) Make multiple copies for submission
c) Bank visits to make tax payments

ICT has enabled online activity which has resulted in the increase of tax payers as the process has become convenient, fast and hassle free.

### 10. Training, Education & Study Material

Training and Education is not limited to a classroom. Study material and knowledge is not limited to a particular teacher, book or reference. The internet is a world of knowledge wherein information is scattered; you need to look for the relevant material and use it effectively.

ICT plays an important role in the emergence of Distant Education. Education has reached beyond boundaries as the technology helps to communicate and share information and provide training across the country and culture. Extending training to people at different locations at the same time has become easy with video conferencing and real time applications. It not only ensures the use of technology to get the appropriate material but also provides time flexibility. Professional educational information provided by various experts is available on the internet which can be accessed appropriately and used effectively.

11. Empowered Business and Services

ICT has made itself a powerful tool in the business context. Be it selling, marketing or providing services, technology has been the key. It has enabled the integrated business processes to be automated increasing productivity and getting better results.

The reach of business is beyond limit and can take the business forward globally. The speed and effectiveness of technology has enabled businesses to grow four folds, breaking barriers in terms of reach and connectivity. Communicating, marketing a product, selling and providing services to a distant client have become very easy with the technology tools. The use of computers and ICT has not been less than a boon to the businesses for growth and success.
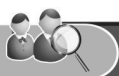
Example

Companies create web sites (on the internet) and provide information about the company, its products and services. Companies now days do their marketing on the internet as a few presentations can be made available on the website which provides a good insight about the company.

The web site provides a list of products and services available with the company which enables the customer to decide on approaching the company for their need. Quotations, invoices and other documents are exchanged on the internet making communication fast. Some service oriented companies provide services online wherein technology is used effectively to make speedy services available save time as customers are attended and served irrespective of the geographical location and distance.

12. Access to latest news & information effortlessly

Getting the information and news is not restricted to television and newspaper. ICT has empowered itself not only to provide the latest news but also in real time. You need not wait for the next day to read the newspaper on the updates and happenings; you can log on to the internet and get the required information with a click. Accessing information has never been so easy and effective.

Not only computers, even mobile phones can be connected with the world through internet and access to news and information is available on the move. ICT has become an encyclopaedia of encyclopaedias which means that it is a single point of information availability on any topic.

Archives take information availability one notch further. It enables you to access information which is being stored over a period of time and can be retrieved whenever needed. The world of media uses the ICT tool to a great effect making news and information available instantly and effectively.

Example

ICT enables access to information and news by various means. Media houses provide live coverage from any part of the world using satellite technology. Examples:

   a) Connection to internet and access to media web sites providing latest and instant news (local and international) along with pictures and videos
   b) Educational websites provide information and study material.
   c) Access Wikipedia site and get information on various things
   d) Get latest news on sports, entertainment, politics, finance etc.
   e) Use dictionary on the internet to know meanings of difficult words.

Mobile phones have internet applications which enable all the above and much more on the move.

13. Security tools

With changing time, more and more communication is being made and each and every one has information and data which is either personal or confidential. Hence it becomes essential to maintain the security and secrecy of the data. ICT enables protection of data with passwords.

Information such as bank details, confidential data, personal information, software, bank vault passwords etc. are safe and secured. The security tools are developing beyond imagination and work towards eliminating easy stealing, data theft, ill-legal access, unauthorised access, trespassing, fraud, etc. Not just mere passwords, but with time, it has developed fingerprints, CC TV, voice recognition, and eye scanning as security tools making access secure and personalised.

Example

Companies have Closed Circuit Cameras fitted in their reception lobby to record visitors coming and going. This enables a sense of security as the recorded data can be used to get the needed the information.

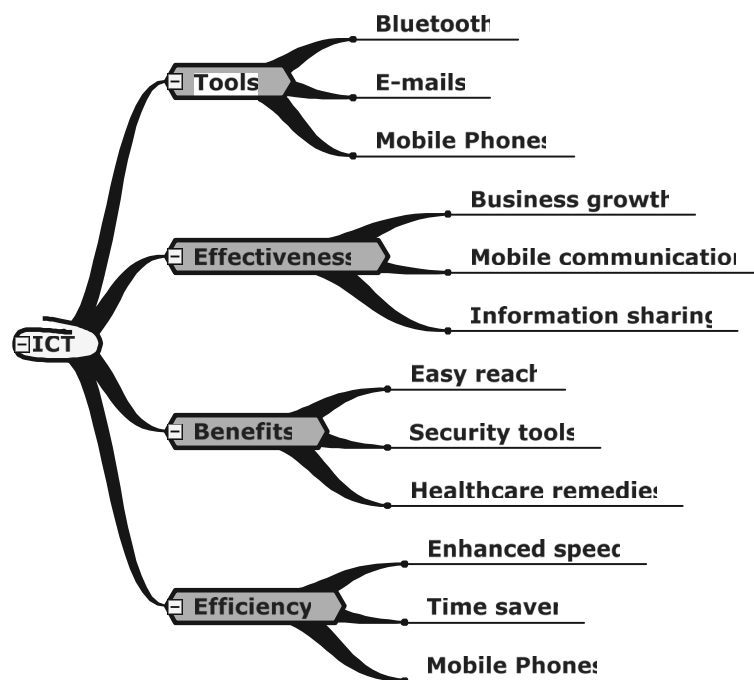**Test Yourself 3**

While ICT brings with it the limitations of data theft, digital divide, information reliability and maintenance cost, there are reasons to believe that technology has empowered us with tools to have a much better lifestyle and enhance the way we live, which is evident because of:

A   Un-employment
B   Security Tools
C   Easy Reach
D   All the above

Summary

```
                                    Bluetooth
                        Tools        E-mails
                                    Mobile Phones

                                    Business growth
                        Effectiveness  Mobile communication
                                    Information sharing
        ICT
                                    Easy reach
                        Benefits     Security tools
                                    Healthcare remedies

                                    Enhanced speed
                        Efficiency   Time saver
                                    Mobile Phones
```

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

ICT has linked all the departments of the business and have kept them closely knitted together. The departments communicate with each other through technology wherein it not only saves time due to its speed but also proves to be effective as the information is available to all the departments and functions and is communicated effectively. ICT ensures that the performance of the business is more system driven than human driven in order to minimise errors.

Answer to TY 2

Carl has missed out investing on Information Communication Technology.

ICT has become an integral part of any business. It has proved its worth by providing high speed services, time saving ability and effective and efficient performance with its tools. Carl will have to spend on ICT tools and systems to integrate and automate the processes together so that the process becomes system dependent, thus enhancing the performance and increasing profitability. Carl will also have to consider investing in latest technology tools so that these can be used to communicate, market, sell and provide services to local and international clients with speed and efficiency.

Answer to TY 3

The correct options are **B and C.**

Technology, with the ability to store huge data which can be easily shared and utilised, does not have any significance until it is secured and safe. The privacy and secrecy of the information has to be maintained wherever relevant. Hence security tools are needed as with advanced technology data theft and stealing creeps in and security plays a very vital role in keeping them at bay making the information safe and secured.

In today's fast moving environment, ICT has ensured that communication happens with a great speed, saving a lot of time and freeing up spare time to do other things. Using instant mail, chat or messaging you can connect with anyone anywhere and communicate quickly and in real time as well. With video conferencing, you can view the other person as well, making communication more effective and pleasant.

Self Examination Questions

Question 1

Name any three tools of ICT which not only enable speedy communication with easy reach, but also provide visual presence, enabling communication to be more effective than it was earlier.

Question 2

Getting connected globally and communicating with people with speed and ease has enabled the growth of business beyond boundaries. This has been only possible with _____.

Question 3

ICT has proved to be a driving force for any business to grow and succeed. Justify this statement.

Answers to Self Examination Questions

Answer to SEQ 1

The three tools are mentioned below:

(a) Mobile Phones: Earlier people could not communicate with each other while they were away from their work place as they had a fixed land line instrument for communication. With Mobile Phones, it became easy to communicate and share information even while being away from the workplace. Accessibility is no more an issue as connectivity is available even on the move.

(b) E-mail: Writing a letter, taking a print, making an envelope, writing an address and eventually posting it and waiting for the recipient to receive it and then wait further to receive a reply on some written matter was a time consuming task. E-mail has made communication happen instantly with a click of the button/mouse. Businesses need communication quite often and if that happens in speed, it enables quick decision making, eventually increasing the performance. E-mails not only enable speedy work but also allow sharing information and data with great speed which helps to perform activities faster.

(c) Video Conferencing: Face to face communication is often effective. While phones enable you to communicate with someone without seeing them, video conferencing goes further and allows seeing the other party with whom you communicate. Communicating with someone at a different location with the help of video conference gives the feeling of everyone being seated in the same room, eliminating the distance barrier. Video Conferencing proves to be very effective, especially when communicating with a view to persuade, influence, express or motivate the other party.

Answer to SEQ 2

The correct answer is ICT.

Internet, e-mail, video conferencing, etc. has enabled businesses to express their potential in distant locations. The technology can be used to identify potential markets, communicate, market, sell and provide services to customers who are geographically far away but within reach with ICT in place. With the tools of ICT, business growth has become easier and effective.

Answer to SEQ 3

With the availability of wide spread marketing opportunities, an effort to reach out and solicit business has become inevitable. The desire to perform better and provide more effective customer service has increased with ICT proving a powerful tool.

It not only provides speed and easy accessibility, but also saves time and enables integration of processes to be automated, thereby eliminating unwanted overhead costs and increasing profitability with minimal errors and increased productivity. Customers can be reached out easily irrespective of the geographical distance.

Technology not only enables connectivity, it also enables the business to be marketed and products to be sold. Service can be provided with the help of ICT. Speedy communication and time saving ability has eliminated the distance barrier. ICT proves as a catalyst for a better business performance.

STUDY GUIDE B1: PROCESSING DEVICES

▓ Get Through Intro

The most important component in the processing device is the central processing unit (CPU). When you plan to purchase a computer or update your existing computer, the most important decision which is made is the selection of the CPU. CPU forms the heart, brain and soul of a computer system. Without a CPU, the computer would not have the capability to work smartly.

The purpose of this Study Guide is to introduce you to various components of the central processing unit and how these components interact with each other to process the data. Furthermore, we will discuss the various processing methodologies and evaluate their relative advantages and disadvantages.

▓ Learning Outcomes

a) Identify various parts of central processing devices.
b) Evaluate various processing methodologies.
c) Compare various processing strategies.

---

1. Identify various parts of central processing devices.

[Learning Outcome a]

1.1 Central processing unit (CPU)

Definition

The CPU is the component of the computer where all the processing related tasks are done.

Classification based on functioning

The CPU is the most important component of computer hardware, consisting of:

a)   Arithmetic Logic Unit (ALU),
b)   Control Unit (CU)
c)   I/O unit (Input Output unit).

These components have been discussed in detail in Paragraph 1.3.

The CPU requires a printed circuit board or microprocessor to perform various calculations. The CPU performs all the calculations and processing in a computer and therefore is referred to as the **brain of the computer**. The functioning of a CPU is further discussed in detail in paragraph 1.3 of this Learning Outcome.

Classification based on hardware component

The CPU comprises the following hardware components:

1.   Chip

The Chip is a small piece of **silicon embedded with an integrated circuit**. A CPU (microprocessor) chip consists of the entire processing unit, whereas the **memory chip** is completely blank. The chips along with the sound and video card are plugged onto a circuit board known as the **motherboard**. Personal computers have one motherboard. The number of motherboards required by a computer depends on the size of the machine. The main manufacturers of chips are Intel and AMD.
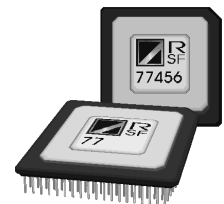
The processor speed is measured by the number of cycles per second e.g. Megahertz (one million cycles per second) or GHz (one billion cycles per second). The sequence known as a cycle is co-ordained by a clock which sends out a pulse.

Example

If a computer system has a configuration of Intel Pentium(TM) III 1000MHz chip, it means that the Intel processor chip is running at 1GZ or 1,000MHz.

---

2.   BUS

A BUS is a collection of wires which **transmits data** from one part of the CPU to another. **Address bus** and **data bus** are two types of buses. The size of a bus is known as width. The data bus carries actual data, whereas the address bus transfers information regarding where the data should go. Usually, the processor of the personal computer is connected with a local bus which enables the personal computer to transfer data at a high speed.

3.   Memory

The **internal storage area** in a computer is called memory. The memory stores the data in the processing units. This speeds up the processing abilities of the computer. Due to its limited size, the memory can only store certain amounts of data at a time.

The main characteristics of memory are:

a) **Capacity:** the total volume of information (in bytes) it can store
b) **Access time:** time taken to process a memory read (to retrieve data from the hard disk) and memory write(to store data on the hard disk),
c) **Cycle time:** minimum time between two accesses
d) **Throughput:** expressed in bits per second, it is the volume of information exchanged per unit of time
e) **Non-volatility:** It is the ability to store data when no power is supplied

The memory contains:

a) **Program data:** control unit operates on various programs (including operating system)
b) **Input data:** this area includes the data which is to be processed next
c) **Working area:** this area stores the data currently being processed
d) **Output data:** this area temporarily stores data that is ready for output

Refer to the detailed discussion in paragraph 1.2 of this Learning Outcome to understand primary memory.

4. Bytes

The memory of a computer is measured in bytes. Any instruction given to the memory must be coded in terms such that a computer will understand. The individual storage units in a computer consist of a simple circuit which can be switched either on or off. The computer understands these two states (on and off) which can be expressed as 0 for 'off' and 1 for 'on'.
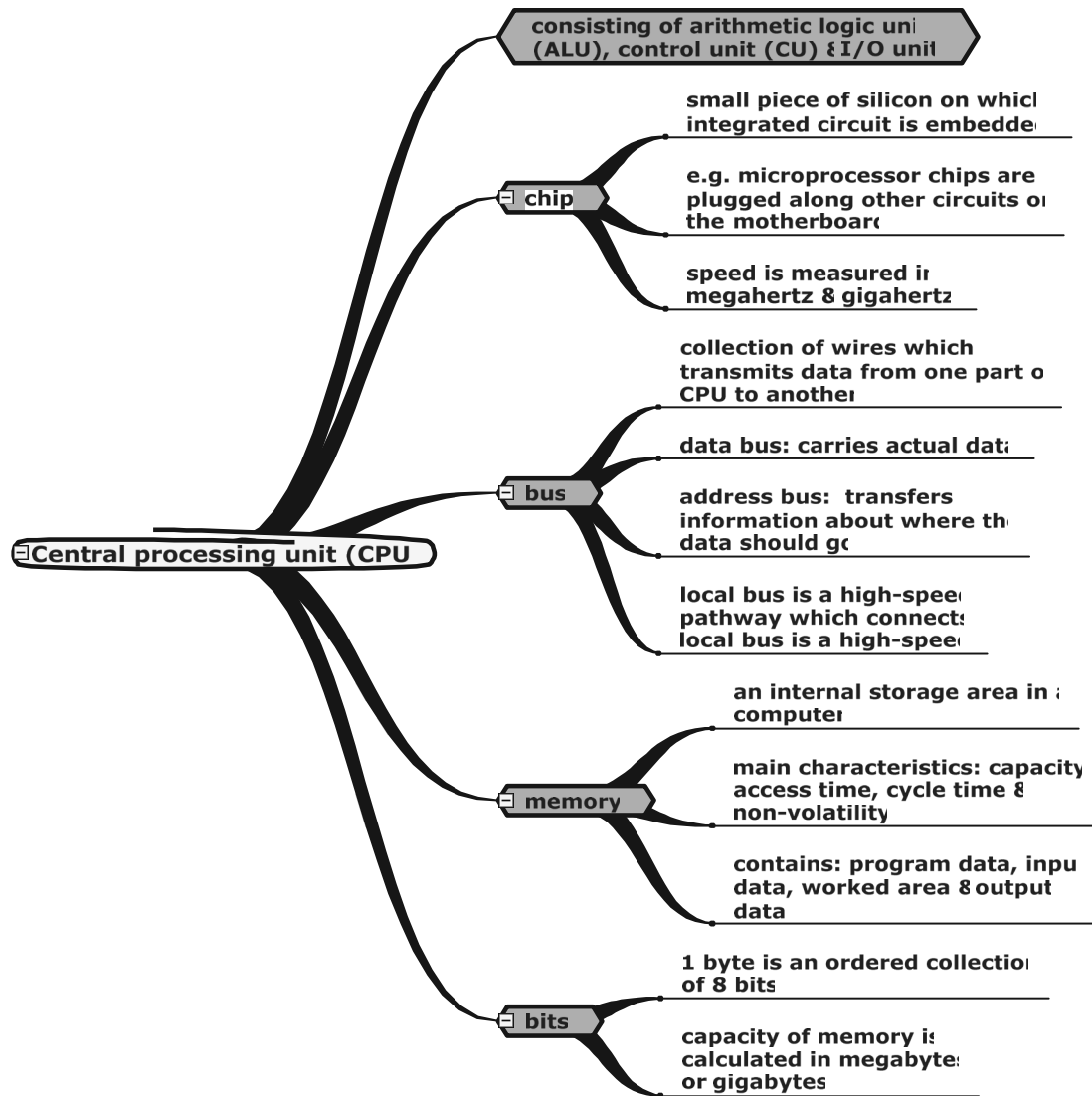
A bit is capable of holding one unit of storage at a time. Hence, every 0 or 1 is a bit. A byte is an ordered collection of bits. A byte is equal to 8 **bits**. Usually a personal computer has a 32 or 64 bit processor. This means the data is transmitted by the processor in groups of either 32 or 64 bits. The capacity of the memory plays an important part in determining the capacity of the processor. It is calculated in Kilobytes (Kb = 2^{10} or 1,024 bytes), megabytes (1 Mb = 2^{20} or 1,048,576 bytes) or gigabytes (1 GB = 2^{30} or 1,073,741,824 bytes).

5. Cards

A computer's capability can be increased or enhanced by installing cards to perform a specific task. These cards can be attached to the motherboard, provided a proper slot is available on the motherboard to fix the cards. Some of the most commonly installed cards include the following:

a) **Sound card:** a sound card is also known as an audio card and it facilitates the input and output instructions to and from the computer system.

b) **Visual Graphics Adapter (VGA) cards:** visual graphics adapter cards aid in presenting videos and graphics animation. Some VGA cards are now equipped with 3D video processing.

c) **Network interface cards (NIC) card:** these cards provide a slot to plug in the network cables into the computer system. The NIC cards act as a communication device between the computer and the network.

SUMMARY

Central processing unit (CPU)

- **consisting of arithmetic logic unit (ALU), control unit (CU) & I/O unit**

- **chip**
  - small piece of silicon on which integrated circuit is embedded
  - e.g. microprocessor chips are plugged along other circuits on the motherboard
  - speed is measured in megahertz & gigahertz

- **bus**
  - collection of wires which transmits data from one part o CPU to another
  - data bus: carries actual data
  - address bus: transfers information about where the data should go
  - local bus is a high-speed pathway which connects local bus is a high-speed

- **memory**
  - an internal storage area in a computer
  - main characteristics: capacity access time, cycle time & non-volatility
  - contains: program data, input data, worked area & output data

- **bits**
  - 1 byte is an ordered collection of 8 bits
  - capacity of memory is calculated in megabytes or gigabytes

Test Yourself 1

Which is the most important component of computer hardware?

- **A** BUS
- **B** Memory
- **C** Accesses time
- **D** CPU

1.2 Types of internal memory

Random access memory (RAM) and Read only memory (ROM) are the two types of memory.

**1. Random access memory (RAM)**
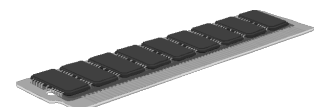
Definition

Random access memory is the memory which can be randomly (directly) accessed to perform read or write operations.

In the RAM, **any location** in the memory can be accessed, in any order, within the same timeframe.

RAM is the **principal memory** of the computer. Data can be written into and read from RAM. Hence, it is also referred to as read and write memory.

Data is temporarily stored in the RAM. This is because the RAM is **volatile**; a steady flow of electricity is required to maintain its content. Data stored in the RAM is erased when the power is turned off.

The efficiency of a computer is heavily dependent on the size of its RAM.
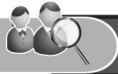
Example

A personal computer with 2 GB RAM and 500 MHz clock speed will be more efficient than a personal computer with 500 Mb RAM and 750 MHz clock speed.

2. Cache memory

Small memory placed between the processor and main memory is termed 'cache'. It is a copy of the most **recently accessed data**. When a program needs to access data from the disk, the cache is checked first. This process improves the performance because accessing a byte of data in the RAM is several times faster than accessing a byte from the hard disk.

In case the cache is full, new entries are made by deleting the old entries from the cache. This process is referred to as 'flushing out'.

3. Read only memory (ROM)

Definition

Read only memory (ROM) is the memory where data cannot be written i.e. data can only be read.

ROM is a read only memory. No new data can be written on it by the computer user. ROM is **non-volatile** i.e. it retains information even when no electricity is supplied.

It stores instructions to **perform basic functions**. The ROM is provided by the manufacturer of the computer and holds the start-up program, known as the '**bootstrap**' program. When this program is run, it is known as 'booting up the computer'.
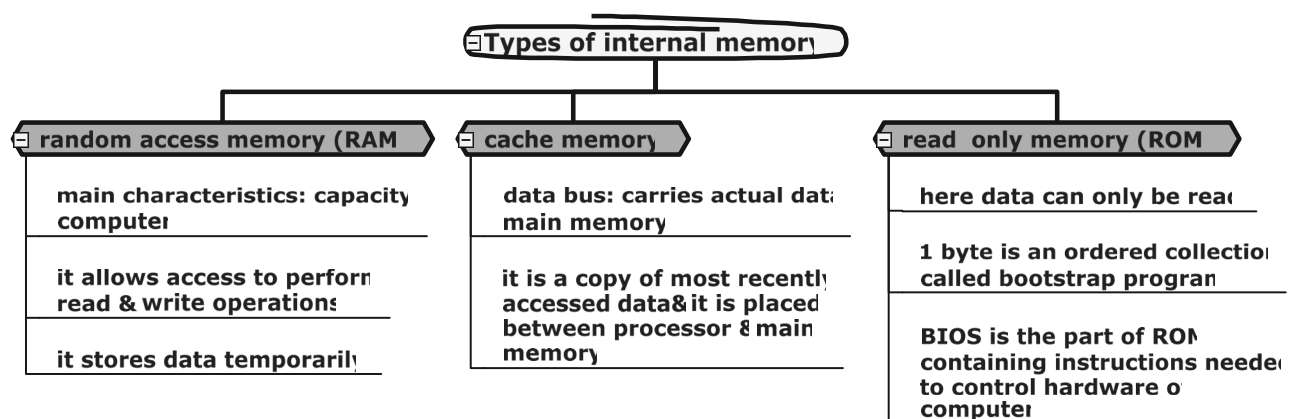
BIOS: is the part of the ROM containing instructions required to control the hardware of the computer, for example, keyboard, VDU and disk drives. At the time of turning the computer on, a BIOS message appears.

Tip

Secondary storage devices are discussed in detail in Study Guide B4.

SUMMARY

Types of internal memory

random access memory (RAM)

main characteristics: capacity computer

it allows access to perform read & write operations

it stores data temporarily

cache memory

data bus: carries actual data main memory

it is a copy of most recently accessed data & it is placed between processor & main memory

read only memory (ROM)

here data can only be read

1 byte is an ordered collection called bootstrap program

BIOS is the part of ROM containing instructions needed to control hardware o computer

Test Yourself 2

Which of the following memory contains a copy of the most recently accessed data?

A   Random access memory (RAM)
B   Cache memory
C   Read only memory (ROM)
D   BIOS

1.3 Functioning of a central processing unit

Figure 1: Central processing unit
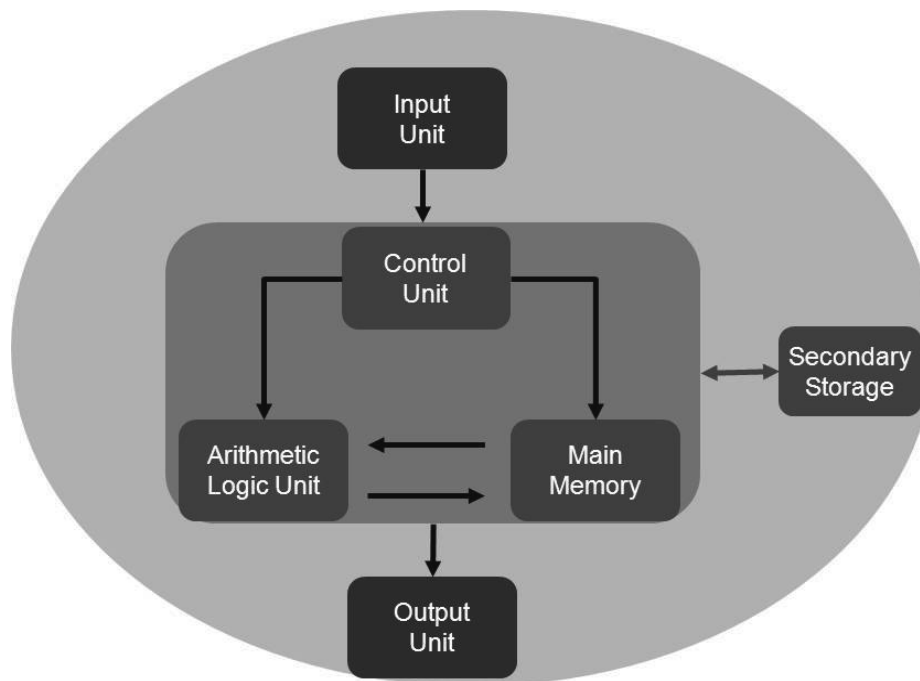
A computer system has four main sections:

1.   Control unit,
2.   Arithmetic and logic unit (ALU),
3.   Main memory, and
4.   Input and Output devices (collectively termed I/O).

The arithmetic logic unit, control unit and the main memory are part of the CPU. The input and output devices and the secondary storage interact with the CPU. All the parts in the CPU are interconnected by groups of wires which are referred to as **buses**.

1.   Control unit

The control unit directs the various components of a computer. It reads and interprets the instructions received in a program from the user. The control unit decodes each instruction and then converts these signals into a series of control signals which are relayed to the other parts of the computer. The operation of a control unit is measured in terms of number of cycles produced per second and is measured in Hertz (MHZ). This is the most popular measure you need to check if you intend to buy a computer system with higher processing capability. (Computer speed is also discussed in paragraph 1.1).

2.   Arithmetic logic unit

The ALU is capable of performing two classes of operations: mathematical calculations (add, subtract, divide, multiply, etc.) and logical comparison (if, and, true, false, etc.). Once these calculations are performed, the ALU transfers the results to the main memory. Similarly, it may access data from the primary storage to perform certain calculations.

3. Main Memory (Primary storage)

Main memory serves as a temporary storage area for data and program instruction for processing. The main memory can also access the secondary storage devices such as hard disk, magnetic tapes, etc. to access data and load it into the main memory.

4. I/O devices

I/O devices include input devices such as keyboard, mouse, etc. and output devices such as VDU, printer, etc.

Test Yourself 3

Which device performs the logical calculations in a computer system?

A Arithmetic logic unit
B Control unit
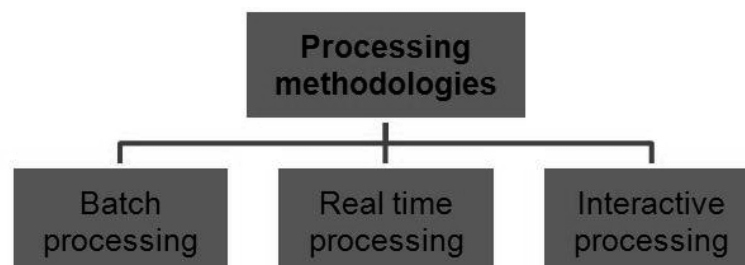**C** Storage device
D Input/output unit

---

2. Evaluate various processing methodologies. Compare various processing strategies.

[Learning Outcomes b and c]

2.1 Processing methodologies

The three processing methodologies include:

Figure 2: Processing methodologies

1. Batch processing

Under the batch processing methodology, the data is not processed until a certain time period is elapsed or a certain number of transactions is reached. Until processing, the transactions are retained on the storage devices and when the system comes online, the transactions are processed as a batch. In a batch processing, there is no user interaction and the data is processed based on pre-programmed instructions.

Example

Batch processing is performed in areas such as processing of bank statements, processing payroll, preparing an ageing report, etc.

One of the advantages of batch processing is that it can be done at the convenience of the user and performed during less busy times of the server. Mostly, batch processing takes place during the evening time or on the weekend when the user activity is at a minimum. If there are many batches, the batches can be lined up in the queue and processed according to priority. Batch processing is suitable for sharing computer resources in a disciplined manner.

The disadvantage of a batch processing system is that there is a time lag between collecting the input data and getting an output from the data due to delay in processing. This can impact the decision making.

Example

Mills runs a stationery shop and maintains an inventory control programme to record every piece of stationery sold each day. Mills has a customary practice to replenish his inventory each week. At the end of each week, Mills can batch run the inventory sold and determine the amount of inventory to be purchased for various items.

2. Real-time processing

This method of processing is used when the input request is required to be dealt with quickly so that the output can be generated quickly. Real time processing needs to be accurate as the output is based on the data being processed. The processing of data in real time is very quick and this can influence the results of decisions being taken. However, real time systems are very expensive and require a lot of development efforts and also require specialised hardware.

Examples of real time processing include:

    International hotel reservations
    Space exploration
    Traffic surveillance systems
    Auto pilot system

Example

A system developed to fly a guided missile to hit a target is an example of real time processing. Once the missile is launched, the control system requires real time data to be processed to keep the missile in trajectory and change its direction if required. Since the missile travels at a high speed, the data processing needs to be real time. This is to ensure that the missile does not result in a disaster and a real time decision can be taken if required.

3. Interactive processing

This method is also referred to as transaction processing. The data is processed one transaction at a time before proceeding to process the next transaction. While updating the transaction, the user needs to provide inputs or responses in order to complete the process. In an interactive processing, the inputs are noted by the computer, but the processing happens after a short delay.

Interactive processing is the exact opposite of batch processing. Data is processed on the basis of user preference and therefore the output generated is more realistic.

Example

Mary is planning to go for a movie with her friends and prefers the centre seats in the cinema hall. When she tries to book the movie tickets through the online movie booking website, the system will accept Mary's input to watch a particular show and then wait for Mary's response for seat selection. After Mary confirms the seats and makes the payments, the website will confirm the seats for Mary. This is an example of an interactive system which requires Mary's response to complete the transaction.

Processing methodologies discussed above are also referred to as processing strategies

2.2 Comparison of various processing strategies

	Batch	Real time	Interactive
Processing	Processing happens after a considerable time after the event takes place	No time lag. Processing happens immediately after the event takes place.	Processing happens with a minimal time lag (usually measurable in seconds) after the event takes place
Data input	Data collected is accumulated over a pre-defined period of time and then processed in batches.	Data can be input at any time and it is processed immediately. Dedicated computer system is needed to process transactions in real time.	Transactions are processed completely on an individual basis before dealing with next transaction.
Efficiency Vs. Effectiveness	Batch system processes more transactions at lower unit cost, which makes it efficient. If process time is not important, batch system can be used.	Very much useful when the system requires latest information at any point of time. Cost per transaction may be high compared to batch system.	Suitable when a continuous dialogue is required between the user and the computer. Per transaction costs may be high compared to batch processing; but comparable to real time processing.
Examples	This method of processing is suited for repetitive tasks such as payroll processing, customer billing etc.	This method of processing is suited for areas such as airline reservation, inventory management, railway reservation, sales order processing, etc.	This method of processing is suited where user response is required before processing the next transaction. For example, booking a movie ticket where a seat preference is required.

Test Yourself 4

Under which of the following are transactions collected and processed over a period of time?

A   Batch processing
B   Online processing
C   Real time processing
D   Online and real time processing

Test Yourself 5

Which of the following data processing systems responds to input immediately without any lag?

A   Batch processing
B   Real time processing
C   Manual processing
D   Interlocking processing

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

The central processing unit (CPU) is the most important computer hardware component.

Answer to TY 2

The correct option is **B.**

Cache memory is a copy of the most recently accessed data.

Answer to TY 3

The correct option is **A.**

The Arithmetic Logic Unit performs the mathematical and logical calculations and transfers it to the main memory.

Answer to TY 4

The correct option is **A.**

In batch processing, transactions are collected over a period of time. They are then grouped in batches for processing.

Answer to TY 5

The correct option is **B.**

A real time data processing system uses client server architecture to process data. This allows the system to respond to the user input immediately.

Self Examination Questions

Question 1

Which part of the Read Only Memory (ROM) contains instructions required to control the hardware?

A   Cache
B   RAM
C   Floppy disk
D   BIOS

Question 2

The distinction between Read Only Memory and Random Access Memory is:

A   Unlike ROM the RAM of a computer cannot be increased.
B   ROM is the internal memory, whereas RAM is the external memory of the computer.
C   Data can be read from the ROM, but not from the RAM.
D   The user can record data on the RAM, but not on the ROM.

Question 3

The central processing Unit consists of:

(i)   Central Unit (CU)
(ii) Arithmetic Logic Unit (ALU)
(iii) Input output unit (I/O)
(iv) Scanning Unit (SU)

A   (i) , (ii) and (iii)
B   (i), (ii) and (iv)
C   (ii), (iii) and (iv)
D   All of the above

Question 4

Which of the following performs arithmetical operations for the computer?

A   Keyboard
B   Central processing unit (CPU)
C   Visual Display Screen (VDU)
D   Hard disk

Question 5

For each of the statements given below, state whether the statement is true or false.

(i)   In batch processing, a user needs to interact frequently with the system.
(ii) Random access memory permits only sequential access to data.
(iii) ROM refers to memory where data can be read and edited.
(iv) BIOS is a part of random access memory.

Question 6

A nation-wide chain of retail clothing stores processes its daily transactions using a batch system based on a mainframe computer at a central location. The company is considering a change from batch processing system to an interactive (online) system.

Required:

(a) Define an 'interactive system'.

(b) Describe the advantages and disadvantages of moving to an interactive system.

(May 2012)

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **D.**

Cache and RAM are not parts of the ROM. The Floppy disk is an obsolete external storage device. BIOS is the part of the ROM containing instructions required to control the hardware of the computer, for example, keyboard, VDU and disk drives.

Answer to SEQ 2

The correct option is **D.**

The ROM is provided by the manufacturer of the computer. New data cannot be written on it by the computer user. The RAM of a computer can be increased. Data can be read from both the ROM and the RAM.

Answer to SEQ 3

The correct option is **A.**

The CPU consists of an arithmetic logic unit (ALU), a control unit (CU) and an I/O unit (Input/output unit). Arithmetic functions such as addition and division and logical operations such as "Is X > Y" are performed by the arithmetic logic unit. The control unit decodes each instruction and then converts these signals into a series of control signals which are relayed to the other parts of the computer.

Answer to SEQ 4

The correct option is **B.**

The Central processing unit (CPU) performs arithmetical and logical operations for the computer. The keyboard is an input device. The visual display screen is an output device. The hard disk is a storage device.

Answer to SEQ 5

(i) **False -** in batch processing, there is no user interaction. User interaction is required only in real time and interactive processing systems.

(ii) **False -** random access memory is the memory which can be randomly (directly) accessed to perform read or write operations.

(iii) **False -** read only memory (ROM) is the memory where data cannot be written i.e. data can only be read.

(iv) **False -** BIOS is a part of read only memory.

Answer to SEQ 6

(a)   Interactive processing

It is the processing system which responds immediately whenever a change occurs. Users can interact with it from time to time.

(b)   Advantages of interactive processing

    Since processing takes place immediately, the data held is always up to date.
    Files are held on-line, which means they can be used to produce ad hoc reports.
    The need for paper work is avoided.
    The occurrence of errors can be detected on a timely basis.

Disadvantages of interactive processing

    Audit trials are harder to perform because processing occurs continually as transactions arise.
    There is very little paperwork associated with the system, so checking is made more difficult.
    Failure to input data at any one point can result into processing delays.

B2

HARDWARE

STUDY GUIDE B2: INPUT DEVICES

■ Get Through Intro

Input devices play a major role in data processing because the output of any computer system is always based on the input given. Mostly, the input devices feed on raw data which is then processed by the computer system to generate meaningful information and useful reports.

Therefore, for the reports to be useful, the input devices need to be selected carefully.

In this Study Guide, we will understand the various input devices and the factors which need to be considered in selecting a proper input device for an organisation.

■ Learning Outcomes

a) Explain various input devices.
b) Compare and contrast various input devices.
c) Identify technical, organizational and management factors that are used in selecting those devices.

1. Explain various input devices.
[Learning Outcome a]

1.1 Input devices

Definition

An **input device** is a hardware component used to record data, program, instructions or any other user response by and into the computer.

Input devices are also referred to as peripherals and are designed to allow the user to enter data in the computer's processing unit commonly known as CPU. Input devices are a part of computer hardware. There are many input devices through which data can be recorded. In this Study Guide, we will discuss some of the popular input devices used by various entities.

1. Keyboard

The keyboard is the most popular and common input device. It allows the user to enter data into the computer through keys which are arranged according to the "QWERTY" typewriter pattern. It also contains certain command and function keys. The keyboard has three types of keys:

(a) **alpha-numeric keys** which include the letters 'A through to Z' and the numbers from '0 – 9;

(b) **punctuation keys** like comma, semicolon, question mark and more;

(c) **special keys** like function keys, control keys and arrow keys.

Inputting data through the keyboard is a time consuming and labour-intensive process. These limitations can be overcome by using automated data capture machines for example, bar code readers (explained later).

2. Touch Sensitive Screen (TSS)

Touch screen is a Visual Display Screen (VDS) which has been developed to be used as an input device. The user makes a selection and data is inputted through **touch or contact** with the display screen of the computer. The display has a touch-sensitive transparent panel covering the screen. This panel includes sensors that determine the area touched and selected by the user. Some users have complained that after extended use the TSS tires their arms. Touch sensitive screens are widely used in vending machines.
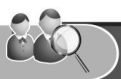
Example

Selling tickets through a vending machine and automated teller machines (ATMs) are examples of touch sensitive screens.

VDS uses '**pixels'** (picture element) to display images on the screen. Pixels are a series of dots on the computer screen. The screen resolution is the number of pixels on the entire screen. A high number of small pixels on the screen will result in a higher resolution whereas a small number of large pixels will result in a lower resolution i.e. poor picture quality.

3. Mouse

The mouse is a small case controlling the movement of the cursor on the screen. It is held under the palm of the user. When the mouse is moved, the internal sensors pick up movement and convert it into electronic signals to simulate the movement of the cursor on the screen. The mouse may have one, two or three buttons. The function of each of these buttons depends on the program run by the computer. If it has scroll wheels, it allows the user to scroll through documents which cannot be displayed on a single screen.

There are three types of mouse:

(a) **Mechanical:** contains a rubber or metal ball which is able to roll in any direction. Mechanical sensors within the mouse detect the direction it is moving in and move the screen pointer accordingly.

(b) **Opto-mechanical:** works on the same principle as the mechanical mouse except that instead of mechanical sensors it uses optical sensors to detect the movement of the ball.

(c) **Optical:** instead of rubber or metal balls, it uses a laser or a small light-emitting diode (LED) to detect the mouse's movement. Due to this, it does not have any mechanical moving parts. It is superior to the mechanical or opto-mechanical mouse in terms of response and accuracy.

Also a trackball can be used as an alternative input device. A trackball can be considered as an inverted mouse or a mouse lying on its back. The pointer / cursor is moved by rotating the ball through the users thumb, fingers or palm. The buttons next to the trackball function exactly as they do for a mouse.

4. Cameras

Web cameras or digital cameras are used as input devices for pictures and videos which are then stored in digital form on the computer. These digital images can be stored on a hard disk, compact disk or any other medium of digital storage for later use as required.
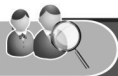
Example

Web cameras serve as an important tool for recording photographs and videos. These are commonly used by banks for recording and storing customer information. Hotels may also install web cameras at reception and check-in desks to record and store guest information. Web cameras are an important input device for video conferences also.

5. Touchpad

Touchpad, as the name suggests, is a touch-sensitive pad that is used to move the cursor on the VDU. By moving a finger on the touchpad, the user can move the cursor on the screen. Due to its small size, the touchpad is used as a point device in Laptops.

6. Joystick

The joystick is a movable control device which controls the movement of the cursor on the screen. It has a vertical stick which can tilt in various directions. The user moves the cursor by moving the stick in the desired direction.

Example

Joysticks are popularly used to play video games, simulations, in airplanes and cranes.

7. Light Pen / Stylus

A light pen or a stylus is a **pointing device**. It is called a light pen because it is shaped like a pen and has a light receptor at its tip. When placed against the Video Display Unit (VDU) it detects light coming from it. This enables the computer to identify the location of the pen on the screen. The light pen enables images to be drawn on the screen with a greater positional accuracy as compared to the touch screen.
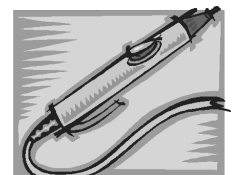
Automatic input devices (AID): Inputting data through the keyboard or mouse is a labour-intensive method. Automatic devices allow the user to enter input data, accurately, at a very high speed. This substantially decreases the labour cost involved in manually inputting data into the computer.

8. Magnetic Ink Character Recognition (MICR) readers

The MICR is a character identification technique that uses special ink and characters, usually containing iron oxide. When a document containing MICR ink is passed through a machine (MICR reader), it magnetises the ink and then translates the magnetic information into characters.

Although expensive to print, MICR brings speed and accuracy to the system. Due to these advantages MICR is used in the **banking industry** to facilitate the processing of cheques.

Advantages of MICR

a) MICR reader has a very high reading capacity. Therefore, even if the cheques are smeared or roughly handled, the data from the cheque can still be read by the MICR reader.
b) Cheques on which magnetic ink is printed can be read both by the human beings and the MICR reader.

Disadvantages of MICR

a) Has not been a very popular technique for feeding data.
b) If the data is incomplete, MICR reader will not input the data and clerical input may be required in such a case.

9. Optical Mark Reader (OMR)

OMR reading is a technology which electronically extracts data from marked fields, for example, the checkboxes on printed forms.

Data is recorded using OMR through the following process:

a) the form containing data is scanned;
b) the OMR reads predefined positions on the scanned form; and
c) the OMR records the position where a mark has been made.

Example

OMR technology is popular in schools and universities. Some schools use "Bubble-sheets" for grading multiple-choice questions or to process examination forms for a large population.

OMR is also used for scanning bar codes (explained later). The United Parcel Services (UPS) prints a two dimensional bar code on every package. This enables accurate scanning, irrespective of any damage incurred to the bar code pattern. Generally, the error rate of OMR technology is less than 1%.

10. Bar Code Reader

The barcode is a system of representing data. They represent data through the width or spacing of the lines (one dimensional), or through the patterns of squares and hexagons (two dimensional). A Bar Code Reader can read these bar code lines and collate the input data for processing. The barcode is an **electronic point of sale device** (EPOS). It enables retailers to collect accurate and detailed information about sales quickly and at minimal cost, which then helps them manage their stock / inventory movement efficiently.
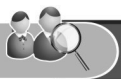
Example

Bar Code Readers are very popular in supermarket stores. They enable faster billing and proper real time updating of inventory of the supermarket.

11. EFTPOS terminals

Electronic Funds Transfer at Point of Sale (EFTPOS) means receipt of payment from customers through credit or debit cards at the point of sale. For EFTPOS a small terminal is used. This terminal reads the customer details on the card and processes payment from his credit account or bank account.

12. Magnetic stripe card (MSC)

A card capable of storing data is known as a Magnetic Stripe Card (MSC). The MSC contains a magstripe (magnetic stripe) which contains relevant information. A magnetic card reader converts the information into a form which the computer can understand.

The magnetic stripe is swiped past a reading head on the Magnetic Card Reader. This physical contact of the reader and the stripe enables it to pick up the information and convert it into a computer readable format.

Example

The magnetic stripe cards are widely used in the form of credit and debit cards issued by banks.

The data on magnetic cards can be easily read and modified without the consent of the card holder. Because of this lack of security, Smart Cards are slowly replacing Magnetic Stripe Cards.

13. Smart cards

A Smart Card or Integrated Circuit Card (ICC) is a pocket sized card with an embedded microprocessor or integrated circuit. The microprocessor or the integrated circuits in the smart cards replace the magnetic strip on the magnetic stripe card.

Smart cards can receive input, process data and deliver output. This enables a smart card to make more effective security checks then a magnetic stripe card.

Example

Storing a patient's medical records, debit and credit cards, cards used in cable / satellite television systems.

14. Microphone

The microphone is an input device which transfers audio (sound waves) into electronic signals. It allows the user to use speech and sound as inputs for the computer.

Certain software programs enable the microphone to input data into the computer. The software converts words spoken into the microphone into machine readable input.

To accustom these software programs to a particular voice and accent, the user has to train the program extensively. Moreover, to enter data using this technique, the user, will have to speak slowly and clearly.

Due to the high cost of implementation, the voice recognition software is used when the user is incapable of inputting data using the keyboard.

15. Scanner

Scanners capture information and convert it into **digital images which** can then be processed by the computer. Several printer manufactures supply OCR (Optical Character Recognition) software. OCR software is capable of converting a scanned document into a computer editable format.

For example, by using OCR a printed text can automatically be converted into a computer readable document.

Test Yourself 1

Which of the following classifies as an input peripheral of a computer?

A   Magnetic disk
B   Hard disk
C   Magnetic tape
D   EFTPOS

Test Yourself 2

Smart cards are also known as _____.

A   Integrated Circuit Card
B   Magnetic Stripe Card
C   Optical Recognition Cards
D   Image Recognition Cards

---

2.   Compare and contrast various input devices.

[Learning Outcome b]

The selection of input devices for recording data is based on several factors and varies from situation to situation. Few important considerations for selection of an input device for data feeding include the following:

a)   requirement of the user;
b)   ease of use;
c)   speed at which data needs to be recorded;
d)   cost of input;
e)   geographical location of data;
f)   availability of the software programme needed for the input device and whether it is being used by the user;
g)   cost of the man power needed to feed data (labour cost);
h)   cost of the input device;
i)   availability and technical knowledge.

Based on the above parameters, we can compare and contrast the various input devices, discussed in Learning Outcome 1, and understand the relative advantage and disadvantage of using a particular input device. For the purpose of comparing and contrasting input devices, they have been divided into two broad groups:

1.   Data input devices - Key Board, Bar Code Readers, Magnetic ink character recognition readers, Optical mark readers and Scanners

Keyboard is the most basic input device. The keys provided on the keyboard are used to punch information manually and therefore inputting data, through the keyboard, is considered a time consuming and labour intensive process.

In cases, where the given data is available in a pre-defined format, the limitations of the keyboard can be overcome by using automated data capture machines like Bar Code readers, MICR readers, OMR readers, scanners etc. However, for these input devices to work properly, data needs to be first entered into the computer system in a systematic manner and also coded on the input documents.

A major limitation of these reading devices is that they can only read pre-defined data fields. Input of new information apart from the data fields is not possible. In such circumstances data needs to be manually entered through the key board. Therefore, some of the readers are used in tandem with a keyboard to enter new data which cannot be captured by the reader. Further, the keyboard is one of the cheapest and widely used methods to input data.

2.   Data pointing devices - Mouse, Stylus, Joystick, Touch sensitive screen and Touch pads

A Mouse performs the task of touching, pointing and dragging. This task of the Mouse can be replaced by use of Touch sensitive screens, Stylus or Touch sensitive pads.

A Touch sensitive screen is a useful device, when certain given commands have to be made frequently and on a repeated basis. However, touch based devices are costly and require special application interface to work with.

Touch screens are popular in the case of Automated Teller Machines (ATMs), Ticket check-in counters and mobiles phones. However, they are not very convenient for drawing pictures or for dragging objects on the screen.

In a laptop, the touch pad performs the same functions as a mouse. Touch pads are compact and are thus more suitable as an input device in laptops.

A stylus on the other hand is considered as a good input device for drawing pictures on the screens, with accuracy. It is popularly used by artists, architects, engineers, etc. and requires special purpose software to record input data. However, Stylus is not suitable for performing drag and drop functions and the error rate is quite high.

To summarise, Touch screens, Touch pads and the Stylus are good input devices for performing the pointing, clicking and dragging options. However, these devices have their own limitations, thereby making the good old mouse an inseparable input device. Further, the technology for touch screen is still in the evolution mode because of which it is costly and therefore will take time to replace the traditional mouse as a dependable input device.

Summary of input devices

The following table will help compare and contrast, various input devices on the basis of their relative advantages and disadvantages.

Input device	Advantages	Disadvantages
Keyboard	Ease of inputting data	Relatively slow and depends upon the speed of the typist
Touch sensitive screen / Touch pads	Easy to use when compared with keyboards	Needs specialised hardware and software which is costly
Mouse	No typing skills are required.	
Cameras	Easy to capture images and videos	Relatively costly as compared to other input devices
Joystick	Easier than keyboard and very popular with gaming devices. Gives the users a real time or virtual experience.	Special interface needed. Users find it too difficult to control in comparison to the mouse.
Stylus	Ideal device to draw graphics and pictures. Can be quickly pointed on different locations of the screen with accuracy.	Needs specialised software and users need special training. It needs a graphic tablet and cannot be used separately.
MICR readers	Ideal input device where volume is high. It is difficult to forge and documents can be read accurately.	All documents have to be coded with magnetic ink for the reader to recognise the input document. System can accept only a few character sets under MICR technology.
OMR readers	Used to process high volume of transactions in a short period of time.	Requires specialised scanners and the scanners may not record data accurately if OMR form is not properly placed in the scanner. Not suitable for data input.
Bar code readers	Relatively cheaper and can handle large volumes of input data	System failures or scratched or crumpled bar codes may create problems in data entry.

Input device	Advantages	Disadvantages
EFTPOS terminals	Ideal and secure way of payment. Can reduce waiting time of customers in billing queue.	Cost of installing EFTPOS terminals is high and it may not work if there is a system failure.
Magnetic stripe card	Small and compact. Data can be accessed without a computer.	Repeated use can damage the magnetic stripe on the card and will need to be replaced.
Smart cards	Small and compact. Data can be accessed without a computer. Unlike magnetic stripe cards, data is stored in electronic chips.	Smart cards prone to identity theft and may not be used at all stores and merchant establishments.
Microphones	Can record audio which can be converted to text by using special purpose software. Also microphones can be used to give commands to computer.	Can take up a lot of disk space and voice commands may at times be difficult for software to recognise.
Scanner	Ease of use and scanned images can be stored as electronic document. This reduces the risk of permanent loss of information due to theft.	Images scanned take a lot of disk space.

Test Yourself 3

The technique of bubble-sheets and check boxes is being frequently used in answer sheets in examinations having multiple-choice question pattern. This is an example of extensive use of which of the following technologies?

A   Optical Character Recognition
B   Optical Mark Reading
C   Smart Card Reading
D   Magnetic Ink Character Recognition

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3. Identify technical, organisational and management factors that are used in selecting those devices.

[Learning Outcome c]

3.1 Organisational and management factors

Every organisation has its own requirements for data processing. For a few organisations, the speed at which data is processed is important, while, for others the data may need to be detailed and elaborative. For example, a stock exchange requires real time data so that the investors can take informed and timely decisions and therefore, the speed at which data is inputted and processed becomes very important.. Thus, based on the priority of each organisation the proper input device needs to be selected.

From the **management point** of view, the most important consideration, is the setup cost and cost of personnel required to input data. If the management thinks that the input device to be used does not satisfy the cost-benefit analysis they may look at alternatives and other cheaper modes of data-input. Following are some factors which each organisation and management should consider before installing an input device:

1.   **Cost of input device:** This not only includes the cost of input device but also the associated cost of data entry personnel.

2.   **Volume of data:** If the volume of data is high, organisations need to think about automating the input process. This can be done by inputting data through OCR Readers, Bar Code Readers, OMR Readers, Scanners, etc.

3.   **Speed of data processing:** If speed is a consideration, organisations need to install bar code scanners or EFTPOS terminals to process huge volumes of transaction in a short time.

4.   **Accuracy and ease of use:** Organisations also need to consider whether the input device is easy to use and will record data accurately. Organisations these days aim at reducing manual processes and automate those processes by installing Bar code scanners, Smart cards and other input devices discussed above.

Example

Pristine is a large supermarket located in Dar-es-Salaam. The supermarket is very popular amongst the local residents and visited by thousands of customers daily. Pristine Supermarket therefore is faced with the challenge to properly serve its customers and also to maintain its inventory. If Pristine Supermarkets manually performs the process of preparing customer invoices and collecting bills it would take a lot of time. In such a situation if Pristine uses Bar Code Scanners to generate invoices for its customers, it would save them a lot of time and result in greater customer satisfaction.

Furthermore, if Pristine Supermarket takes a decision to accept credit cards and debit cards from its customers, it would have to install EFTPOS terminals at its billing counters. Though this is a costly initiative, however, it would lead to the transactions being processed faster and Pristine would be able to serve more customers during the day.

3.2 Technical factors

1. **Features:** Organisations need to check the additional features being offered with each input device.

Example

If the keyboard does not have the number keys on it, it would not be worth buying. Alternatively, input devices such as a keyboard come with lots of additional features such as silent keyboards, keyboard with multimedia keys, keyboards designed for gaming etc. Such additional features need to be checked and considered before selecting the appropriate keyboard.

2. **Compatibility:** Organisations need to check whether the input devices being installed are supported by the existing operating system and infrastructure so that after installing the new input devices the business processes would continue to run smoothly.

Example

John enterprise is planning to purchase keyboards for its data entry staff. John enterprise should check the compatibility of the keyboards with their existing operating system because some input devices work only with a Windows operating system and some only with a Mac operating system. Additionally, some input devices may need certain additional software to work efficiently.

Therefore, John enterprise needs to check compatibility and system requirements before purchasing the input devices (keyboard).

3. **Future upgrades and support:** Organisations needs to check whether the input devices would get adequate technical support and upgrades from the manufacturers of input devices. This would ensure that the input devices continue to function properly and remain efficient for capturing data. If this aspect is ignored, there is a possibility that the device may start malfunctioning after a certain period of time and because of lack of adequate technical support from manufacturers, the organisation may be required to invest once again in a new upgraded device.

Test Yourself 4

Which one of the following is not a technical factor in selecting an input device?

A   Compatibility
B   Future upgrades
C   Support from manufacturers
D   Cost of the device

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

EFTPOS comes under input peripheral of computer.

Answer to TY 2

The correct option is **A.**

Smart cards are also known as Integrated Circuit Cards.

Answer to TY 3

The correct option is **B.**

The technique of bubble-sheets and check boxes is being frequently used in answer sheets in examinations having multiple-choice question pattern is an example of **Optical Mark Reading.**

Answer to TY 4

The correct option is **D.**

Cost is not a technical factor in selecting an input device. Infact, it is an organisational and management factor.

Self Examination Questions

Question 1

Write a short note on mouse and explain the use of its buttons and also understand its types.

Question 2

Match the following input devices with its function:

	Input device			Function
1	Mouse	A		Converts information into digital image
2	Scanner	B		Used for clearing cheques by banks
3	Stylus	C		Payments by credit card
4	MICR reader	D		A small case controlling movement of cursor
5	EFTPOS terminals	E		Used for drawing

Question 3

Which of the following is not an input device?

A   Mouse
B   Microphone
C   Visual display screen
D   Scanner

Question 4

Which of the following is an input device?

A   Printer
B   Microsoft Office Excel 2003
C   Touchpad
D   Operating system

Question 5

Which of the following is not an output device?

A   Printer
B   Visual display unit
C   Digital Versatile Disk (DVD)
D   Speaker

Question 6

Which of the following is a manual input device?

A   MICR
B   Keyboard
C   OCR
D   OMR

Question 7

Which of the following is an automatic input device?

A   Keyboard
B   Smart card
C   Mouse
D   Speaker

Answers to Self Examination Questions

Answer to SEQ 1

The mouse is a small input device, with the help of which, the movement of the cursor on the computer screen is controlled. It is held under the palm of the user. When the mouse is moved, the internal sensors pick up the movement of the mouse and convert it into electronic signals, which then simulate the movement of the cursor on the screen. The mouse may have one, two or three buttons.

The function of these buttons depends upon the program used by the computer. The buttons are used for giving commands by way of right click and left click. If the mouse has scroll wheels, it allows the user to scroll through the documents easily specially those which cannot be displayed on a single screen.

There are three types of mouse

(i)   **Mechanical Mouse:** It contains a rubber or metal ball which is able to roll in any direction. Mechanical sensors within the mouse detect the direction it is moving in and move the screen pointer accordingly.

(ii) **Opto-mechanical Mouse:** It works on the same principle as the mechanical mouse except that instead of mechanical sensors it uses optical sensors to detect the movement of the ball.

(iii) **Optical Mouse:** In this type of mouse instead of rubber or metal balls, a laser or a small light-emitting diode (LED) is used to detect the movement of the mouse. Because of this it does not have any mechanical moving parts. It is superior to the mechanical or opto-mechanical mouse in terms of response and accuracy.

	Input device		**Function**
1	Mouse	A	A small case controlling movement of cursor
2	Scanner	B	Converts information into digital image
3	Stylus	C	Used for drawing
4	MICR reader	D	Used in clearing cheques in banks
5	EFTPOS terminals	E	Payments by credit card

Answer to SEQ 2

The correct option is **C.**

Microsoft Office Excel 2003 is application software. The Keyboard and the Mouse are input devices. The Keyboard inputs data using keys, whereas the Mouse controls the cursor on the Visual Display Screen. The Laser printer is an output device. It prints the output on paper.

Answer to SEQ 3

The correct option is **C.**

The Visual Display Screen (VDS) is an output device. The output generated by the computer is displayed in a visual form. The mouse is an input device, used to control the movement of the cursor on the VDS.

When the mouse is moved, the internal sensors pick up the movement and convert it into electronic signals to simulate the movement of the cursor on the screen. A microphone allows the user to input speech and sound into the computer. Scanners capture information and convert it into digital images.

Answer to SEQ 4

The correct option is **C.**

A Touchpad is a touch sensitive pad which controls the cursor on the Visual Display Unit. A Printer is an output peripheral. Microsoft Office Excel 2003 and Operating Systems are software.

Answer to SEQ 5

The correct option is **C.**

A Digital Versatile Disk (DVD) is an external storage device. Its storage capacity ranges from 4.7 GB to 17 GB. Printers produce output on paper. Speakers produce output in audio (sound) form. The VDU or monitor displays output in the form of images generated by the computer.

Answer to SEQ 6

The correct option is **B.**

Keyboard, MICR, Smart Card and OMR are classified as automatic input devices. When a document containing MICR ink is passed through a machine (MICR reader), it magnetises the ink and then translates the magnetic information into characters.

OCR converts scanned documents into a computer editable format. Optical Mark Reading is a technology which electronically extracts data from marked fields

Answer to SEQ 7

The correct option is **B.**

A Smart card is passed through a reading head and data is recorded into the computer. The keyboard and mouse are classified as manual input devices. The speaker is an output device.

B3

HARDWARE

STUDY GUIDE B3: OUTPUT DEVICES

▉ Get Through Intro

Output devices play a major role in displaying processed data which is then used as 'information' by different users in decision-making. The purpose of the output device is to translate the machine's response to an understandable and usable form for the user. Proper selection of the output device can not only lead to substantial cost-saving for the company but also prove to be crucial in data-interpretation from point-of-view of the user.

In this Study Guide, we will understand the various output devices and the factors that need to be considered while selecting an output device for any organisation.

▉ Learning Outcomes

a) Explain various output devices.
b) Compare and contrast various output devices.
c) Identify technical, organisational and management factors that are used in selecting those devices.

1.   Explain various output devices.
[Learning Outcome a]

Definition

An **output device** is any device which presents processed data as information in front of the user. In other words, it conveys processed information to the user in a usable form.

While, there are many output devices which can be used for displaying information, for the purpose of this Study Guide, we will discuss three main types of display devices:

    a) Visual display unit.
    b) Printer.
    c) Audio output device i.e. speaker and headsets.

1.   Visual display unit (VDU) / Monitor

A VDU or a Monitor displays output generated by the computer in the form of **images.** These images are formed using pixels and text is displayed by combining these pixels .VDUs are not capable of producing a permanent record.

Types of VDUs

(a) Cathode Ray Tube (CRT) displays

CRT is the technical name given to the screens of those computer monitors that use cathode ray technology to function. Since, cathode rays are used to project an image on the computer screen; these screens came to be called CRT displays. The CRT monitors use large, tube type elements that look like a TV set. They are bulky and provide a limited range of image resolution. However, in comparison to other types of monitors they are inexpensive.

(b) Liquid Crystal Display (LCD)

With advancement in technology, the LCDs have replaced CRT displays. LCD screens use a thin-film-transistor (TFT) technology which is similar to a digital watch screen but has a much more complex matrix than that of the digital watch. LCDs use crystalline material, sandwiched between two panes of glass, and provide images with excellent resolution

Compared to CRTs, LCDs consume less energy and do not flicker. Another advantage of using LCD screens is that they are lightweight and compact and can work even on very low power.

Example

Since, LCDs are lightweight and low on power consumption they are suitable for laptops, notebooks and personal computers.

(c) Plasma displays

The plasma displays are a recent introduction and in comparison to CRTs and LCDs, offer a very high resolution. Depending upon the resolution, they consume slightly more power than an LCD. The viewing angles of a Plasma display are comparatively wide, but they are very costly when compared to CRTs and LCDs.

(d) Projection displays

Projection displays have a large screen and are appropriate for presentations given to large groups. The display screen uses a special type of white cloth to reflect images projected from the projector.

Figure 1: Output peripherals

CRT display   LCD display   Plasma display   Projection display

2. Printers

Printers produce hard copies of the output or data stored on the hard disks in the form of text or image which are human-comprehensible and are permanent records. Printers are widely available in the market and based on their features, can be classified in many different ways. However, for the purpose of this Study Guide based on their printing speed, printers have been divided into three major groups:

(a) Dot-matrix printer

A dot matrix printer uses a pin to create a dot. A **combination of dots** creates an image or a character. The dots are printed by striking the pins against an ink ribbon. The printing speed ranges from 40 characters / second (CPS) to 1000 CPS. In comparison to other printers, Dot-matrix printers have the **lowest** per page printing cost; however their print quality is relatively poor.
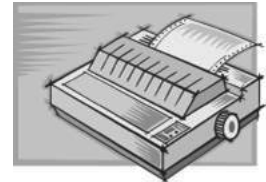
The biggest advantage of these printers is their speed and they are best suited for organisations that do not require multimedia printing.

The disadvantages are that they make a lot of noise while working, are very slow, the quality of the print is poor and they are able to print only in a few fonts.

(b) Ink Jet Printers

Ink jet printers print high quality text and images by spraying a controlled **stream of tiny ink droplets** on a sheet of paper. The speed usually ranges from 50 CPS to 300 CPS. Compared with laser printers (explained later), the cost of installing an ink jet printer is low. Ink jet printers are capable of producing prints at a fairly high speed and in several different fonts.

The **maintenance costs, however,** can be higher than that of a dot-matrix or laser printer because the ink cartridges need to be frequently replaced.

(c) Laser printer

Laser printers print one page at a time. The speed ranges from 10 pages per minute (PPM) to 200 PPM. Laser printers are **superior** to ink jet printers in terms of printing quality, speed of printing and also have a lower maintenance cost. On the disadvantage aspect, the purchase price of laser printers is significantly higher than that of an ink jet printer.

(d) Special purpose printers

Photo printers are used by image-processing labs and use special photo paper to print their output.

A label printer is a small printer that is capable of printing labels on an adhesive coated material which are later placed on a variety of packages/objects. This printer is very popular with departmental stores.

Plotters are advanced printers which are used to produce high-quality drawings such as blueprints, maps, and circuit Figures.

Printers can also be classified **on the basis of whether the print head touches the paper or not**. The two broad categories are:

a) Impact or
b) Non-impact

(i)   Impact printers

Impact printers operate by striking a metal or plastic head against an ink ribbon that physically contacts the paper. Impact printers are capable of printing multiple copies and are used where a draft quality of print is required.

Example

A dot-matrix printer can be classified as an impact printer. It prints on the paper when tiny pins on a print head strike an inked ribbon which then touches the paper.

(ii) Non-impact printers

Non-impact printers form characters and graphics without actually striking the paper. They are capable of printing much sharper images and are also quiet in comparison to impact printers. Non-impact printers are much faster than impact printers because they involve less physical movement of the mechanical parts. They are capable of printing in a wide range of fonts and print quality.

Example

An ink-jet printer is a non-impact printer that sprays drops of ink onto a sheet of paper. A laser printer is a non-impact printer that creates images using a laser beam and a powdered ink, called toner.

Test Yourself 1

The _____ prints high-quality text by spraying a controlled stream of tiny ink droplets on a sheet of paper.

A   Dot-matrix printer
B   Ink jet printer
C   Magnetic printer
D   Laser printer

3.   Speaker and headsets

Computer speakers are devices that produce output in audio form. Speakers provide output from sound files, audio / music CDs or other audio data. If the computer has an important message to convey, it can alert the user by giving a sound alert. These days speakers come in various sizes and shapes. They range from portable speakers to speakers used for the purpose of multimedia entertainment.

Headsets are an alternative to speakers. They can be plugged into the audio-port of the computer and the user can hear the audio file from his headset. The advantage of using headset is that it can be used when the audio is confidential and is intended only for a particular user.
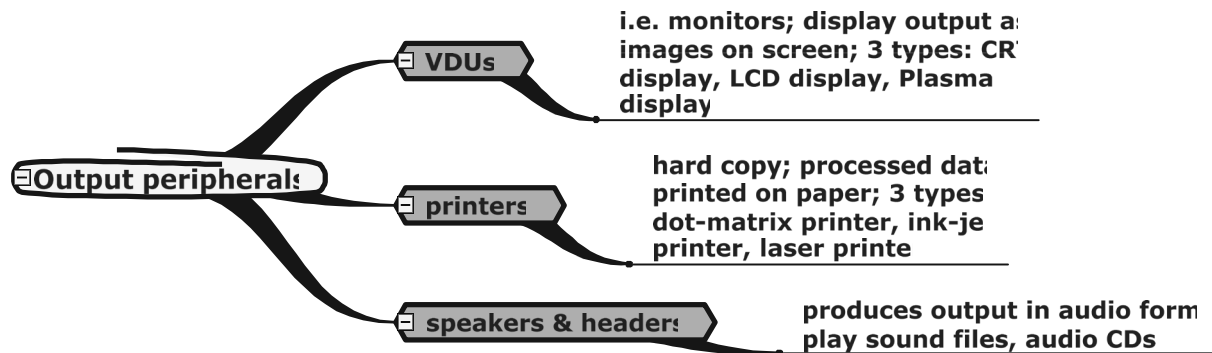
Example

Utalii Trans Border Services run a business process outsourcing (BPO) centre. The purpose of this BPO is to handle Debit-card customers of a bank. At a given time, 50 employees are attending to different clients through video chat sessions.

In this case, it is appropriate to give each employee a headset, instead of speakers, to listen to calls. Although, speakers would serve the purpose of relaying client query to an employee, it would obviously disturb the other employees on the floor who are also busy receiving calls from other customers. It may also result in leakage of confidential information to other customers who otherwise are not authorised to hear the same.

SUMMARY

```
                                    i.e. monitors; display output as
                                    images on screen; 3 types: CRT
                   VDUs             display, LCD display, Plasma
                                    display

 Output peripherals                 hard copy; processed data
                   printers         printed on paper; 3 types
                                    dot-matrix printer, ink-jet
                                    printer, laser printer

                                    produces output in audio form
                   speakers & headers  play sound files, audio CDs
```

Test Yourself 2

Which of the following is an output device that produces output in an audio form?

A Printers
B Speakers
C Visual Display Screen (VDU)
D Touch Sensitive Screen (TSS)

---

2. Compare and contrast various output devices.

[Learning Outcome b]

Functionally, one output device is not a replacement for another one. For example if a person requires a hard copy of a document they it can only be obtained with the help of a printer and not through a monitor. Hence, the selection of an output device basically depends on the specific requirement of the user.

Other important considerations while selecting an output device are:

a) ease in use;
b) cost of the device;
c) cost of the raw material required to obtain the respective output e.g. electricity, paper, ink, etc.;
d) geographical location of the data;
e) availability and technical knowledge;
f) secrecy required for output information.

Each and every output device has many variants that are available in the market. In case of printers, for example, the variants available are ink-jet printers, dot-matrix printers and laser printers. Based on the above parameters, we can compare and contrast the features of each variant of the output devices that have been discussed in Learning Outcome 1 and understand their relative advantages and disadvantages.

For the purpose of comparing and contrasting the output devices, the table below, compares, each output device on the basis of its variants available in the market and the relative advantages and disadvantages of each.

1. VDU / Monitors

		CRT	LCD	PLASMA
1.	**Colour and brightness**	Has a dynamic range of colour and is brighter.	Has a wide range of colour but is a little less bright especially in direct sunlight.	Has excellent colour but the screen is highly reflective and can be effectively used in a comparatively dark environment.
2.	**Weight and physical appearance**	Heavy, bulky and huge - especially the larger units.	Very thin, light-weight and compact. Can also be mounted on the wall.	Very thin, light-weight and compact. Can also be mounted on the wall.
3.	**Energy consumption**	High power consumption	Low power consumption	High power consumption when compared to an LCD based on its screen resolution.
4.	**Cost**	Very cheap compared to LCD and plasma.	Costlier than CRT displays	Costliest of all three variants

To summarise, though CRT monitors are the cheapest, they are heavy, take more space and also consume higher power. Therefore, LCD and Plasma monitors are preferred. While these monitors are initially expensive however, they give considerable savings in power-usage over a period of time. Further, since they are compact, they do not use too much desk space.

2. Printers

The following factors need to be considered while deciding on a printer:

(a) Total printer cost: it includes cost of supplies and maintenance cost along with the initial cost of the printer. This is the most important factor where quantum of printing is huge.

(b) Frequency of use: this is important because some printers need maintenance service after lapse of a certain time-period irrespective of usage.

(c) Type of output produced: whether the printer is capable of printing in colour or grey scale.

(d) End use of the output: whether the output is meant for internal use or for external correspondence.

(e) Whether multiple copies are required: this is important because only impact printers can produce multiple copies on a print command.

(f) Location of the printer: Impact printers are noisy and therefore may not be ideal for closed locations. These printers, however, are more resistant to extreme conditions and continue to work efficiently.

No.	Distinction	Impact Printer	Non-Impact Printer
1.	Mechanism	Use some form of striking device to transfer ink from an inked ribbon to the paper.	There is no direct contact between the paper and the printing head.
2.	Noise	Makes noise while printing.	Does not make noise while printing.
3.	Copies	Multiple copies can be printed at the same time by using carbon papers.	Can print only one copy at a time.
4.	Colour printing	Does not support multi-colour printing	Supports multi-colour printing.
5.	Usage	Used for printing text and low quality graphics	Used to print both high quality graphics and text.
6.	Examples	Dot-matrix printer	Inkjet and laser printers

If printing requirements include printing of pictures and high quality graphics then laser and inkjet printers are more suitable. However, if the requirement of the organisation is to print simple receipts and invoices and do not include graphics dot matrix printers are quite suitable. The basic drawback of using dot-matrix printers is that they make a lot of noise and if, in future, the organisation may like to print graphics then this printer may not print the desired quality.

3. Speakers and headsets

As already discussed above, speakers may be more suitable where the audio-files need to be conveyed to a large audience. However, if secrecy and confidentiality of information is important, then headsets may be more suitable.

To summarise, monitors are inevitable output devices and cannot be replaced by any other output device. However, if the requirement of the user is to maintain hard copy of the data output it may opt to use printers as well as an output device. Some users use monitors and printers together to analyse the output.

Test Yourself 3

Which output device generates maximum noise while conveying output data?

A   LCD monitor
B   CRT displays
C   Impact printers
D   Non-impact printers

---

3. Identify technical, organisational and management factors that are used in selecting those devices.

[Learning Outcome c]

3.1 Organisational and management factors

From organisational and management point of view the most important consideration is **the cost of the output device including any cost of supplies and maintenance**. Selection of an output device, is based on the fact, that, whether the organisation needs to maintain its records in the form of a hard copy or as a soft copy.

In case, the organisation is required to maintain documentary evidence of certain transactions then output devices capable of printing (such as **printers**) need to be installed. However, if information is required only for the purpose of viewing, display devices, such as LCD and Plasma displays, can be installed instead of a printer. This will help save considerable money in terms of cost of paper and printing supplies. Following are some important factors which each organisation and management should consider before installing an output device:

1. Cost of output device

This includes not only the purchase price of the output device but also the cost associated with its maintenance and the expense on its supplies.

Example

Highveld Ltd is planning to purchase printers for printing customer invoice copies for its accounts department. However, given the range of printers available, it is confused as to which printer to buy. The dot-matrix printers are relatively cheaper than laser printers but in terms of speed, laser printers are faster.

In this case, since the printers are needed only for invoice printing and if bulk printing is not required then Highveld Ltd can decide on buying dot-matrix printers. This will reduce the overall cost of purchase and maintenance. However, if Highveld Ltd needs to print graphics as well and printing is required in bulk, then laser printers would prove to be cost effective.

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2.   Ease of use

Organisations also need to consider whether the output device is easy to use and will display output information accurately. If the users of output data need to perform further analysis, based on the output displayed on the screen, data in soft copy would be more useful. Also if the organisations have implemented a go-green policy, wherein, they stress reduction in use of paper and encourage use of soft copy to read emails and access data, then, monitors would be the preferred output device.

Example

Star Broking Ltd provides technical advice on shares and mutual funds to its clients. The staff of Star Broking is constantly monitoring the movements in share prices and advising their clients whether to buy or sell the securities.

In case of Star Broking, the preferred output device would be a 'Monitor'. Monitors can display real time data of share prices, which, can be used by the staff instantly to advice their clients. Generating a hard copy and then conveying the information through the hard copy is a lengthy process and wasteful process that would not be of any use to the customers of Star Broking Ltd.

3.   Level of detail

The selection of an output device also depends upon the level of detail required by the users. Paper printouts have a space limitation and can only display limited information. However, data displayed on a computer screen is more detailed and also cross-referenced. Data is capable of further processing and the results of processing can be displayed instantly.

Example

John wants to buy a flat in a newly constructed housing scheme. The housing scheme has printed brochures giving the details of the flat and they have also posted a 3D image of a sample flat on their website.

If John goes through the printed brochure he will get a basic idea of the dimensions of the flat and its layout. However, if instead of the brochure he chooses to view the flat on a computer screen, he will get a virtual tour of the flat which will give him a better idea and help him make a good decision. In comparison to the brochure, the 3D image will give more detailed information about the flat.

4.   Noise level

As already discussed before dot-matrix printers are impact printers and make a lot of noise while printing. If the organisation, prefers a silent work environment it may decide to ideally purchase inkjet and laser printers instead of dot matrix printers.

Example

Tanzania Library is planning to purchase printers for their library. While selecting a printer, the library wants to ensure that the printers are cost effective and at the same time they do not make noise while printing.

In such a case, the library should decide to buy inkjet or laser printers as these printers do not make much noise. Further, if the library has bulk printing requirements then laser printers would be ideal as they are more suited for large print requirements and also prove to be cost effective.

5.   Speed of output

In some organisations, data needs to be monitored on real-time basis. Thus, the speed at which the output reaches the user becomes a critical consideration. In such cases, monitors would be the preferred output device as compared printers.

6. Data sharing

If data needs to be shared with multiple users at the same time then the hard copy form of circulation is not a viable option. In such cases, data in the form of soft copy can be easily shared with multiple users, located over different geographical zones at the same time.

3.2 Technical factors

1. Features

Organisations need to check the additional features being offered with the various output devices. These additional features enhance the user experience while using those devices.

Example

Monitors come with features such as in-built speakers. Headphones come with features such as in-built microphone and volume control.

2. Availability of supplies

Organisations need to ensure continuous availability of supplies for running the output devices.

For example, if the organisation is planning to buy inkjet printers, then, it should check, whether the required ink cartridges would continue to be available in future. If ink cartridges are not available or they are available with a delay it would disturb the business processes leading to a delay in information reaching the users.

3. Compatibility

Organisations need to check if the proposed output devices are supported by the existing operating systems and infrastructure and that after installing the new output devices the business processes would continue to run smoothly.
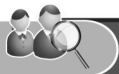
Example

John Enterprise is planning to purchase new monitors for the staff doing data-entry work. John Enterprise needs to check the compatibility of the new monitors with its existing operating system. This is required because some output devices only work with either Windows while others only with Mac operating systems. Again, some output devices may require certain additional software to work efficiently. Therefore, John Enterprise needs to carefully check compatibility and system requirements before buying and switching to new monitors.

4. Future upgrades and support

Organisations need to check whether the output devices would get adequate technical support and upgrades from the manufacturers of output devices. This will ensure that output devices continue to function properly and display data efficiently. If this aspect is ignored, there is a possibility that the devices may malfunction after a certain period of time and, because of lack of support from manufacturers, become defunct, in which case, the organisation may end up investing in a new and upgraded device.

Test Yourself 4

Which one of the following is not a technical factor for selecting an output device?

A   Compatibility
B   Future upgrades
C   Support from manufacturers
D   Cost of the device

Answers to Test Yourself

Answer to TY 1

The correct option is **B.**

Ink Jet printers print high quality text and images by spraying a controlled stream of tiny ink droplets on a sheet of paper. Dot-matrix printers use a pin to create a dot. A combination of dots creates an image or character.

Answer to TY 2

The correct option is **B.**

Computer speakers are output devices that produce output in audio form. Speakers provide output (play) from sound files, audio/music CDs or other audio data. Printers produce output in the form of text or images on paper. A visual display unit or monitor displays output in the form of images generated by the computer. A touch sensitive screen is an input device. The user makes a selection by touching the   screen and data gets inputted into the computer.

Answer to TY 3

The correct option is **C.**

Impact printers operate by striking a metal or plastic head against an ink ribbon that physically contacts the paper. This generates a lot of noise. Non-impact printers are relatively silent.

LCD and CRT monitors do not have any moving parts and are noiseless.

Answer to TY 4

The correct option is **D.**

Cost of device is an organisational and management factor for selecting an output device.

Self Examination Questions

Question 1

The output quality of a laser printer is measured by:

A   Dot per inch
B   Dot per square inch
C   Pages per minute
D   Dots printed per unit time

Question 2

Which of the following is an output peripheral of a computer?

A   MICR
B   OMR
C   OCR
D   VDU

Question 3

VDU stands for:

A   Virtual display unit
B   Visual display unit
C   Vertical display unit
D   Visual device unit

Question 4

Match the following output devices with its function:

	Output device		Function
1	Printer	A	Used to display output data on the computer screen
2	Monitor	B	Produces output in form of audio
3	Headphone	C	Used to produce high-quality drawings such as blueprints, maps, and circuit Figures
4	Plotter	D	Produces output in form of audio and intended for private listening
5	Speaker	E	Produces hard copy of data output

Question 5

Which ONE of the following is not an output device?

A   Headphones
B   Plotter
C   Impact printers
D   Smart cards

Question 6

Which ONE of the following is an output device?

A   MICR
B   OCR
C   OMR
D   VDU

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **C.**

The output quality of a laser printer is measured by pages per minute.

Answer to SEQ 2

The correct option is **D.**

A Visual Display Unit (VDU) is an output peripheral of a computer.

Answer to SEQ 3

The correct option is **B.**

VDU stands for 'Visual Display Unit'.

Answer to SEQ 4

	Output device		Function
1	Printer	E	Produces hard copy of data output
2	Monitor	A	Used to display output data on the computer screen
3	Headphone	B	Produces output in form of audio
4	Plotter	C	Used to produce high-quality drawings such as blueprints, maps, and circuit Figures
5	Speaker	D	Produces output in form of audio and intended for private listening

Answer to SEQ 5

The correct option is **D.**

Smart cards are input devices. All other options are classified as output device.

Answer to SEQ 6

The correct option is **D.**

VDU stands for 'Visual Display Unit' and is an output device. All other options are examples on input device.

HARDWARE

B4

STUDY GUIDE B4: STORAGE DEVICES

◼ Get Through Intro

With increasing modernisation of computing requirements, the need for data storage has expanded from text and numeric files to include data such as digital music files, image files, video files, and much more. The multimedia files, especially the videos and image files, occupy larger space for storage and therefore storage devices with higher storage capacity are preferred. Organisations are required mandatorily to preserve books of accounts for a certain time period and therefore they prefer to store the documents and books of accounts in a digital format. Furthermore, some organisations also keep video and audio records of important meetings and customer conversations. Due to the digital revolution, a great demand for storage devices with much larger capacity is created.

In this Study Guide, you will learn about various storage options available, including their capabilities and limitations.

◼ Learning Outcomes

a) Explain various storage devices.
b) Compare and contrast various storage devices.
c) Identify technical, organizational and management factors that are used in selecting those devices.

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1. Explain various storage devices.

[Learning Outcome a]

Having discussed the various input and output devices in Study Guides B2 and B3, let us make an attempt to understand the various storage devices and their functionality. A storage device is used in the computer system to store data. Before we look at storage devices, we need to understand the difference between a storage device and a storage medium.

There are two parts to a storage system, which include a storage device and a storage medium.

Definition

A **storage device** is a hardware that records and retrieves items to and from a storage medium. For example, floppy drive, compact disk reader, etc.

A **storage medium** is a physical material on which a computer keeps data, instructions, and information. For example floppy disk, compact disk, etc.

Often, the storage device and the storage medium are two separate pieces of hardware. However, in some storage systems (e.g. a hard drive), the storage device and storage medium are bundled together as a single piece of hardware. Let us discuss a few popular storage systems in this learning outcome:

Data storage peripherals

1. Floppy disk

A floppy disk is a portable magnetic storage medium encased in a square or rectangular plastic shell.

There are three sizes of floppies:

a) 8-inch: used in the late 1960s and early 1970s
b) 5 ¼ -inch: capable of storing between 100k to 1.2 megabytes of data
c) 3 ½- inches: capable of storing 400k to 1.4 megabytes of data

Tip

The floppy disk is an **obsolete** data storage medium which has been superseded by portable USB drives and other optical storage devices.

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2. Magnetic disk

A magnetic disk is a flat disk where data is stored. It is covered with magnetic coating on both sides. The data is stored on various circular, concentric tracks on the surface of the disk. Stored data is retrieved or modified by rotating the disk. The mechanism which causes the disk to rotate is known as the disk drive. Data on a magnetic disk can be written and re-written over and over. Floppy disks and hard disks are also types of magnetic disks.

3. Hard disk

The hard disk is a rigid disk sealed inside the computer. It is used to store files and applications. Data is read in a random-access manner, meaning individual blocks of data can be stored or retrieved in any order rather than sequentially. The basic advantages of hard disks are capacity and storage. Usually personal computers have a hard disk drive ranging between 20 to 100 Gigabytes (GBs). Hard disks are connected to computer systems by standard interface cables such as SATA (Serial ATA), USB or SAS (Serial attached SCSI) cables. Some personal computers may have removable hard disks. These are referred to as external hard disks.

Now-a-days external hard disks with huge storage capacities are available, which can be connected very easily to various devices like computer systems, laptops, tablets, televisions, speakers, etc. by means of USB cables and data can be written, stored and accessed very conveniently on them. The capacity of these hard disks is now measured in Tera bytes (TB). 1 Tera Byte is equivalent to 1,024 Giga Bytes.

4. Zip disk

The zip drive is a **high capacity removable storage disk**. Initially it had a capacity of 100 Mb which was increased to 250 Mb and then to 750 Mb in subsequent versions. Being inexpensive they are suitable for taking back-up of data, storing a large quantity of data in one place or for moving large files between computers. A special zip disk drive is required to run a zip disk.

5. Optical Disks

Data is stored on Optical Disks using laser light. There are three major kinds of optical disks.

(a) **CD-Rom:** it has the capacity to store data ranging between **650 MB to 1 GB**. Data stored on a CD-ROM can be accessed any number of times. Data once written on CD-ROMs is permanent and cannot be altered, although certain re-writeable disks (known as rewritable CD- ROMs) are available in the market. The speed of the CD-Rom determines the speed of data retrieval, for example; a four-speed drive works slower than an eight-speed drive.

CD-ROMs are unable to handle multimedia files embedded with video and sound, which require a huge disk capacity and faster retrieval. This gave a boost to the development of DVDs.

(b) **Digital Versatile Disk (DVD):** they have the capacity to store data ranging from **4.7 GB to 17 GB**. Due to high access speed and a high data storage capacity (compared to the CD-ROM) the DVD is slowly replacing the CD-ROM. DVD players are backward compatible i.e. they can play CD-ROMs as well as DVDs.

(c) **Blu-Ray disk:** they have been developed to store large amounts of data, and to enable recording and playback of high-definition videos. A single layer Blu-Ray disc can store up to **25 GB**, while a dual-layer disc can hold up to **50GB** of data. Several major movie making studios (e.g. Sony, Warner Brothers) have decided to use Blu-Ray discs to release their movies. This is helping Blu-Ray to gain acceptance among computer users.

6. Magnetic Tapes

Magnetic tapes are primarily used as a **back-up storage medium**. They consist of long, narrow strips of plastic. The storage capacity is measured in terms of width and length. For example; an 8mm tape that is 112m long can store up to 5 GB of data. Magnetic tapes such as tape streamers are used to create quick back-up files.

The major benefits of using magnetic tapes are portability and low cost of storing. But they do not offer random access to memory. Hence, the tape has to be played forward and backward like a movie on a video cassette, in order to access a particular file. Moreover, they cannot be used for on-line retrieval of data.

7. Flash drives

Flash drives are small, **portable memory cards** which can be plugged into computers and function as hard drives. The USB flash drive is the most common type. It can be plugged into the USB (Universal Serial Bus Port) port of the computer.

Flash drives do not contain any moving parts. Since they are designed to read and write data using the same system commands as mechanical disk drives, they are called Flash drives. Flash drives are very handy and nowadays the capacity of flash drives ranges from 2 gigabytes to 64 gigabytes.

Flash drives are more reliable, compact and faster than other portable devices. But due to their small size, flash drives can be easily misplaced or lost. Flash drives can sustain only a limited number of write and erase cycles. The cost of storing, per unit of data, on a flash drive is higher than an external hard drive.

Hard disks (discussed above) and pen drives or flash drives are the most easily and widely used storage devices. They can be connected to all types of devices like personal computers, televisions, tablets, mobiles, speakers etc. The data on the pen drives and hard disks can be easily edited and re-written and also accessed as and when required. Hard disks are the preferred storage device for taking back-ups of huge data as the speed of read and write on hard disks is very fast.
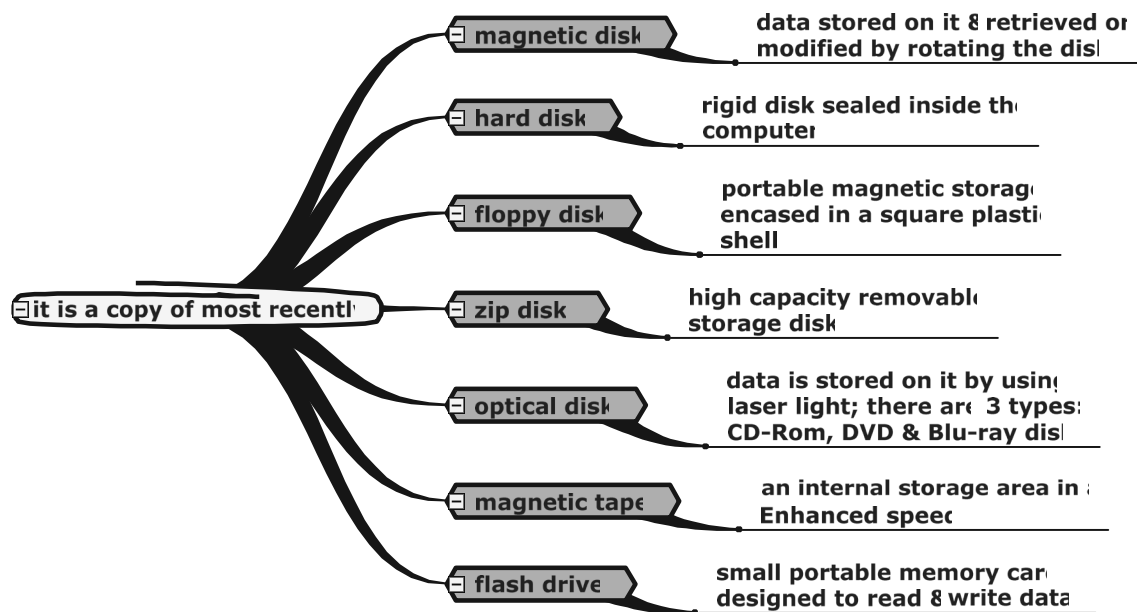
Example

Bony Ltd is a multi-national company having offices in major cities across the globe. The head office of Bony Ltd is located in Arusha, Tanzania and it maintains all the financial records of data for all the offices. It is the policy of the company to store the records for a minimum of 10 years. These records include financial statements, sales reports, marketing reports, payrolls, receivables data, etc.

In the case of Bony Ltd, the most convenient medium for storage of the data shall be computer hard disks or external hard disks. It would be convenient for Bony Ltd. to record, edit and access the data as and when required on hard disks. Furthermore, the data can also be written on CDs and DVDs and stored once it becomes old and is not required often. Hard disks are much more reliable storage devices compared to magnetic tapes, zip disks and optical disks.

SUMMARY

magnetic disk	data stored on it & retrieved or modified by rotating the disk
hard disk	rigid disk sealed inside the computer
floppy disk	portable magnetic storage encased in a square plastic shell
zip disk	high capacity removable storage disk
optical disk	data is stored on it by using laser light; there are 3 types: CD-Rom, DVD & Blu-ray disk
magnetic tape	an internal storage area in a Enhanced speed
flash drive	small portable memory card designed to read & write data

(central node: it is a copy of most recently)

Important

Popular terms used to express data storage capacity

1 Byte	8 bits
1 Kilobyte (KB)	1,000 bytes
1 Megabytes (MB)	1 million bytes
1 Gigabytes (GB)	1 billion bytes or 1,024 MB
1 Terabytes (TB)	1 trillion bytes or 1,024 GB

Test Yourself 1

Which one of the following is not a storage device?

A   Magnetic disk
B   Optical disk
C   Flash drive
D   Joystick

Test Yourself 2

One Gigabyte is equivalent to _____.

A 1,000 bytes
B 1,024 bytes
C 1,024 Megabytes
D 1,024 GB

---

2. Compare and contrast various storage devices.

[Learning Outcome b]

The selection of various storage devices to store data is based on several factors and varies from situation to situation. Some of the important considerations in selecting a storage device to store data include the following:

a) Requirements of users
b) Speed at which data needs to be recorded and accessed (referred to as read and write speed)
c) Capacity of the storage device
d) Geographical location of data
e) Cost of the storage device
f) Availability and knowledge of technology
g) Connectivity options of the storage devices

Based on the above parameters we can compare and contrast the various storage devices discussed in Learning Outcome 1.

The following table will help you compare and contrast the various storage devices which are popularly used today:

	Hard disks	Flash drives	Optical disks
Capacity	These have very high capacities ranging from 50 GB to 2 TB.	Have limited data capacity ranging from 2Gb to 64 GB and above.	Have a limited capacity. CD – 700 MB DVD – 4.7 GB to 17 GB Blu-ray disk – 25 GB to 50 GB.
Data read-write speed	Hard disks have the highest data read-write speed among the three. The read-write speed ranges from 20 MB/sec to 100 MB/sec.	The read-write speed is relatively lower than hard disks. The read write speed ranges from 4 MB/sec to 30 MB/sec.	The read write speed of optical disks is very low.
Cost	Costliest among the three.	Costlier than optical disks, but cheaper than the hard disks.	These are relatively inexpensive storage means to store data.
Portability	Hard disks are available in a portable version. However, hard disks with higher capacities (above 2 TB) may be bulky and inconvenient to carry.	Flash drives are small in size and therefore are the most preferred portable storage device.	Optical disks are portable. However, to read and write data from the optical disks, an optical drive reader is required. An optical drive reader is generally not preferred as a portable device.
No. of cycles	Data can be copied and erased any number of times.	Data can be copied and erased any number of times.	Data once written cannot be erased. Rewritable optical disks are available; however, they have limited life and need to be discarded after certain amount of usage.

Floppy disks and magnetic tapes

Floppy drives have become obsolete as storage devices as they have a very limited capacity (of only 1.44 megabytes) and require a floppy drive in order to be written and read. Therefore, they cannot be connected to many other devices like televisions, tablets, mobiles, speakers, etc.

Floppy disks have been completely replaced with hard disks, flash drives and optical disks.

Magnetic tapes are generally used to store audio and video files such as songs, movies etc. Data has to be accessed on the magnetic tapes only in a sequential manner. Therefore this storage medium has a limitation that it can be played forward and backward like a movie on a video cassette, in order to access a particular file. Moreover, it cannot be used for on-line retrieval of data. Optical disks have replaced the magnetic tapes. Compared to magnetic tapes, optical disks give the users access to data randomly.

Example

Bashiru is a student and enjoys watching movies and listening to songs. He has a huge collection of movies gathered by him over a period of time. He wants a safe and inexpensive medium to store his collection. The best device to store his audio and video files shall be optical disks. By using optical disks, he can play any movie from the point he wishes to watch, instead of having to watch it from the beginning. If Bashir would have chosen a magnetic tape to store his collection, he would not have got adequate storage space and also access to the collection would be limited due to the limitations of a magnetic tape.

Test Yourself 3

Which one of the following storage devices has the highest read/write speed?

A   Magnetic disks
B   Hard disks
C   Optical disks
D   Flash drives

---

3.   Identify technical, organizational and management factors that are used in selecting those devices.

[Learning Outcome c]

Organisational and management factors

Every organisation has its own requirement and policy for data storage. For a few organisations, the most important consideration in selecting a storage device is the ease of access as data is required frequently by the users. Some organisations do not require data very frequently, but require storage devices to store data for future reference. Based on the needs of each organisation, a proper storage device needs to be selected.

From the **management point of view**, the most important consideration in selecting a storage device is the cost to store data and the speed at which data can be accessed and used for decision making.

Following are some factors which each organisation should consider before selecting a storage device:

a)   **Capacity of storage medium:** if the data storage requirement of an organisation is high, the organisation needs to choose a storage medium with a higher capacity.

b)   **Speed of data access:** the speed at which data can be accessed from the storage medium by the computer system is also important. This includes both: reading speed and writing speed. If the writing speed is less, it will take a very long time to store the data on the storage device. Similarly, if the reading speed is less, it may take a lot of time for the computer system to display the data to the user. This may result in wastage of productive time.
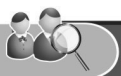
Example

Data stored on a hard disk can be accessed by the computer system much faster in comparison to an optical disk such as a DVD or a CD.

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c) **Cost of storage device:** cost of storage device is one of the most important factors in selection. For example, CDs and DVDs are the cheapest form of storage, but they have limitations relating to limited storage capacity and can be read only by a special player. On the other hand, a hard disk is costly, but has a higher capacity to store data. Furthermore, if data just needs to be backed-up, optical disks are best suited for the task.

d) **Volume of data:** if the volume of data to be stored is high, organisations need to think about storage devices that can retain a high volume of data at a low cost, like hard disks, CDs and DVDs.

e) **Accessibility of the data:** organisations also need to consider whether the storage device is easy to use and will record data accurately.

Example

ABC Enterprises is engaged in providing pest control services to its customers. The data of various customers is stored in a common storage device and can be accessed by the staff simultaneously. To access the data simultaneously, it is important that the choice of storage device is appropriate. ABC Enterprises should therefore choose a hard disk to store the data for its customers, as multiple users can access hard disk and retrieve data. An optical disk may not be suitable to them as the data on optical disks can be accessed by a single user only.

a) **Reusability:** storage devices can be reused by erasing the old data on them and re-writing new data when the user requires. Storage devices should be checked for the number of times the storage device can be reused.

b) **Non-volatile storage device:** it should be checked whether the storage device is a non-volatile storage device. 'Non-volatile' means that when the power is switched off, the storage device does not lose its data.

c) **Universal connectivity:** storage devices with universal connectivity are preferred. This allows transfer of data through various computing systems, without any problems.

d) **Data security:** if security of the data stored is important, organisations should use flash drives and hard disks instead of optical disks. This is because flash drives and hard disks can be password protected for the user to access data stored on them.

Technical factors

Technical factors include capacity, read-write speed and security of storage devices. These factors have been discussed above. Some other technical factors in selecting a storage device include the following:

a) **Compatibility:** the storage device selected should be compatible with the hardware of the computing system.

b) **Future upgrades and support:** organisation need to check whether the storage device would get adequate technical support and upgrades from manufacturers of storage devices. This will ensure that storage devices will function properly and will be replaced in case of any problems.

Test Yourself 4

Which of the following is a storage device of a computer system?

A Hard disk
B Bar code reader
C EFTPOS
D Printer

Test Yourself 5

Which ONE of the following is not a technical factor in selecting a storage device?

A Compatibility
B Future upgrades
C Support from manufacturers
D Cost of the device

Answers to Test Yourself

Answer to TY 1

The correct option is **D**.

Joystick is an input device. The other options are examples of storage devices.

Answer to TY 2

The correct option is **C**.

One Gigabyte is equivalent to 1,024 Megabytes.

Answer to TY 3

The correct option is **B.**

Hard disks have the highest data read-write speed among the options provided. The read-write speed ranges from 20 MB/sec to 100 MB/sec.

Answer to TY 4

The correct option is **A.**

Hard disk is a storage device.

Bar code reader and EFTPOS are input devices, whereas a printer is an output device.

Answer to TY 5

The correct option is **D.**

Cost of device is not a technical factor in selecting a storage device.

Self Examination Questions

Question 1

Which of the following is a storage device?

A   Printer
B   Microsoft Office Excel 2003
C   Touchpad
D   Flash drive

Question 2

Which of the following is not a storage device?

A   Hard disk
B   Magnetic tapes
C   Visual display screen
D   Flash drive

Question 3

State three advantages of using a flash drive.

Question 4

Which one of the following storage devices allows sequential access to data?

A   Magnetic tapes
B   Optical disks
C   Hard disks
D   Flash drives

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **D.**

> Flash drive is a storage device.

> Printer is an output device.

> Microsoft Office Excel 2003 is an application package.

> Touchpad is an input device.

Answer to SEQ 2

The correct option is **C**.

Visual display screen is an output device.

Answer to SEQ 3

The advantages of using a flash drive are as follows:

> Flash drives are very compact and therefore are preferred as a portable storage device.

> The read and write speed of flash drives ranges from 4 MB/sec to 30 MB/sec. This means data can be copied on the flash drives quickly.

> Data can be copied and erased any number of times.

Answer to SEQ 4

The correct option is **A.**

Data stored on magnetic tapes can be accessed in a sequential manner. The other storage devices given in the options allow random access to data stored on them.

HARDWARE

STUDY GUIDE B5: TYPES OF COMPUTERS

■ Get Through Intro

Computers are showing up everywhere. Even in places where we don't expect them to. Think about this text book. How was it created? Qualified people wrote the Study Guides after a lot of researching (with a lot of it on the Internet). They then typed it into a computer. Another programme formatted the Study Guide so all Study Guides had a similar look and feel. Then an index was made by a computer programme picking up key words in each Study Guide. Then a contents page was generated. Once the whole book was completed, it was sent digitally to the printer, who then entered it into his printing machinery computer system and printed the books. The books were then picked up and sent to the warehouse where they were logged onto a system. Then they were distributed to you. Wow! Could we have done it without computers? It would have been extremely difficult, if not impossible, especially if we wanted to keep the prices low.

The purpose of this Study Guide is to introduce you to different types of computers.

■ Learning Outcomes

a) Explain various computer types based on size.
b) Explain various computer types based on technology (analogue and digital).
c) Explain various computer types based on processor types.

1. Explain various computer types based on size.

[Learning Outcome a]

1.1 Computer

Definition

A computer is an electronic information processing machine. It accepts data (Input) manipulates the input on the basis of a pre-determined set of instructions (Process) and provides results (Output) to the user or retains information (Store).

From the above definition we can conclude that a computer does four functions:

A	Accepts data	Input
B	Process data	Processing
C	Stores data	Store
D	Produces data	Output

Computer systems are categorised based on their size (starting with lowest):

(i)   Micro Computers
(ii) Mini Computers
(iii) Main Frame Computers
(iv) Super Computers

1.   Microcomputers (Personal Computer)

The microcomputer performs tasks relating to general purposes. It is designed to be used by one person (single-user) at a time. It has its **own processor, hard drive and display unit**. Nowadays people refer to microcomputers as 'personal computer' or 'PC'.

Microcomputers are usually used at home or in small to medium-sized businesses. To share information, organisations link microcomputers with each other.

Most of the microcomputers are developed around Intel and AMD chips. With technological progress, microcomputers are available in very small sizes. The major suppliers of microcomputers are HP, Lenovo, and Dell.

Macintosh, commonly nicknamed Mac, is a series of microcomputers (i.e. personal computers) manufactured by Apple. The Macintosh128K released on 24th January, 1984 was the first personal computer to use GUI (Graphical User Interface) instead of command line interface. In the past, Apple distinguished Mac from other personal computers by providing a user-friendly interface and a different operating system to Windows® (offered by the Microsoft Corporation). Today, Apple offers several Macintosh models with varying degrees of power.

Laptops, tablet computers, notebook computers and smart phones are also included in this category. These computer systems use a microprocessor, which is a combined or integrated circuit that performs the complete task of processing.

2.   Minicomputer (Mid-range computers)

The term minicomputer was first used in the 1960s to define a computer which had more power than a microcomputer but less power than a mainframe (discussed later). Minicomputers are **multi-user and time-sharing** systems. The development of microcomputers was propelled with the realisation that instead of mainframes, a small, inexpensive computer can solve several computing problems.

With technological advancement, the role of minicomputers has diminished considerably. Minicomputers are commonly used in industrial control systems and for scientific application in universities and research laboratories. The major suppliers of minicomputers are IBM and Digital Equipment Corporation (now available as HP).

3. Mainframe

Mainframes have been in existence since the 1950s. Mainframes are best suited to organisations that need to manage large amounts of data. Mainframes are used as the centre of large computer systems. Due to this, mainframes require **significantly higher processing powers** than microcomputers and extensive data storage facilities.

Some people refer to mainframes as 'enterprise servers'. These are the most powerful computers, barring supercomputers. In terms of size, these are bigger than minicomputers and microcomputers. Major suppliers of mainframe are IBM and HP. These computers are used in large organisations like banks, government and big corporate houses where the amount of data is huge and the number of users is large.

4. Supercomputers

Supercomputers are computers designed to process huge amount of data. Supercomputers have the **highest processing speed** among computers and use multiprocessing techniques. This allows supercomputers to use several processors to solve complex problems. Supercomputers are not used to solve business problems. They are designed to solve specific kinds of problems. Supercomputers are used for remote sensing, climate forecasting and the simulation of detonating nuclear bombs. These computers are very huge and take up a lot of space in comparison to other computer types discussed above.

The processing speed of a Supercomputer is measured in floating point operations per second, or FLOPS. In other words FLOPS means the number of computing instructions a super computer can execute in one second. These computers have the ability to perform a large number of operations simultaneously. Cray and IBM are leading manufacturers of supercomputers.

Example

The USA has two major super computers named 'Titan' and 'Sequoia'.

5. Other types of computers

     File servers
     Laptops or notebooks
     Workstations

(a) File servers

File servers usually do not run any application or perform any complex calculations. They are responsible for **providing a location to store data**. Being attached to the network, they can be accessed by any computer on the network. They allow users on the same network to share data without physically transferring files e.g. transferring data using a USB or CD-ROM.

Organisations prefer file servers because they are designed primarily to enable rapid storage, sharing and retrieval of data.

(b) Laptops or notebooks

Laptops are similar to desktop computers and perform the same function. But, they are smaller in size and **optimised for portable use**. A laptop or notebook is a small computer which a person can carry and use anywhere he wishes. Compared with desktops, laptops consume less space, less energy and can operate in spite of power supply problems. Laptops run on a battery or an AC / DC adapter which is able to charge the battery.

Usually, laptops have less processing power than desktops. With developments in technology, some laptops are able to offer the full features of a desktop.

The limitations of laptops are limited battery power and keyboard ergonomics (i.e. keys are too close together or too small to type quickly). Moreover, there is a limited scope to upgrade laptops.

(c) Workstations

Workstations refer to computers used for technical or scientific purpose. Workstations tend to **offer a higher performance in terms of graphics, computer processing unit**, memory capacity or multi-user operating systems. Occasionally, this term is used to describe the working environment of a person i.e. the person's desk, chair and computer.

Test Yourself 1

Which type of computer allows only a single user to perform general tasks?

A Minicomputers
B Mainframe computers
C Microcomputers
D Supercomputers

2. Explain various computer types based on technology (analogue and digital).
[Learning Outcome b]

Based on the technology used to build a computer system, computers can be classified as:

Analogue or
Digital

2.1 Analogue Computers

Definition

An analogue computer is defined as a computing device that works on a continuous range of values.

The result given by the analogue system is generally approximate as it deals with parameters which vary continuously. Analogue systems generally deal with physical variables such as voltage, pressure, speed, etc.

Analogue systems were generally used in the 1940s, although they are uncommon now. Analogue computing systems were widely used then in the scientific and industrial applications where digital computers at that time were not suitable for measuring the performance. However, with the advancement of technology, digital computing systems have replaced the analogue systems.

Example

Examples of analogue computing systems include speedometer, electric meter, thermometer, pressure gauge, etc.

2.2 Digital Computers

Digital computer systems use digital technology to perform their functions. Under the digital technology, calculations and logical operations are executed using quantities and other inputs in digits. These computing systems handle numbers discretely rather than using approximations, as in the case of analogue systems.

The digital computer uses a binary number system. Under the binary number system, data is represented as two digits (0 and 1), referred to as bits.

The series of eight consecutive bits is called a "byte" and the eight-bit byte permits 256 different on-off aggregations. Circuits of the computer execute the mathematical operations such as addition, subtraction, division and other mathematical functions using the binary system.

Nowadays, the computer systems which are used are digital computer systems. These can be used for various purposes like data processing, electronic games, etc., and run various applications. These systems are well suited to solve complex problems in the field of engineering and technology.

Example

Examples of digital computers are digital computers, digital watches, digital phones and digital radio.

Distinguish between analogue and digital computing systems

	Analogue computers	Digital computers
Mode of computing	It does not deal with numbers. Rather, these systems take input from physical magnitudes such as temperature, pressure, voltage etc. It performs arithmetical operations and comparisons by measuring changes in the magnitudes.	It deals with numbers, and especially, uses the binary number system. The input is received and encoded in forms of "0" and "1" (which is the machine language). The processing is done in machine language and converted to human language as output.
Data processing	Processes data in wave form and on a continuous basis	Processes data in a step by step form
Stored program	Does not work on a stored computer program concept	Works on a stored computer program concept
Results	Results of analogue system are generally approximate.	Digital system will always give an accurate result
Examples	Speedometers, voltage meters	Digital computers, digital watches

Test Yourself 2

Which one of the following statements is true for digital computing systems?

A   Digital computing systems do not work on a stored program concept
B   Digital computing systems always give an approximate result
C   Digital computing systems use the binary language to process data
D   Digital computing systems process data on a continuous basis

3. Explain various computer types based on processor types.

[Learning Outcome c]

The most important component of a computer system is the processor as it serves the function of the heart as well as the brain of the computer. Without a processor, a computer system will not be able to perform the functions it is expected to carry out. Today, there are several processors to choose from, which vary in the speed of processing data. The three main processor manufacturers include Intel, AMD and Cyrix. These companies produce a range of processors, depending upon the various needs of the users.

The type of processor to be installed on the computing system is largely dependent on the compatibility of the motherboard.

Example

If an Intel motherboard is installed into the computer, then ideally an Intel Processor will be required to be installed in it. An AMD processor may not work on a motherboard designed for Intel.

Various computers can also be classified based on the type of processors installed. Various types of processors include:

(i)   Single Core Processors
(ii) Dual Core Processors
(iii) Quad Core Processors

(i) Single Core processors

Single core processors are the oldest type of processors used in computers. These processors were capable of performing only one operation at a time. Therefore, when multi-tasking operations were required their performance would significantly decrease and sometimes the computer would simply 'hang', and stop responding. The users had to terminate the first task given to the computer before continuing with another task. These processors, due to their limitations, are not used nowadays. The earliest known computers such as Pentium 286, Pentium 386 etc. used single core processors.

(ii) Dual Core processors

After the limitations experienced due to the single core processors, dual core processors were developed. The dual core processor was a single processor that had two cores and thus functioned like two processors in one. This resolved the problems of handling multi-tasking operations and users could switch back and forth between different sets of tasks when more than one task was running.

Example

Some of the common dual core processors include the Intel Core 2 Quad, Intel Core 2 Duo, Intel Pentium Dual Core, AMD Phenom 1 X3 and AMD Turion family.

(iii) Quad Core processors

Quad Core processors are the latest development in the field of computing. Just like the dual core, a single processor houses four cores and functions like four processors running together. This allows for even greater multitasking. A quad core processor will not execute a task four times faster; rather, it can run several programs together. The individual cores in a quad core processor can run multiple programs simultaneously to execute instructions, thereby increasing the overall speed for programs running on the computer system.

These types of processors are generally used by gamers and users who operate several different applications at a time. As technology is being reinvented each day, processors with more than eight cores are also available. These processors are used in large computing systems such as the mainframe systems.
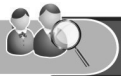
Example

Examples of quad core processors include Intel's I5, Intel I7 processors and the AMD Phenom Family.

Factors to be considered for selecting a computer based on its processor

The choice of computer processor depends on two important factors:

    a) Type of software to be used and
    b) Budget allocated to the processor

If there is no financial constraint, users should opt for higher-end processors irrespective of the computing need. This will help ensure that the computer is functioning, without upgrading and maintenance in the future.

On the other hand, if there is a budget allocated, users may choose quad core processors which are mid-range or economy processors and can address the user's needs.

Test Yourself 3

Arrange the following types of processor based on their processing capabilities. (Arrange from low to high).

A   Quad core, single core, dual core
B   Dual core, single core, quad core
C   Single core, dual core, quad core
D   Single core, quad core, dual core

Answers to Test Yourself

Answer to TY 1

The correct option is **C**.

A microcomputer allows general tasks to be performed only by a single user.

Answer to TY 2

The correct option is **C.**

The other options are a feature of analogue computing systems.

Answer to TY 3

The correct option is **C.**

Single core processors perform only one operation at a time. Dual core and quad core are technologically more advanced processors.

Self Examination Questions

Question 1

What are the functions of a computer?

A	Accepts data	Processes data	Stores data	Produces data
B	Accepts data	Doesn't processes data	Stores data	Produces data
C	Denies data	Manages data	Doesn't save data	Saves data
D	Denies data	Manages data	Doesn't store data	Saves data

Question 2

Which of the following statements refers to a Supercomputer?

A Supercomputers are suited for medium-sized organisations which need to manage a small amount of data.
B Some people refer to supercomputers as 'enterprise servers'.
C Supercomputers are similar to desktop computers and perform the same functions but are miniature in size and optimised for portable use.
D Supercomputers are designed to process huge amounts of data and have the highest processing speed among computers.

Question 3

A series of _____ consecutive bits is called a "byte"

A Four
B Six
C Eight
D Twelve

Question 4

A computer system which allows multiple programs to be run simultaneously is referred to as:

A Multi-tasking system
B Multi-user system
C Real time system
D Time sharing system

Question 5

Arrange the following computing devices in order of their performance (starting with the highest performance):

(i) Analogue computer
(ii) Quadcore computer
(iii) Super computer
(iv) Mainframe computer

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **A.**

A computer is an electronic information processing machine. It accepts data (input) manipulates the input on the basis of a pre-determined set of instructions (process) and provides results (output) to the user or retains information (store).

Answer to SEQ 2

The correct option is **D.**

Supercomputers are designed to process huge amounts of data with the highest level processing speed among computers with multiprocessing techniques.

Answer to SEQ 3

The correct option is **C**.

A series of eight consecutive bits is called a "byte".

Answer to SEQ 4

The correct option is **A**.

A computer system which allows multiple programs to be run simultaneously is referred to as a multi-tasking system. Several programs can be run simultaneously, without the need to terminate the earlier programs which are running.

Answer to SEQ 5

The computing devices arranged in order of their performance (starting with highest performance) are:

(i) Super computer
(ii) Mainframe computer
(iii) Quadcore computer
(iv) Analogue computer

COMPUTER SOFTWARE

C1

STUDY GUIDE C1: SOFTWARE

■ Get Through Intro

Everything we see around us today has become computerised and digitised. Our day-to-day life has become too much dependent on gadgets. We now cannot imagine our lives without televisions, cell phones, computers, video games, etc. and the list is endless. However, did you ever wonder how these gadgets work so smartly?

Do these gadgets have an in-built brain?

The answer to these questions lies in the software which gives these devices their functionality.

The software is the brain behind all the gadgets we operate. Particularly, for computing systems, there is software available and new inventions take place each day. Due to the use of such software, our life becomes easy & quick.

In this Study Guide, we will discuss and understand the term "software" and also discuss the various types of software.

■ Learning Outcomes

a) Define the term software.
b) Identify various types of software based on type of problem that the software addresses.

1. Define the term software.

[Learning Outcome a]

Introduction

Software today is used by each of us in every aspect of our life. Due to the use of software, our lives have become easier. With just a click of a button, you can execute an online transfer of money or book a movie ticket or pay taxes. These are just a few examples of how software is able to help the users to perform daily tasks comfortably and quickly. There is software which is used by the computer system to initiate itself, enable the hardware to trace the operation it has to execute and perform other user-desired tasks.

As already discussed in Section B, hardware is one of the most important components of a computer. Hardware comprises devices such as mouse, keyboard, CPU, monitor, etc. In simple words, hardware is anything that has physical existence. It is sometimes denoted as 'h/w'. However, it is the software which gives life to the hardware.

Let us discuss software in technical terms, which is also one of the most important parts of a computer. It is also denoted as 's/w'.

What is software?

Software is the collection of instructions that are used to communicate with hardware devices (input and output devices) to perform a particular task required by the user. For a computer system to work properly, it is essential that hardware & software work together as a unit.

Definition

Software is a collection of logically arranged instructions to perform a desired task. The term software includes system software (e.g. operating system) and applications software (e.g. word processors).

Software increases the capability of the hardware. Therefore, the term software is not just limited to computing systems, but also extends to other devices. Software works on a set of instructions, referred to as a program, on the basis of which the software derives the logic to complete the task.

Software can be divided into system software and application software (also referred to as application package). These are discussed in detail Study Guides C2 and C3.

Example

A teacher at a school has to prepare reports of 60 students and calculate their marks and their respective percentage. Instead of doing this manually, the teacher makes use of Microsoft Excel spread sheet, which is one of the software used for different mathematical operations to be carried out. The marks of all the students can be entered easily, and after the data is uploaded into the excel spread sheet, all calculations and analysis can be done using mathematical formulas for deriving percentages. Here, the spread sheet (software) received instructions from the user (teacher) to calculate the percentage of all the students and then executed a series of instructions to give the desired result. Finally, the results are displayed to the teacher on a computer screen. This shows software and hardware work together to give the user the desired result.

Test Yourself 1

Identify the software from the following:

Processor	Joystick
Motherboard	Microsoft Word
Utility program	CPU
Windows XP	Paint
Monitor	Media player

2. Identify various types of software based on type of problem that the software addresses.
[Learning Outcome b]

As already discussed in the earlier learning outcome, software can be categorised into two parts:

Figure 1: Types of software

```
                    ┌─────────────────────┐
                    │  Types of software  │
                    └─────────────────────┘
                              │
            ┌─────────────────┴─────────────────┐
 ┌─────────────────────┐            ┌─────────────────────┐
 │   System software   │            │ Application software │
 └─────────────────────┘            └─────────────────────┘
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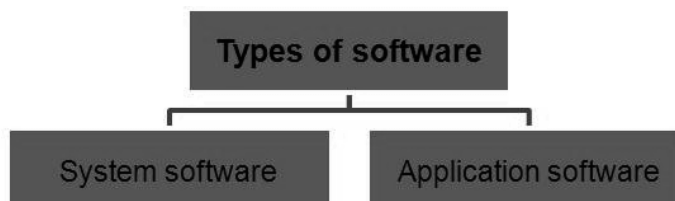
2.1 System software

System software includes software and various system utilities. The computer operates on the basis of instructions provided by the system software. The operating system provides the user with an interface, which allows the user to manage and control the computer.

System software addresses the problems of communication between the hardware system & the application software. It consists of background programs that enable the application software to run smoothly on a given set of hardware. Usually, the computing system comes pre-loaded with basic system software because it constitutes an essential part of the system.

System software comprises the following:

(a) **Operating system**: it is the backbone of the system, which solves the problem of communication between the hardware & the application software.

Example

Examples of operating system include Windows XP, Windows 7, Windows 8, Mac OS.

(b) **Utility Software:** use of the utility software increases the performance of the system.

Example

Examples of utility software include calculator, notepad, remote desktop sharing software, etc.

(c) **Device drivers:** this software helps to introduce external devices to the operating system.

Example

Examples of device drivers include sound card drivers, Bluetooth drivers, video display drivers, etc.

(d) **Translator Software:** this software is used to convert the language that is understandable to humans into machine language.

Example

Examples of translator software include Borland C, C++, etc.

System software is covered in detail in Study Guide C2.

2.2 Application software

Application software is designed to help the user to perform specific tasks e.g. editing a document or making calculations on a spread sheet. It is also referred to as an application package. However, application software is unable to function without an operating system. Unlike system software, which controls the working of the computer system, the application software is used to perform specific tasks of users. Application software addresses the problems of communication between system software & the end users.

Application software helps users in their daily tasks. In simple words, application software is the software used by the end user.
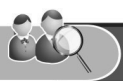
Example

Microsoft word, Microsoft Excel, Microsoft PowerPoint, Adobe Photoshop, Media player, Mozilla Firefox, etc., are a few examples of application software.

Application software is used to perform various tasks including writing a report, performing calculations, watching movies, listening to music, viewing photographs, etc. According to the users' requirements, there are various applications available in the market, which may either be paid or available for free.

The sole purpose of the application software is to help users solve their problems and to address specific needs. Application can be pre-installed on the operating system (for example, media player, internet browsing applications etc.) or you need to install them (Microsoft Office, Adobe Acrobat Reader).

Some examples of application software and the tasks performed are given in the table below:

Application Software	
Electronic spread sheet	Excel, Multiplan, PC-focals, professional plan, Quattro, Lotus 1-2-3,
Word processor	Excel, Multiplan, PC-focals, professional plan, Quattro, supercals, Lotus 1-2-3,
File managers, database management systems	Dbase, Rbase,
Graphics generators	Corel Draw, Adobe PageMaker, and PowerPoint

Some application software may be developed by organisations in-house to meet a specific requirement. These are called bespoke software.

Application software is covered in detail in Study Guide C3.

Interrelation of application software, system software and hardware

The interrelationship between application and system software can be depicted with an onion skin Figure. Onion skin Figure is a kind of block Figure. It is made of concentric circles and each circle represents a component that is dependent on the one inside it & so it is called onion skin.

It shows different hardware & software used to make a computer system & will also show the order in which each layer plays its role.

Figure 2: Onion skin Figure of computer components

Hardware:
CPU, Mouse, Printer etc.

System software:
Operating system, utility software, Device drivers etc.

Application software:
Spreadsheets, work processors, Text editors etc.
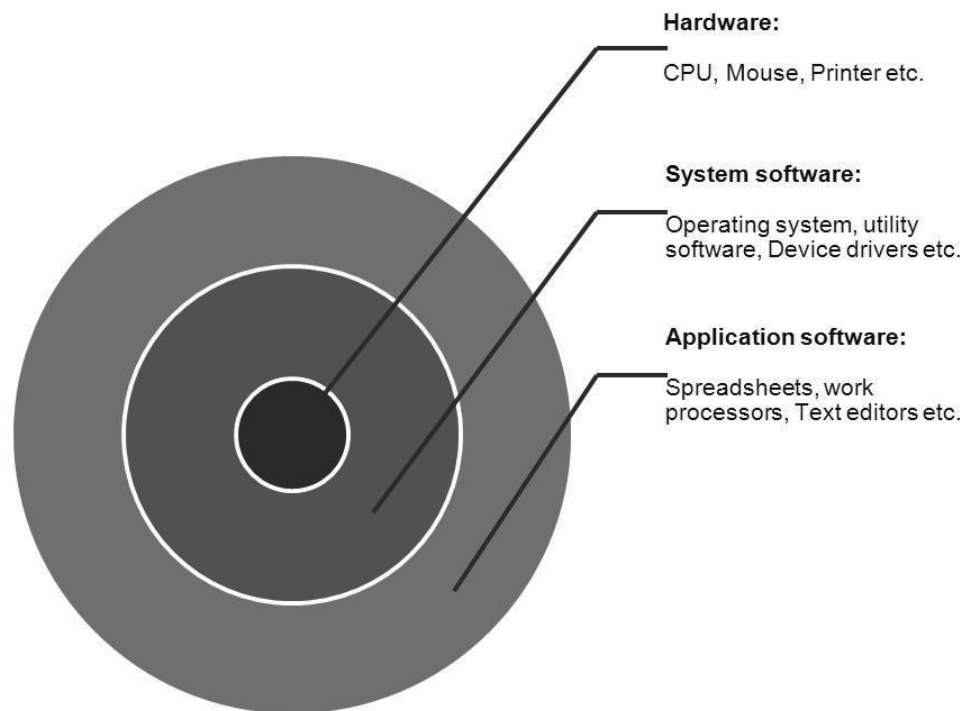
In the above Figure, we can see the different components of a computer system in different layers, namely Hardware, System Software, and Application Software.

First layer: **Hardware**

The first layer comprises hardware devices which are connected to the computer system. These include CPU, monitor, mouse, disks, printer, keyboard speakers etc.

Second Layer: System Software

The second layer comprises system software like operating system, utilities, device drivers & translator software. This layer is in the middle of Application Software & hardware, because the system software works as a 'middle-man' between them by providing interface for communication.

Third Layer: Application Software

There are different applications which we need to serve our daily tasks. This software is directly used by the end users. Such software includes different spread sheets, games, internet browsers, databases, word processors and many others. All these work together in co-ordination, and so a computer system works successfully.

Example

Robert wanted to take a printout through a printer connected to his computer system. In order to do so, he opens the file which is a Microsoft word file (application software). Through the keyboard (input device), he sends instructions to the Microsoft Word program to print the document. Now this word document informs the system software that the user wants to print some document. Then the system software instructs the concerned hardware i.e. printer to print that particular document.

This way, the application software, system software and hardware work in co-ordination, making the computer work successfully and execute the user's instructions.

Test Yourself 2

The computer operating system is _____.

A   Application software
B   System software
C   Bespoke software
D   Drivers and utilities

Test Yourself 3

Find the odd word from the below sets of words provided:

Translator, Utility software, spread sheet, calculator, music player, printer

Answers to Test Yourself

Answer to TY 1

Software includes the following:

Utility program, Windows XP, Microsoft word, Paint and Media player.

Answer to TY 2

The correct option is **B.**

Computer operating system is an example of system software.

Answer to TY 3

The odd word is printer.

Printer is an output device. The other words are examples of system software and application software.

Self Examination Questions

Question 1

Application software addresses the problem of communication between:

A   Hardware & user
B   System software & hardware
C   System software & user
D   Application software & system software

Question 2

System software can be handled by the end user. State whether this statement is:

A   True
B   False

Question 3

Device drivers and utility software are examples of _____.

A   Application software
B   System software
C   Bespoke software
D   Third-part applications

Question 4

Which of these would NOT be classified as system software?

A   Microsoft PowerPoint
B   Windows XP
C   Device drivers
D   Utility software

Question 5

For each of the statements given below, state whether the statement is true or false.

(i)   Software programs such as Microsoft Word, Excel, PowerPoint, or Access are all examples of application software.

(ii) Translator software helps to introduce an external device to the operating system.

(iii) Software can take limited instructions from users at a time.

(iv) Application software developed by organisations in-house to meet a specific requirement is called bespoke software.

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **C**.

The application software lies in the third layer of the onion skin Figure of a computer system. It comes in direct contact with the system software & the end user. It therefore addresses the problem of communication between system software and end user.

Answer to SEQ 2

The correct option is **B**.

According to the onion skin Figure, application software is used by end users, not system software.

Answer to SEQ 3

The correct option is **B**.

Device drivers and utility software are examples of system software.

Answer to SEQ 4

The correct option is **A**.

Microsoft PowerPoint is an application software.

Answer to SEQ 5

(i) **True -** Software programs such as Microsoft Word, Excel, PowerPoint, or Access are all examples of application software.

(ii) **False -** Translator software helps to convert language understandable to humans into machine language.

(iii) **False -** Software can take unlimited instructions from users at a time depending upon how it is programmed.

(iv) **True -** Application software developed by organisations in-house to meet a specific requirement is called bespoke software.

COMPUTER SOFTWARE

STUDY GUIDE C2: SYSTEM SOFTWARE

▓ Get Through Intro

Studying system software is important, as it will help us understand how a computer works. Without system software, the computer would just be useless and it would not be able to process user information.

Therefore the study of system software will help you understand the how the various computer components (or hardware as commonly known) are controlled by the system software.

In this Study Guide, we will discuss various types of system software such as operating system, utility programs etc.

▓ Learning Outcomes

a) Define the term systems software.
b) Explain various types of systems software (operating systems, utility software, device drivers, and programming languages).
c) Explain various types of operating systems in terms of capabilities.
d) Explain various emerging issues in operating systems such as graphical user interface (GUI).

---

1. Define the term systems software.

[Learning Outcome a]

In Study Guide C1, we already discussed software and its sub-types. Furthermore, we also defined system software. In this Study Guide, we will be focussing on various components of system software.

As discussed already, **system software is a collection of system software and various system utilities**. The computer operates on the basis of instructions provided by the system software. The operating system provides the user interface which allows the user to manage and control the computer.

The first system software loaded when we turn on the computer is **Operating System (OS).** This process of loading the operating system is called **booting**.

The system knows how to boot, because the instructions for it are built in in one of the chips, i.e. BIOS, fitted in the central processing unit. From this we understand that, from the time of switching on the computer, the work of the system software starts. After this, a series of processes takes place in which the operating system and device drivers are loaded on the system, which communicate with the various types of hardware such as mouse, keyboard, display, etc. All this communication is only possible due to the system software.

Test Yourself 1

Which of the following statements about software is true?

(i) It is a collection of logically arranged instructions to perform a desired task.
(ii) It is a small, portable memory card which can be plugged into the computer and functions as a hard drive.
(iii) It is used to operate and control the computer.
(iv) Software is divided into two parts i.e. operating system and application software.

A (i),(ii) and (iv)
B (iii) and (iv)
C (iii), (ii) and (iv)
D (i), (iii) and (iv)

---

2. Explain various types of systems software (operating systems, utility software, device drivers, and programming languages).

[Learning Outcome b]

Various types of systems software are:

Figure 1: Types of system software
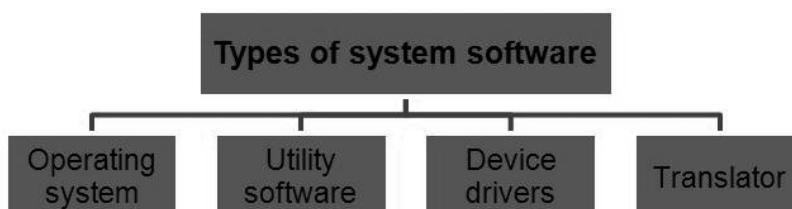
2.1 Operating System

Definition

An operating system contains the fundamental set of instructions required to operate and manage a computer. Operating systems allow the user to interact with the computer hardware with the help of the computer software.

The operating system is the most important program running on a computer. It performs the basic tasks required to operate a computer, for example, it sends input for processing, displays output on the VDU and keeps track of files and directories on the hard disk. It manages all the other programs running on the computer.

1. **Functions of an operating system**

The operating system carries out the following functions

(a) **Loads** various programs and data files in the memory of the computer.

(b) Controls the **input and output devices**. It also checks whether all the peripherals are functioning correctly.

(c) It manages **various user accounts**. It remembers the passwords, and allows the user to log in only if the

(d) password matches the user name.

(e) When an operation fails, it sends an **error message** to the user.

(f) It enables the memory to be **shared** among several applications.

(g) It acts as an **interface** between the computer and the user. It allows the user to control various icons, windows and menus displayed on the VDU.

(h) It sends messages to the user about the **status of an operation.**

(i) It **determines the order** in which applications must run. It also determines the time to be allotted for an application to be processed.

(j) **It creates folders** and keeps track of various files saved in them. It keeps a track of where files are physically stored on the hard drive and opens and closes them.

(k) It provides a tool to measure the **performance** of the computer.

Tip

Here is a mnemonic to help you remember the functions of an operating system:

Lives is DCP

L - Loads	I - Interface	D - Determines the order
I - Input / output device	S - Status of operation	C - Create folders
V - Various user accounts		P - Performance
E - Error message		
S - Sharing of memory		

2. **Various types of operating system**

(a) **Microsoft Windows® operating system**

Windows® is a series of operating systems developed and marketed by the Microsoft Corporation. It is estimated that more than 90% of all personal computers use Microsoft Windows® as their operating system. Although not free from bugs and highly vulnerable to viruses, it is priced relatively low compared to the other operating systems. The below mentioned features made Microsoft Windows® popular among the personal computer users.

Screen shot of Windows® operating system

Microsoft Windows® operating system has the following features:

(i)   It supports **multimedia files**. Multimedia files are files which include several media e.g. text, graphics, audio and video.

(ii) Applications can be launched with the help of a **single click.**

(iii) It provides a variety of features such as Internet explorer and Outlook Express to provide integrated **internet access** to the user.

(iv) It is easy to **regularly test** the files on the hard disk. This helps in fixing problems (if any) easily and quickly.

(v)   Most of the applications written for Microsoft Windows® have a similar **look and feel**. This helps in cutting costs by reducing the training time.

(vi) It has an area where the user can place several files, applications, folders (directories) or short cuts to files and disk drives. This area is called the **Desktop,** and is displayed when the user logs in.

(vii) Deleted files are moved to the **Recycle Bin**. They can be restored by accessing the Recycle bin.

(viii) A personal computer using Microsoft Windows® as an operating system can be easily connected to a **network** of computers.

(ix) The taskbar contains a **start button which** provides access to several programs.

(x)   The **taskbar** (at the bottom of the VDU) provides quick access to the running applications.

(xi) Windows **Explorer** (explained later) allows the user to see the organisation of files on the hard drive.

(xii) When the user plugs a device into the computer, Windows automatically recognises the device and allows the user to use it. The user doesn't have to reconfigure the computer. This feature is known as **plug and play**.

(xiii) It is able to **multitask**. It can run more than one application at the same time.

(xiv) It has a **Graphical User Interface (GUI).** It allows the user to input instructions using a mouse i.e. by clicking on the dialogue box instead of the typed text. One of the features of GUI is that it allows the user to input instructions using WIMP (windows, icons, menu and pointing device).

Window: the 'window' here refers to the screen which displays an application and not the operating system. The screen, displayed on the VDU can be divided into several panels called windows. The size of a window can be altered according to the requirements of the user. The window can be opened and closed with the help of the mouse or keyboard. This enables the user of the computer to view and work on several applications at the same time e.g. Internet explorer, Notepad and Microsoft Office Power Point 2003.

Icons: an **i**con is a pictorial representation of a program. When it is clicked, with the help of the mouse, it starts a program.

Menu: this is a combination of text and symbols used to represent choices to a computer user. The user chooses an option by highlighting the item and then clicking on it, using the mouse. There are six types of menu:

    a)   Pop-up menu: appears temporarily when a selection is made.
    b)   Cascading menu: this is a sub-menu, and opens when a choice is to be made from another menu.
    c)   Pull-down menu: this is a kind of pop-up menu that appears beneath the command selected.
    d)   Moving bar menu: options are highlighted so that the user can move one item to another.
    e)   Menu bar: this is a horizontally arranged menu. Usually, a menu option is associated with another pull- down menu.
    f)   Tear off menu: this is a kind of pop-up menu which can move around the VDU like a window.

Pointing device: includes Mouse, trackball and lighting pen (explained in Learning Outcome 2 of this Study Guide).

Tip

Here is a mnemonic to help you remember the features of Microsoft operating system:

Ms. Ril Dr. Nst EMG

MS.RIL	DR.NST	EMG
M – Multimedia files	D- Desktop	E – Explorer
S – Single click	R – Recycle bin	M – Multitask
R - Regular test	N – Network	G – Graphical user interface
I – Internet access	S – Start button	
L – Look and feel	T – Task bar	

(b) Overview of other operating systems

Along with Microsoft Windows®, there are several other operating systems which are available for personal computers. A few of them are mentioned below:

i. Mac OS X®

Mac OS X® is the operating system developed and marketed by **Apple Inc**. It is available with Apple products such as the MacBook Air®, MacBook Pro® and iMac®. Apple produces a specialised version of Mac OS X® for the iPod® and iPhone®. Users of Mac OS X can now use data files created for other operating systems e.g. Microsoft Windows®.

ii. UNIX®

UNIX® is a multi-user and multitasking operating system. It can be used for a personal computer as well as a mainframe computer. Due to this reason, UNIX® has become a leading operating system for Client-server architecture. UNIX® is a non-proprietary operating system. This means that the development of UNIX® cannot be attributed to one single manufacturer. Microsoft Windows® is a proprietary operating system owned by the Microsoft Corporation. The trademark "UNIX" is owned by The Open Group.

iii. Linux

Linux is a freely distributable (no charges are levied on installation of Linux) open-source (the user can modify the operating system according to his requirements) operating system. It runs on several hardware platforms, for example, personal computers and Macintosh. Due to these features, Linux has emerged as an alternative to the proprietary operating systems.

2.2 Utility software

Utility software is a type of system software which helps in the managing, optimising and maintaining the operating system, computer hardware and application software.

It is usually concerned with adding capabilities to the working of an operating system and ensures that a computer system works efficiently as a unit.

There are many different utility software categories. Some of the most popular types of utility system software are discussed below:

(a) Anti-virus and firewall

Firewalls form a first layer of defense to prevent viruses and Trojans from attacking the computer system. Anti-virus utility on the other hand scans the computer for finding different viruses and Trojans which have infected the computer system. Both firewall and anti-virus are designed to prevent data being misused by unauthorized persons.

Example

Examples of popular anti-viruses include Quick Heal, Net Protector, Norton Anti-virus etc.

(b) Disk Compression

This utility is used to compress all types of files on the disk, allowing it to store more and more data on it. It works in the background, without the user directing it for compression of particular files.

Example

Disk compression utility is Microsoft Windows utility and is known as **defrag.**

(c) Network Utilities

Network utility provides diagnostic checks in case of problems with a connection within a network. It analyses and configures the computer's network and provides different information related to the network.

(d) System Monitors

System monitors are utilities to monitor resources of the computer like free space on memory usage of RAM and ROM, CPU usage, free space on different drives and also network-related information of a computer system.

(e) Memory Testers

Memory tester utility detects failures occurring in memory modules.

(f) Disk defragmenter

Disk defragmenter utility rearranges files and unused spaces to optimize the operations. This in turn speeds up the access to files stored on various location of a hard disk. Furthermore, disk defragmenter also identifies and eliminates unnecessary fragments.

2.3 Device Drivers

Device driver, as the name suggests, is system software that helps the new device to be connected, and drive in through the system.

There are device drivers for printers, displays, CD-ROM readers, diskette drives, and so on.

Device Driver is system software that manages I/O operations for any device connected externally to a system.

Example

When we connect a USB modem for the first time, it installs in the Program Files. If we happen to open that modem's folder in Program Files we can see a folder named "Driver". Here, all drivers which are necessary to run that modem in the system are stored.

Function of the device driver files

a) It works like a dictionary for each hardware device connected to the computer that makes the computer's hardware understand how to communicate with each of the hardware parts and also with each of the software modules.
b) They ease the access of external devices to the operating system. Drivers are installed for all the devices externally attached.
c) The manufacturer of a particular device gives the device driver as well, if the OS does not support that particular device.
d) The file of the device driver contains all the code that is necessary for the communication of that device with the rest of the system by providing a set of interfaces.
e) By using this system software, it becomes easy to maintain a computer system and also makes it portable.

2.4 Translator

We are already aware that a computer system interprets the instructions in the form of "1" and "0". A program can be written in various programming languages like C, C++, assembly language, java, COBOL etc. However, this programming language needs to be converted into machine language. A translator converts normal statements that humans can understand into language understandable by machine.

There are **three types** of translators:

1. **Compilers**: these are programs whose purpose is to translate the high level language program into a machine readable language program (i.e. bits and bytes). Each computing system requires a separate compiler for each high level language that it supports.
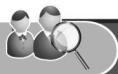
Example

A COBOL (programming language) compiler is only capable of translating programs which have been written in COBOL.

2. **Interpreters**: an interpreter is a computer program whose purpose is to translate the high level language statements into machine readable language. The difference between a compiler and an interpreter is that a compiler translates the complete program before execution and an interpreter translates on a line by line basis. Therefore, compilers are faster than interpreters.

3. **Assemblers**: an assembler is similar to a compiler. However, an assembler understands only "Assembly Language", which it then converts to machine readable language.

Test Yourself 2

Which one of the following is not system software?

A   Microsoft Access
B   Mac OS
C   Disk Compression
D   Compilers

Test Yourself 3

A device driver is a system utility that:

A   Converts normal statements, that human can understand, into statements understandable to machines
B   Manages I/O operations for any device connected externally to a system
C   Helps in the managing, optimising and maintaining the operating system, computer hardware and application software
D   Handles computer hardware and also provides interface for enabling the use of application software

---

3. **Explain various types of operating systems in terms of capabilities.**
                                                              [Learning Outcome c]

Different types of organisations have different forms of management and therefore different information requirements. Therefore, the method of recording and processing data also is also different. Based on the needs of the organisations, operating systems used to process data can be classified into:

   a)   Batch operating system
   b)   Multi-user, multi-tasking operating system
   c)   Online real time operating system
   d)   Network operating system (NOS)
   e)   Distributed operating system (DOS)

1. **Batch Operating System**

Under a batch operating system, the users do not interact with the computer system directly. This type of operating system needs grouping of identical jobs/programmes often referred to as batches. After they are grouped, these identical programmes are submitted for further processing to the computer system and are executed at the same time.

The important function of a batch operating system is to execute the lined up jobs/programmes in a batch on its own, without user intervention. The result of the batch may be a set of printed hard copy reports or the results may also be displayed on the screen,

Batch operating systems are used to perform repetitive tasks such as payroll processing, invoice printing, sending reminders to customers for payments, generating ageing schedule, weather forecasting, etc.

Example

Jupiter Ltd is manufacturing company and has employed around 500 workers in its factories. The workers are paid salary on the 3rd of each month and are also issued a payslip with detailed break-up of the salary paid.

In order to print the salary slips, Jupiter uses a batch process. Once a command is given to the batch operating system, the OS performs the task of grouping the similar tasks and then retrieves data stored on hard disks to print the salary slips.

Benefits of batch processing

(i) Data processing can be scheduled at specific times. Hence, data can be processed when the computing resources are idle.
(ii) It is less expensive to implement than a real time processing system.
(iii) The batch number provides a quick reference to locate errors in the transaction records.

Disadvantages of batch processing

(i) The accounting system is not always up-to-date. Due to this, the accounting system is unable to provide real time or current information at any given moment of time.
(ii) Delay in data processing makes it unsuitable for accounting sub-systems involving customer contact e.g. maintenance of debtors account.

2. Multi-user, multi-tasking operating system

Multi-tasking operating systems handle more than one task at a time. This is done by stopping one task temporarily and switching to the other, then vice versa. This is efficiently done by a personal computing system. However, there are times when the task is complicated and requires a powerful operating system to handle the job. Moreover, buying a supercomputer or a mainframe computer may be a costly investment. Instead, the mainframe or a supercomputer may be shared by various users. These systems are therefore referred to as multi-user operating systems where more than one user can share the resources.

Example includes airline reservation system or railway reservation system where multiple users access the OS and make their bookings. Furthermore, the users can run multiple tasks on these systems.

3. Online Real Time Operating System

OLRT (online real time) operating system responds to inputs immediately. It uses client server architecture to process data.

Under an OLRT operating system, the computer receiving input (client) is connected with a central computer (server). As soon as the client receives the input, it forwards the input to the server. The server immediately collects and processes the data. This allows the computer system to produce updated and current information at any given moment of time.

In real time operating system, the response time is already fixed by the processor/C.P.U. The primary objective focus of such an operating system is the response time, as against resources utilisation, which is true for multiprogramming operating systems. The response time should be short in an online system. Here, the system needs to respond in a predetermined time, usually fixed in seconds, by the processor.

Response time means time between displaying the output on screen after the inputs are processed by the processor. Applications used with such OS can be flight control, real time simulation etc.

Online operating systems are used when the delay caused using batch operating system is unacceptable.

Example

Jane wants to withdraw money from an ATM (Automatic Teller Machine). As soon as a request for transaction is made at the ATM (client), the request is forwarded on a real time basis to the central computer (server). The server immediately processes the transaction, updates the records and approves the ATM to dispense cash to Jane.

4. Network Operating System (NOS)

Network operating system is an operating system with built-in features related to networking, with many computers connected together in a private network called LAN (Local Area Network) through a central hub or a router. Network operating system runs on a server. Under the NOS, the server has the capability to manage data, users, groups, security, applications, and other networking functions. The purpose of NOS is to allow sharing of data and hardware devices such as printers, scanners, etc. among multiple users.

The advantage of NOS is that these systems are highly stable and security is built into these systems. However, these systems require frequent updates and maintenance.

Examples of network operating systems include Windows NT, Microsoft Windows Server 2008, Novell Netware, etc.

Example

Snow Ltd is a company engaged in the manufacture of printed laminated sheets. It has several sales branches across the country. The production is planned based on the specific sales orders received from the sales branches.

Snow Ltd has installed a network operating system, including the sales offices. Through the NOS, the server (head office) can manage the production and also co-ordinate with the sales branches for timely delivery.

5.   Distributed Operating System (DOS)

A distributed operating system is an operating system in which several computing systems work together as a unit. The purpose of a distributed operating system is to enhance the users' experience by providing collective power of several computing systems on a single machine.

In a distributed operating system, the computing systems are connected through a network. Use of such a system makes the users feel that they are operating an ordinary operating system; however, distributed operating system executes the tasks on multiple, distributed and independent CPUs.

Computer systems in a distributed operating system are connected to each other through LAN if they are close to each other. They can also be connected through WAN (Wide Area Network) if the computers are located in geographically distant areas.

Main difference between network and distributed operating systems is that under a network operating system, only similar computing systems can be connected together, while in a distributed operating system, operating systems with different computing systems can be connected. This is a very complicated and sophisticated operating system. But it is gaining popularity in the market due to its dynamic capabilities of connecting to entirely different operating systems.

Examples of distributed operating systems are LOCUS and MICROS.

Test Yourself 4

Which operating system requires applications to respond within a certain period of time – usually in seconds?

A   Batch processing
B   Time sharing
C   Real time processing
D   Multiprocessing

Test Yourself 5

Which operating systems require grouping of identical jobs/programmes for processing?

A   Batch operating systems
B   Time sharing systems
C   Real time operating systems
D   Network operating systems

4. Explain various emerging issues in operating systems such as graphical user interface (GUI).

[Learning Outcome d]

Before discussing the emerging trends in OS, let us discuss the graphical user interface. Graphical user interface (GUI) is the program which allows the user to interact with a computer with the help of images and text instead of commands.

It was Steve Jobs who introduced GUI in personal computers in the late 1970s, for simplified access of data.

With the use of GUI, the use of computer becomes interesting. It simplifies the use of a computer for non-programmers. When you use a computer, you open different programmes and different applications, helping users to do multitasking.

Components of GUI of an operating system:

(a) Icons
(b) Windows
(c) Menus

(a) Icon

An icon is a small graphic or an image, which on a clicking, opens up a program.

Example

In a Windows operating system, the screen displays various icons such as "My Computer" "Recycle Bin", "My documents", etc. By clicking the various icons on the screen, the user can give instructions to the computer system to execute commands.

(b) Windows

In this context, a window is not the windows operating system. This window refers to the rectangular box which pops up on the display screen.

Some GUIs allow the use of multiple windows to pop up when the user has to do multiple tasks simultaneously. This aids in doing multi-tasking operations.

Example

Colin has to calculate certain ratios and also perform accounting work in an Excel spread sheet. Simultaneously, he is also compiling a report based on the accounting data and ratios calculated. Therefore, he opens up these three applications and uses them simultaneously. These open up in separate windows, thus helping Colin to do multiple tasks at the same time.

(c) Menus

Menus are commands listed in the form of lists. On clicking that particular menu item, the command is either activated or deactivated if it was running previously.

Example

The start menu at the bottom left corner of the Windows operating system screen has menu items like Shut Down, Log Off, and All Programmes etc., which, on clicking, executes that particular program or operation.

Behind every GUI lies a **Command Line Interface (CLI)** which internally gives the commands in text format. Some of the widely known CLIs are MS DOS, and other operating systems based on Linux and UNIX, wherein the execution of programs have to be done by writing commands on CLIs.

Without the proper knowledge of the programming language, it is not possible to execute any of the instructions. For non-programmers, it is difficult to remember the commands each time they need to perform certain tasks. This brings in limitations to the non-programmers to use such kind of operating systems. With the use of GUI, for non-programmers, operating a computer has become far easier. Therefore, the DOS operating system used in the first computing systems were replaced with graphical user interface (GUI).

Use of GUI has transformed the world of computers from black and white screens to beautifully coloured ones. In fact, the computing systems with GUI are also equipped with touch functions and voice command functions to enhance user experience.

Test Yourself 6

_____ is the program which allows the user to interact with the computer with the help of images and text.

A   GUI
B   CLI
C   Icon
D   Device Driver

Test Yourself 7

GUI   stands   for
.

A   Graphical user interface
B   Geographical user interface
C   Geometrical user interface
D   Geological user interface

Answers to Test Yourself

Answer to TY 1

The correct option is **D**.

(i)   It is a collection of logically arranged instructions to perform a desired task
(ii)   It is used to operate and control the computer.
(iii) Software is divided into two parts i.e. operating system and application software.

Answer to TY 2

The correct option is **A**.

Microsoft Access is application software. All the other options are examples of system software.

Answer to TY 3

The correct option is **A**.

A device driver is system software that manages I/O operations for any device connected externally to a system.

There are device drivers for printers, displays, CD-ROM readers, diskette drives, and so on.

Answer to TY 4

The correct option is **C**.

Answer to TY 5

The correct option is **A**.

Batch operating systems need grouping of identical jobs/programmes often referred to as batches. After they are grouped, these identical programmes are submitted for further processing to the computer system and are executed at the same time.

Answer to TY 6

The correct option is **A**.

Graphical user interface (GUI) is the program which allows the user to interact with the computer with the help of images and text.

Answer to TY 7

The correct option is **A.**

Graphical user interface (GUI) is the program which allows the user to interact with the computer with the help of images and text instead of commands.

Self Examination Questions

Question 1

Define system software and list its types along with their functions.

Question 2

Describe ONE system utility that you have used and comment on its usefulness.

Question 3

Software that controls application software and manages the interaction of various hardware devices is known as:

A Application software
B Utility software
C Operating system software
D Spread sheet software

Question 4

The first system software that is loaded when we start a computer is:

A Utility software
B Operating System
C Microsoft Word
D Device Drivers

Answers to Self Examination Questions

Answer to SEQ 1

System Software

System Software is defined as a computer program that operates and controls the underlying hardware of a system and provides a platform for the application software.

Different types of system software are:

(i) Operating System

Efficient utilization of computing resources like memory, processor, input output devices etc.
Provides an interface between the end user and the computer hardware. That is, it makes use of computer convenient, by hiding the details of hardware.

(ii) Utility Software

It is used to manage, optimise and maintain the operating system.

(iii) Device Drivers

It works like a dictionary for each hardware device connected to a computer that makes the computer's hardware understand how to communicate with each of the pieces of hardware and also with each of the programs of software.

(iv) Translator Software

Its function is to convert the program written in any kind of programming language into a language understandable by machines.

Answer to SEQ 2

Utility software is a type of system software which helps in the managing, optimising and maintaining the operating system, computer hardware and application software.

The most commonly used utility software is antivirus.

Antivirus scans the computer in order to find different viruses and Trojans, which might be a threat for the data stored in your computer.

Due to the use of this antivirus, the data stored in the system is secured and also prevents different viruses from attacking the data stored on a computer system. Also, it prevents unauthorised access to personal data from Trojans.

Answer to SEQ 3

The correct option is **C.**

Software that controls application software and manages the interaction of various hardware devices is known as operating system software.

Answer to SEQ 4

The correct option is **B.**

The first system software that is loaded when we start a computer is an operating system.

COMPUTER SOFTWARE

C3

STUDY GUIDE C3: APPLICATION SOFTWARE

■ Get Through Intro

The study of application software will show how different types of software help us in performing our daily tasks and also provide us with the much-required entertainment. Using application software, we can write articles, make calculations, listen to music, view photographs and watch videos. Different types of application software are available in the market to suit individual requirements and they can either be bought on payment or some may even be free of cost.

We all are familiar with the word "App", but what it exactly does, will be discussed in this Study Guide.

This Study Guide will acquaint you with detailed knowledge of application software and how it is different from System software.

■ Learning Outcomes

a) Define the term application software.
b) Explain various types of application software (general purpose and specific purpose).
c) Explain various types of emerging issues in application software like integrated systems.

1.   Define the term application software.

[Learning Outcome a]

Definition

Application software is software, which helps the user perform their tasks using a computer.

Each application is developed to solve the specific or multiple tasks. Tasks can be any activity such as:

a) creating a presentation;
b) creating a database of all the students in school;
c) writing a news article;
d) playing games;
e) listening to music;
f) viewing of photos;
g) reading documents;
h) accounting;
i) maintaining records of sales & purchase;
j) billing.

Example

A teacher at school needs to explain to her students the advantages of **'Internet.'** She collects all the required information and decides to make a presentation. Now the problem is how will she manage make it?

Solution to her problem lies in Microsoft PowerPoint, application software that has all the inbuilt tools to design the presentation using graphics that will enable the students to understand the topic quickly.

Application software is also referred to by different names, such as software application, application program, application or simply App. These different terminologies, however, do not change the sole purpose of application software which is to help the user solve a problem. Application can be pre-installed on the operating system e.g. media player on MS Windows operating system or install them later like, MS Office for example. Applications are freely available in the market for one to purchase and many of them are free also.

Application software is divided in two different categories:

a)   General purpose software, and
b)   Specific purpose software

The details of general purpose and specific purpose software are covered in Learning Outcome b

Tip

An application program always requires a system software (OS) (discussed in Study Guide C2), to perform the desired task. Without an operating system it is not possible to run any application.

Operating system is the software which provides the environment for running the application. Environment includes all the requirements of any application such as hardware access, physical memory, files and storage. In short, you always run an application which is installed on operating system.

Test Yourself 1

Define application software and name the different types of application software.

2. Explain various types of application software (general purpose and specific purpose).
[Learning Outcome b]

Introduction

Application software refers to software which helps the user in performing their tasks by using a computer.

Two broad categories of application software are:

a) General purpose software
b) Specific purpose software

2.1 General purpose software

General purpose software is designed considering the requirement of many users. This type of software provides special ability to perform a task. Using this type of software a user can perform multiple tasks.

> Detailed working of spread sheet will be explained in study guide F2

Spreadsheet, which is an example of general purpose application software, can be used for multiple purposes like:

a) simple accounting/tax evaluation;
b) time-tables;
c) creating results (mark sheets) of students in schools & colleges;
d) profit forecasting;
e) creating charts;
f) creating graphs;

Example

A teacher has the marks of Marry, John, Suzan and James in the subjects of Science, Mathematics, History, Geography and English. She wants to calculate the percentage of each of the five subjects and display them in such a manner that it should be readable and understandable for others when they refer to it. So she uses the application Microsoft Excel.

The details are:

	A	B	C	D	E	F	G	H	I
1	Name	Science	Mathematics	History	Geography	English	Total	Out-off	Percentage
2	Marry	54	65	38	88	90	335	500	67
3	John	78	52	64	44	55	293	500	58.6
4	Suzan	41	78	82	94	65	360	500	72
5	James	55	65	75	40	59	294	500	58.8
6									
7									
8									
9									
10									

Sheet1

Formulas used:

For total: "=sum(B2:F2)"
For Percentage: "=(G2/H2*100)"

Depending upon the type of task they perform, General purpose software can be classified into different categories:

(a) **Word processing:** It helps the user to create and read a document. This type of application software enables us to create reports, write news article, read documents etc. Different types of word processing software are MS Word, Pages, and WordPad etc. More details of the spreadsheet will be covered in Study Guide- F1.

(b) **Spreadsheet:** It helps user to arrange multiple data and perform calculations on it. It is also useful for creating graphs, charts etc. The data is stored in a tabular form which becomes easy to read and understand. More details of the spreadsheet will be covered in Study Guide F2.

(c) **Database:** Database is the collection of data, which is organised by various apps, so that its contents can be easily accessed. The data is generally organised in the form of tables, while database software is used to manage data. Huge amount of data can be stored & retrieved from tables using this type of application software. Storing data in a database system and managing it is much easier than the file system. Different types of database application software are: MS Access, Oracle etc. More details of the spreadsheet will be covered in Study Guide F3.

(d) **Presentation:** It helps the user in creating a visual presentation, in the form of slides, which helps us to convey our ideas. Presentation software has rich tools which are useful for creating slides, with the help of charts, graphs, animation, videos and sound. The use of these tools gives an edge to our presentation and the message can be made attractive and easy to understand.

(e) **Multimedia software:** Multimedia means different types of media. Here media means audio files, video files or pictures. Multimedia software helps users to play audio files (.wav, .mp3) & video files (.avi, .dat, mp4). Also, there is a photo viewer like Windows Photo Viewer which helps view the digital photographs.

Example

The table below tabulates the list of different application software available for Windows & Mac OS (operating systems have been discussed in SG C2).

	Windows OS	**Mac OS**
Word processing	MS Word	Pages
Spreadsheet	MS Excel	Number
Presentation	MS Power Point	Keynote
Multimedia	Media Player	iTunes

2.2 Specific purpose software

Specific purpose software is designed, considering the, business and scientific requirements. This software is designed to handle specific tasks, which solve business and scientific problems. In performance, it is specialised to perform only a particular task and its capacity, limited to only what it is meant for. Specific purpose software performs much better than General purpose software.

Example

A car designer wants to design a car, so he decides to use paint software to do so. He started with his design, but soon realized that the paint software does not provide all the tools required for designing different dimensions, missing views and interiors of the car. In other words, he cannot use general purpose application software for this job; he needs to use specific purpose application software.

Then, he switched to CAD (Computer-Aided Design), which is specific purpose application software and he was happy with all the designing tools available on it. Using these specific purpose software his business problem was solved.

Specific purpose software is not used by a wide range of users. To use specific purpose software you need to have the knowledge of the domain on which you are working. The various specific purpose application software's available are:

(a) CAD: It stands for Computer-aided design. Using this software, car designer can easily design cars; a mechanical engineer can easily design the machine parts. CAD provides rich tools for designing purposes and by using CAD many business problems are solved.

(b) Supply chain management software: It is used in supply chain transactions such as sales and purchases, managing supplier relationships and controlling associated business processes. The functions performed by this software are:

(i)   customer requirement processing;
(ii) purchase order processing;
(iii) inventory management;
(iv) goods receipt and warehouse management.

(c) Sales ledger software: This software is used in businesses for customer dealings. When a customer orders the goods that he wants to purchase, an invoice is generated using this software. An invoice is the list of goods ordered by customer, along with their quantity and price.

(d) Accounting software: It is used to record and process accounting transactions such as accounts payable, accounts receivable, payroll and trial balance.

Test Yourself 2

Application software can run without system software. State whether this statement is true or false.

Test Yourself 3

MS power point = creating presentation;   MS word = -----------------------.

A   Creating music file
B   Creating images
C   Creating documents
D   Creating folders

Test Yourself 4

State any one difference between specific purpose software and general-purpose software.

3.   Explain various types of emerging issues in application software, like integrated systems
[Learning Outcome c]

3.1 Emerging issues in application software

Any person using computers for either personal or office use always uses application software. At personal level, general purpose application software such as MS Word, Power point, Media players etc. are mostly used, whereas, at office level both general as well as specific purpose software is used. General purpose software assists in creating documents and presentations, while specific purpose software is used for specific business processes. In this Learning Outcome, we shall examine the various issues faced by application software.

1.   **Change in system hardware:** This is the most common type of issue faced by any application software. When the hardware of any system is upgraded, there are chances that the application might not work due to a complete different configuration.

2.   **Change in system software:** Many a times, the user changes its system software / operating system (OS); in this case the application which is installed on a particular OS also gets deleted. With any change in OS we need to re-install the particular application software.

3. **Upgraded Version:** With new versions of software being available after every three months, it may happen that the updated software does not support the files created by the older version of the software.

4. **System software failure:** Application software runs on system software and without system software it is not possible to run application software. Thus, if system software fails we cannot run our application.

These are the issues faced while using application software. We shall now examine the emerging trends in application software known as Integrated System.

3.2 Integrated System

In computer science, the term integrated system is referred to the process of linking together different computing systems or application software, physically or functionally. When two or more applications are combined together to perform a task it is referred to as **software integration**.

Many businesses allow their systems to add new functions by installing new application software and hardware as the requirement arises. This often leads to confused and mixed data over different locations in the system. Due to the additional functionalities, similar data is reflected over several locations and it becomes tough to handle it. This can cause confusion and frustration for the person using the system. The solution to this problem lies in integrating your system.

Example

Many employees in the company require a printer to print documents or for scanning purpose. So the company decides to purchase a printer for each PC. It is a possible solution but very expensive.

After some technical advice, the company purchases a single printer, connects it to a network and integrates it to all the PC's. This allows all the employees to access the printer and complete their task.

Thus, by integrating the system, the problem is solved and the cost factor is also reduced.

The benefits of integrating a system are:

a) improves efficiency and reduces errors;
b) better access to information;
c) reduces the cost of an organisation by sharingresources.

Answers to Test Yourself

Answer to TY 1

Application software is software which helps the user in performing his daily tasks.

Types of application software are:

(i) General purpose
(ii) Specific purpose

Answer to TY 2

The statement is false. Application software needs system software for interacting with hardware.

Answer to TY 3

The correct option is **C.**

MS word is used to create documents.

Answer to TY 4

General Purpose Software	Specific purpose Software
General purpose software is developed considering the requirements of a large group of people. (Students, teachers, employees)	Specific purpose software is developed considering the problem of a particular field (Domain).
This software is easy to use and does not require any specific knowledge.	To use the specific purpose software domain knowledge is a must. For example, a school going student cannot use the supply chain management software.
This type of software is less expensive.	Is expensive compared to general purpose software.

Answer to TY 5

(a) Issues faced by application software are:

(i) Change in system hardware: This is the most common type of issue faced by application software. When the hardware of a system is upgraded there are chances that the application might not work due to a completely different configuration.

(ii) Change in system software: Many a times, the user changes its system software (operating system). In this case, the application which is installed on a particular OS is also deleted. With the change in OS, we need to re-install the particular application software.

(iii) Upgraded version: With new versions of software being available every three months, it is possible, that the updated software does not support the files created by the older version of the software.

(iv) System software failure: as we know that application software runs on the system software and without system software it is not possible to run any application software. Thus, if the system software fails, the application also cannot be run.

(b) Benefits of using an integrated system are:

(i)   Improves efficiency and reduces errors. (ii)

Better access to information.

(iii) Reduces the cost of an organisation by sharing resources.

Self Examination Questions

Question 1

What are the two main types of software?

A   Input and output
B   Application and system
C   CPU and RAM
D   Application and input

Question 2

Which software controls application software and manages the interaction of various hardware devices?

A   Application software
B   Utility software
C   Operating system software
D   Spreadsheet software

Question 3

Which of the following pairs represents general purpose software tools?

A   Spreadsheet and database software
B   Word processor and accounting software
C   Students record system and database software
D   Insurance processing and spreadsheet software

Question 4

Which of these would NOT be classified as "application software"?

A Microsoft Excel
B Microsoft Access
C Macintosh OSX
D Adobe Photoshop

Question 5

Which one of the following is the odd man out?

A Windows
B iTunes
C CAD
D MS Word

Question 6

State whether the given statement is true or false.

(a) Software's such as Microsoft Word, Excel, PowerPoint, or Access are all considered examples of utility software.
(b) It is possible to run an application without system software

Question 7

How does application software interact with system software?

Question 8

State the differences between application software and system software?

Question 9

List any two examples of system software and application software?

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **A.**
Answer to SEQ 2
The correct option is **C.**

It is the basic functionality of an operating system.

Answer to SEQ 3

The correct option is **A.**

Rest all are combinations of General purpose and specific purpose software

Answer to SEQ 4

The correct option is **C.**

Macintosh is an operating system.

Answer to SEQ 5

The correct option is **A.**

Windows is a system software and rest all are application software.

Answer to SEQ 6

(a) False. They are all examples of application software.

(b) False. application software requires an environment for running which is provided by system software.

Answer to SEQ 7

Application software requires a system software (operating system) to perform. The interaction of application software with operating system to perform various tasks is discussed below:

Each and every application requires access to the hardware of the computer to perform the given task. It is in the form of access to the physical memory of the computer, printing documents through the printer etc. Apart from this, an application also requires fetching and store files from the hard disk drive. These tasks cannot be performed directly on the computer components like HDD, Printer or Ram etc. These series of tasks are to be carried out through the system software i.e. the operating system (OS).

The given Figure clearly depicts that application software has to interact with system software (operating system) to access computer hardware.
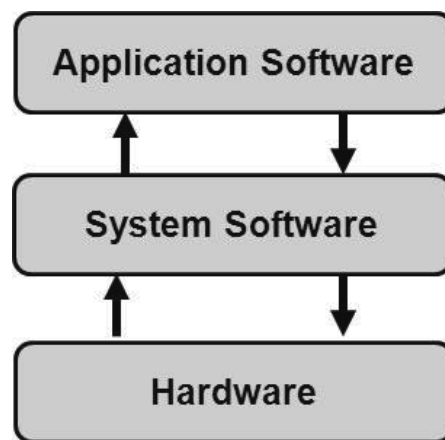
Whenever we turn on the computer, the operating system is loaded from the computer hard disk onto its memory. Once the operating system is loaded, it is ready to provide an interface to the application software for accessing hardware. It is then that the desired application can be run and used.

Upon starting an application the operating system carries out the following functions:

(a) allocates physical memory to run the particular application;
(b) allows access to the files on hard disk upon a particular request;
(c) handles the calls of the system e.g. request from an application to use printer for printing documents.

Thus we can say that, system software keeps control over files and / or devices that the application software has access to and can also control how much memory and even how much CPU time the application software is using.

Answer to SEQ 8

System Software	Application Software
System software (OS) is the backbone of our computer which provides a platform to run application software.	Application software is used to solve the tasks of a business or for scientific purpose.
System software (OS) has full access to physical memory of the computer.	When we run an application, it is the system software (OS) which provides memory.
System software (OS) controls all the peripherals of the computer i.e. monitor, keyboard, mouse, printer etc.	Application software needs to request OS to have access over the computer peripherals.
If system software (OS) crashes we cannot run application software	Crashing of an application does not affect system software (OS).

Answer to SEQ 9

(a) Examples of system software are

(i) Microsoft Windows
(ii) Ubuntu OS
(iii) C-Compiler
(iv) Norton Anti-virus

(b) Examples of application software are

(i) MS Word
(ii) Media player
(iii) CAD-Computer Aided Design
(iv) Movie maker

DATA COMMUNICATION SYSTEMS

D1

STUDY GUIDE D1: INTRODUCTION TO DATA COMMUNICATION SYSTEMS

▮ Get Through Intro

When we make a call to our family and friends over telephone, we are actually using the data communication system. Using data communication systems, we are able to communicate with people over long distances. Another example of data communication system is Radio broadcasting. These systems are widely used in our daily lives, but we seldom notice them. Section D will cover all the concepts of data communication system.

The study of data communication system will make us understand, how data is being transferred from one device to another with the help of transmission media. Transmission media can be wired or wireless and the details will be covered in Study Guide D3. Data when transferred through transmission media is in the form of analog or digital signals which will be covered in the Learning Outcome a. Data communication system has five major components which will be discussed in the Learning Outcome.

This study guide will acquaint you with data communication systems. Moreover, it will also help identify the advantages and disadvantages of data communication system compared to age old methods of transferring messages. The difference between data communication systems and computer networks will also be covered in this Study Guide.

▮ Learning Outcomes

a) Define the concept of data communication systems.
b) Identify the differences between data communication and computer networks.
c) State advantages and disadvantages of data communication systems.
d) Identify the components of data communication systems.

> **1. Define the concept of data communication systems.**
> **Identify the components of data communication system.**
> **[Learning Outcomes a and d]**

1.1 Introduction

When we communicate we share Information or data. Information can be local or remote. Local sharing of information mostly occurs face-to-face, whereas remote communication takes place over distances. For communicating over distances we need systems which will enable us to communicate quickly. With the ever increasing demands of the organisations, it has become very important to transfer the data quickly and accurately over distances. In this age of internet nobody relies on or uses the age old methods of transmitting information through mails. Today, businesses completely depend on computers and internet for transferring data.

We need systems using which we are able to send messages over long distances within a few minutes and also without generating any errors. Development in the field of telecommunications and networking has enabled us to develop such a system which is called - Data Communication System. With the help of data communication system we can send messages over long distances within few minutes or even seconds without generating any errors. Let us define data communication and understand what is meant by data communication system.

1.2 Data communication and data communication system

Definition

Data communication is the exchange of data between two devices via some form of transmission medium such as a wire; whereas **data communication system refers to the** collection of hardware and software through which data is transmitted.

Example

We use data communication system in our day-to-day life. Most common things around us are examples of data communication system. For example:

(i)   **Telephone:** communicating with a friend
(ii) **Cell phone:** sending text messages
(iii) **Computer: s**ending e-mails
(iv) **Cell phone:** sharing pictures via Bluetooth
(v)   **Radio:** listening to songs etc.

1.3 Effectiveness of data communication system

The effectiveness of data communication system can be determined by the following factors:

1. **Delivery**: The system should deliver the data to the correct destination. For example, while dialling a telephone number, the person to whose number the call has been placed must be able to receive the call.

2. **Accuracy:** The system must deliver the data accurately without any changes in it. For example, we want to convey the message, 'meet me at 6'o clock'. It is important that the message should be delivered without a change in its contents. Any changes in the message will cause confusion. Consider another example of share markets where share/stock prices are sent through data communication systems to various clients all over the world. A single change in stock prices can prove hazardous.

3. **Timeliness:** The system must deliver the data within the specified time. Let us again consider the example of share market. The stock prices keep on changing every second and if the data i.e. the stock prices are not delivered at a specified time, then the value of information received will be useless.

4. **Jitter:** Jitter means variation or the time between the arrival of two data packets. When data is transferred over the network, it is divided into smaller packets which are called data packets. It is not possible to send large volumes of data at once and hence they are divided into packets known as data packets. Thus it becomes necessary that these packets are delivered serially without any delay between them.

1.4 Components of a data communication system

As stated, data communication system consists of both, hardware and software. These can be further categorised into five components, called the basic elements of a data communication system or the basic components of a data communication system.

They are:

1. **Message:** Message is the data or information that needs to be communicated. There are different types of data that can be transmitted like text files, audio files, pictures, videos etc.

2. **Sender:** The sender is the device which sends the message. Sender can be in the form of a computer, mobile, workstation etc.

3. **Receiver:** The receiver is the device which receives the message. There can be multiple receivers depending on the sender, who decides on the recipients of the sent message. Likewise, a receiver can also be a computer, mobile, workstation etc.

4. **Transmission media:** Transmission media is also referred to as the data communication channel. When the sender sends the message it needs to be transferred through a transmission media. Transmission media can be wired as well as wireless. Details of transmission media will be covered in Study Guide D3.

5. **Protocol:** Protocol is a set of rules which governs data communication. Protocol represents the agreement between the sending and receiving device. It is necessary that the message sent from one device should be understood by the other. To ensure this, the messages are sent in some standard formats are called a 'protocol.'

Figure 1: Block Figure of data communication system
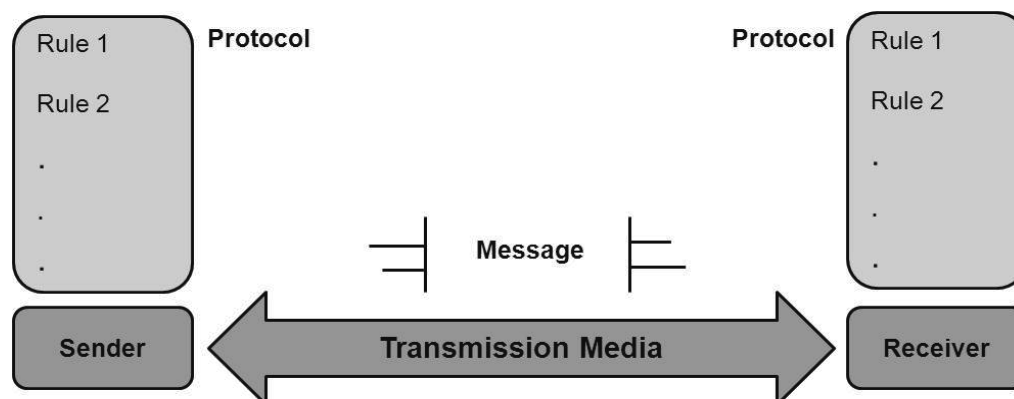
Example

Suppose a manager has to write several emails to many clients. He will first use his PC and the word processing package to prepare the email and if the PC is connected to all the clients through networking, he can send the letters to all the clients within minutes. Thus, irrespective of geographical barriers, if the PCs are connected through communication channels data, information, computer files and any other programs can be transmitted to other computer systems within seconds.

Here, the components of data communication are:

(i) **Sender -** manager's PC
(ii) **Receiver -** client's PC
(iii) **Message -** contents written in email
(iv) **Transmission mode -** computer network (can be wired or wireless)
(v) **Protocol :** SMTP (simple mail transmission protocol) which will be covered in Study Guide D5

Thus, we can state that data communication system has brought the world closer in which communicating with another person over a distance is not a limitation anymore. With the development in technology and improvement in the network devices we are able to send data in any format. Earlier, data transmission used to be only in the form of plain text but now we are able to transfer pictures, audio files and even videos.

1.5 Types of signals of data communication system

For data communication to happen the communicating devices such as computers should be connected to a network. Network can be wired or wireless. When we send data through a network, the data communication system transfers data in the form of signals.

These signals are of two types:

    a) Analog
    b) Digital

Depending on the type of the system the signal can be analog or digital. For example, when we enter the text through keyboard we are sending data to CPU and the data transmitted in this case is in the form of a digital signal whereas, when we talk to our friends over telephone the data is in the form of analog signals.

1. Analog Signal

Analog signals are the signals which we encounter in our day-to-day life. Speech is an example of an analog signal. Radiation from sun is also an example of analog signals. These signals are continuous in nature.

They are measured in amplitude and frequency.

(i) Amplitude: This is the strength of the signal. It can be expressed in a number of different ways such as volts, decibels etc. Higher the amplitude better is the signal strength.

(ii) Frequency: It is the rate of change the signal undergoes every second. It is expressed in Hertz (Hz) or in cycles per second. A 30Hz signal changes thirty times in a second.

Figure 2: Analog Signal
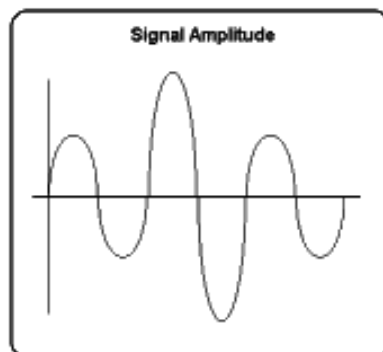
2. Digital Signal

Digital signal are discrete in nature. These signals are the language of computers. It compromises of only two states i.e. on and off which are represented by 1s and 0s respectively. In other words, it is also represented by high (1) and low (0).

Example

Signal which are entering into the keyboard, television broadcasting (DTH) etc. are few examples of digital signals. These devices will process the input data based on the digital signal received by them.

Figure 3: Digital Signal
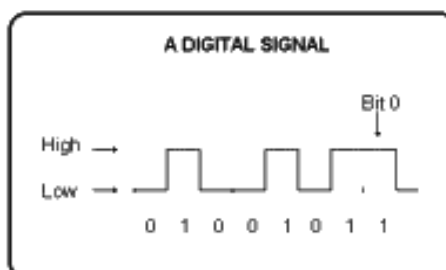
Test Yourself 1

Define the term data communication.

Test Yourself 2

What do you mean by data communication system and what are the factors by which we can determine the performance of data communication system.

Test Yourself 3

Consider an example of data communication system and identify the following components: sender, receiver, transmission media and message.

On New Year's eve, the president of Tanzania wished "Happy New Year in advance" to citizens of Tanzania through Radio.

2. Identify the differences between data communication and computer networks.
[Learning Outcome b]

In Learning Outcome 1, we discussed what exactly data communication is and we also know that the message is sent from one device to another for purposes of communication or for sharing information. But when we send the message from one device to another through transmission channels (media) we are actually using the network for delivering the message. In this Learning Outcome, we will study the concept of computer network and how it is different from data communication.

2.1 Meaning of computer networks

Computers when connected with each other form a computer network. A computer network is a channel for exchanging (transmitting and receiving) information between two sources. Computer networks allow the users to access files stored on other computers. This helps in improving the efficiency of available resources.

2.2 Types of networks

The two main types of networks are:

    a) LAN   (local area network)
    b) WAN (wide area network)

1. Local area network (LAN)

LAN is a data communication network connecting several computers within a localised area, usually a building or within a radius of 2 - 5 kilometres. They are generally economical to setup and data transmission speed is generally very high between computers connected through LAN. For connecting computers in LAN different network topologies as discussed below are used.

(a) **BUS topology:** In this topology, each terminal is connected to a single cable. A signal from the source travels in both directions to all the terminals connected on the BUS cable until it finds the intended recipient. If the terminal address does not match the intended address for the data, the terminal ignores the data. Alternatively, if the data matches the terminal address, the data is accepted.

Figure 4: BUS topology
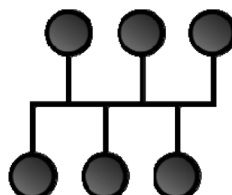
(b) STAR topology: In Star topology every terminal (computer workstation or any other peripheral) is connected to a central node called hub. The hub is the main part of the Star topology. When a terminal wants to send data to another terminal, it sends the data to the HUB with an address of the destination terminal. Now it is the responsibility of HUB to send the data to its destination.

Figure 5: STAR topology
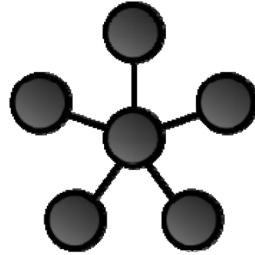
(c) RING topology: In this topology the terminals are connected in a circular fashion in which the last terminal is connected to the first terminal and forms a ring. When a terminal sends data, it must travel through each terminal on the ring until it reaches its destination.

Figure 6: RING topology
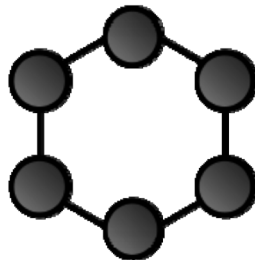
(d) MESH topology: In this type of topology each and every terminal is connected to the other. So for transmitting the data we will have a direct link with the destination terminal.

Figure 7: MESH topology
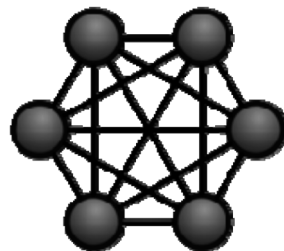
(e) HYBRID topology: Hybrid networks use a combination of any two or more topologies. A hybrid topology is always produced when two different basic network topologies are connected. Example for hybrid network is a star-bus network.

Figure 8: HYBRID topology
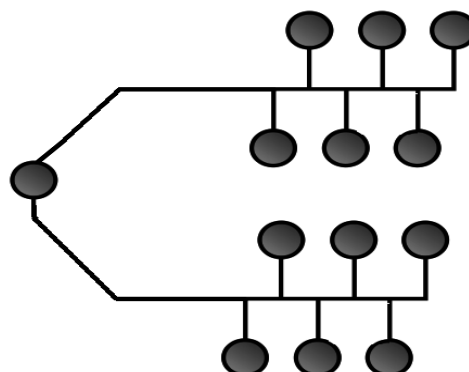
2. Wide area network (WAN)

Wide area network is a network which links computers operating in a **broad area** e.g. cross metropolitan or regional. The **internet** is a WAN, connecting computer's from all over the world.

3. Differences between LAN and WAN

(a) The geographical area covered by a **WAN** is much **bigger** than that by a LAN.
(b) WAN has more computers and terminals than a LAN.
(c) A WAN may link two or more than two LAN's.
(d) Since a WAN has more users than a LAN, it needs a larger file server.
(e) WAN uses **telecommunication lines** to send data.

2.3 Difference between Data Communication and Computer network

Data Communication	Computer Network
Data communication is used for transferring the data between two or more devices and is not restricted to computers.	Whereas computer network is concerned with how computers are connected to each other for sharing data and information among themselves.
It deals only with the transfer of data, sharing of devices (resources) is not its concern.	Computer network facilitates sharing of resources for better efficiency in transferring data.
Data communication replaced the age old method of transferring messages via hand written letters	Computer network connected these devices (computers) for quick transmission of messages. The connection can be of LAN or WAN type.

Test Yourself 4

What is a computer network?

Test Yourself 5

What does LAN and WAN stand for?

Test Yourself 6

What is the difference between a data communication system and a computer network?

Test Yourself 7

Fill in the blanks.

(a) LAN: Local area network; WAN:_____.

A World area network
B Wide area network
C World association network
D Wide association network

(b) LAN usually covers the distance of _____ kilometres.

A 2-5
B 10-20
C 20-40
D Up to 100

Test Yourself 8

State whether the following statements are true or false.

(a) In star topology, the last terminal is connected to the first terminal.
(b) BUS topology uses two cables for transmitting data (one for sending and other for receiving data).

---

3. State advantages and disadvantages of data communication systems.

[Learning Outcome c]

With the invention of data communication system the communication methods like letters are no longer in use. The development in the field of data communication system has also replaced existing methods of communication such as fax. With data communication system, data can be sent within minutes across long distances. These systems have their own advantages and disadvantages which are discussed below:

3.1 Advantages of data communication systems

1.   **It is faster and easier.** The data sent through these systems can be delivered within minutes over two geographically distant locations. Moreover, data communication systems are user friendly which makes sending messages or communicating through these systems very easy. For example, when wishing to communicate with a friend we only have to dial their telephone number and within seconds the call is connected and we can talk to the friend.

2.   **Paper wastage is reduced.** All the text documents which we are required to send are in the form of digital files and do not require paper for transferring the information.

3.   The messages can be **stored in the devices for a longer time** without the risk of damage. This is unlike the paper files that get easily damaged over time or are attacked by insects.

4.   Transmission of message is **comparatively cheaper** since the medium of transmission is electronic, which is much cheaper than human capital.

5.   It **removes semantic barriers** because the written data can be easily changed to different languages using specialised software. Data transmission happens only in analog or digital signals which are standardised across the globe.

6.   It provides **facilities like video conferencing** which saves a lot of time and money.

3.2 Disadvantages of data communication systems

1.   The biggest disadvantage of data communication system is **SECURITY**. The message transferred through data communication system can be easily hacked. For security reasons, the message sent through data communication system, has to be encrypted so that it is not understood by a third person. Hence, extra effort in the form of encryption and decryption is required for secured communication.

2.   The establishment of Digital Communication **causes degradation of the environment** in some cases. 'Electronic waste' is an example.

3.   The vibes (**electromagnetic waves) given out by the telephone and cell phone towers are so strong** that they can kill small birds. In fact the common sparrow has vanished due to so many towers coming up.

4.   Many people **misuse the efficiency of digital communication** by sending hoax messages which harm the society.

Test Yourself 9

Has the use of data communication benefited our life and how?

Test Yourself 10

What are the advantages and disadvantages of data communication system?

Answers to Test Yourself

Answer to TY 1

Data communication is the exchange of data between two devices via some form of transmission medium such as a wire cable. Data can be in any form like a text file, audio file, pictures or even videos.

Answer to TY 2

Data communication system is a collection of hardware and software through which data is transferred.

The factors by which the performance of a data communication system can be determined are:

(i) Delivery: the system should deliver data to its correct destination.

(ii) Accuracy: the system must deliver data accurately without any changes in it.

(iii) Timeliness: the system must deliver data within the specified time.

(iv) Jitter: jitter means variation in arriving of data packets or the time lapse between arrival of two data packets. When data is transferred over network, it is divided into small packets and it becomes necessary to deliver these packets serially without any delays.

Answer to TY 3

In the given example, the components of data communication system are:

(i) Sender: radio transmitter

(ii) Receiver: the radio device of the citizens of Tanzania

(iii) Message: happy new year in advance

(iv) Transmission media: wireless

Answer to TY 4

A computer network is a channel for exchanging (transmitting and receiving) information between two sources.

Answer to TY 5

LAN stands for Local Area Network while WAN stands for Wide Area Network.

Answer to TY 6

The difference between data communication and computer network is:

Data communication	Computer network
Data communication is used for transferring the data between two or more devices and is not restricted to computers.	Computer network is concerned with how the computers are connected to each other for sharing data and information among themselves.
It deals only with the transfer of data, sharing of devices (resources) is not its concern.	Computer network facilitates sharing of resources for better efficiency in transferring data.
Data communication replaced the age old method of transferring messages i.e. hand written letters	Computer network connected these devices (computer) for quick transmission of messages. The connection can be of a LAN or a WAN type.

Answer to TY 7

(a) The correct answer is **B.**

(b) The correct answer is **A.**

Answer to TY 8

(a) The given statement is **False.** In Star topology the data is transmitted by a central device known as HUB. It is the Ring topology in which last terminal is connected to first one.

(b) The given statement is **False. I**t uses only one wire to send and receive data.

Answer to TY 9

The use of data communication has benefited our lives. Data communication systems are widely used in almost all aspects of our daily life. Some of the examples are given below:

(i)   If we need to book our train or flight ticket we either call up the customer service centre or book it online. This is only possible because we have data communication systems in place.

(ii) If we want to enjoy some entertainment or watch news then we tune in to our television sets and the transmission of programs from television stations to our television sets in our living room is possible only because we have data communication systems in place.

(iii) If we have a medical emergency at home and we need to call up the emergency services we dial from our phone and this is possible because we have data communication systems in place.

(iv) Data communication system has made this world a better place to live. Major benefits of using data communication system are:

   a) pace of communication has increased
   b) has reduced paper wastage
   c) it is cheap
   d) easy to use

Answer to TY 10

Advantages and disadvantages of data communication system are:

Advantages

(i)   **Speed:** Using data communication systems, data can be delivered within minutes over two geographically distant locations.

(ii) **Eco-friendly:** Reduced paper wastage. All the text documents which we need to send are in the form of digital files so we do not need paper to transfer the information.

(iii) **Cheap:** Transmission of message is comparatively cheap, because transmission is done using an electronic medium which is cheaper as compared to human capital.

(iv) **Advance technology:** It provides facilities like video conferencing which save a lot of time and money.

Disadvantages

(i) Security issue: The first and the biggest disadvantage of data communication system is SECURITY. The message transferred through the data communication system can easily be hacked so extra effort is needed to secure the data being transmitted.

(ii) E-waste: Due to development of new and advanced devices, the older models are replaced and are dumped which causes degradation of the environment. 'Electronic waste' is an example.

(iii) Environment: To enable improved performance of data communication systems, many telephone and cell phone towers have been installed and the waves given out by these towers are so strong that they kill small birds. In fact, the common sparrow has vanished because of so many towers coming up. The vibrations generated hit them on the head thus killing them.

(iv) Hoax messages: Using data communication systems people try to send hoax messages which harm the society.

Self Examination Questions

Question 1

Which of the following is not an example of data communication system?

A   Telephone
B   Radio
C   Walky-talky
D   Windows

Question 2

Which of the following is an example of data communication system?

A   Telephone
B   Windows
C   Ubuntu
D   Macintosh

Question 3

Which of the following is not a component of the data communication system?

A   Message
B   Sender
C   Radio
D   Channel

Question 4

State whether the following statements are true or false:

(a) The data sent by a data communication system is in the form of analog or digital signals.

(b) Analog signals are represented by 0's and 1's.

(c) Radiation from Sun is an example of an analog signal.

(d) The low signal of a digital signal is represented by '1'.

Question 5

Write a short note on data communication systems.

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **D.**

Windows is an operating system.

Answer to SEQ 2

The correct option is **A.**

Telephone is an example of a data communication system, while the others are operating systems.

Answer to SEQ 3

The correct option is **C.**

Radio is an example of data communication systems while the others are the basic components of a data communication system.

Answer to SEQ 4

(a) The given statement is **True**.

(b) The given statement is **False**.

Analog signals are measured in terms of amplitude and frequency.

(c) The given statement is **True**.

(d) The given statement is **False**.

It is represented by '0'.

Answer to SEQ 5

Data communication is the exchange of data between two devices using some form of transmission medium, such as a wire. Data communication system, on the other hand is a collection of hardware and software through which data is transferred. Examples of data communication systems are: telephone, radio, computer etc. Data communication systems have five basic components.

They are:

(a) Message: Message is the data which we need to send. There are different types of data that can be transmitted like text files, audio files, pictures, videos etc.

(b) Sender: The sender is the device which sends the message. Sender can be in any form like a computer, mobile, workstation etc.

(c) Receiver: The receiver is the device which receives the message. There can be multiple receivers depending on the sender who decides on the recipients of the sent message. Likewise, a receiver can also be a computer, mobile, workstation etc.

(d) Transmission media: Transmission media is also referred to as data communication channel. When the sender sends a message it needs to be transferred through a transmission media. Transmission media can be wired or wireless.

(e) Protocol: Protocol is a set of rules which govern data communication. Protocol represents the agreement between the sending and receiving device. It is necessary that the message sent from one device is understood by the other. The messages are thus sent using standardised format which are called protocol.

DATA COMMUNICATION SYSTEMS

D2

STUDY GUIDE D2: DATA COMMUNICATION TERMINAL

◼ Get Through Intro

Using data communication systems, it is possible to send data over long distances but for doing so, devices are needed to compose messages and also to send them. Data communication terminals are these electronic devices which are used to send and receive messages.

When we send a message using a device like a radio, the same is in the form of analog or digital signals. It is the data communication terminal which converts the message into an audio format understandable to us.

In this study guide, we will cover the details of data communication terminals like Electrical Telegraph, Radio, Telephone and Computer and compare their capability and capacity with each other.

◼ Learning Outcomes

a) Explain various data communication terminals.
b) Compare the capabilities of each type of terminal.
c) Explain the capacity (measure) of each of these data communication terminals.

---

1. Explain various data communication terminals.

[Learning Outcome a]

1.1 Introduction

Data communication dates back to the year 1809, when the first electrical telegraph was invented. With development in the field of data communication, the systems have become more and more advanced and the capacity to transmit data has increased. To transmit data we need a sender and a receiver (studied in SG-D1) which are also called terminals.

Earlier data communication terminals were only capable of sending data in the form of signals but later, with the improvement in technology, the capabilities of terminals also increased. According to the processing power of the terminals they were categorised as a dumb terminal or an intelligent terminal. These will be discussed below.

Definition

In data communication, a terminal is defined as the device through which data is sent to its destination or received from a source.

Over the years, these terminals have improved and their capability and capacity has also increased. In the year 1809, the first data communication system, the electrical telegraph was developed. This system could only send text messages, but today technological advancement has made transmission of voice messages, images, videos and other forms possible.

In this study guide four terminals will be discussed: Electrical Telegraph, Radio, Telephone and Computer.

1.2 Data communication terminals

1. Electrical telegraph

Definition

Electrical telegraph or simply, 'telegraph' is a way of sending text messages over long distances using electrical signals transmitted through wires.

(a) History

The idea of sending messages with the help of electricity was first put forward in the year 1753. Years passed by and various experiments to facilitate sending messages over long distances were carried out by different scientists all over the world. Then, in the year 1809, a German physician succeeded in sending a message over a distance of a few kilometres. However, the system was too complex and could not be used.

Different experiments continued to be carried out around the world with continuous improvement in technology. In the year 1832, Pavel Shilling successfully designed a telegraph system which was able to send messages over long distances and he then also received the contract to install them. But the project could never be completed because of his death in 1837. In the year, 1840 Charles Wheatstone developed a telegraph named 'ABC telegraph system' which was widely used.

Many systems were designed in 19th Century, each with the objective of reducing the hand-work while operating them. The first telegraph in which the message used to be automatically printed was designed by David Hughes in the year 1855. Later, attempts were made to develop systems in which transmitting the message was also possible and this was achieved by Charles Wheatstone. He used *Punch cards* for transmitting the messages.

20th century witnessed further technological developments and advanced telegraph terminals, referred to as Teleprinters were designed. These were capable of automatically sending and receiving messages.

Now let us understand the working of the 'ABC telegraph system', developed by Charles Wheatstone.

(b) Working

The ABC telegraph system consisted of three main components - the generator, the communicator and the indicator. The communicator and the indicator were mounted on top of a wooden box. The generator was inside the box and was operated by a handle projecting through one end of the box.

The generator consisted of an armature, carrying a coil of fine wire and rotating between the poles of a set of permanent magnets. Rotating the armature by means of the external handle generated a series of positive and negative current pulses which were fed into the telegraph line connecting to the receiving station.

The communicator controlled how the current pulses were transmitted. It had a circular dial with letters of the alphabet marked around its periphery and a needle pivoted at the centre of the dial. Opposite each letter on the communicator dial was a key. To transmit a letter, the appropriate key on the communicator was depressed and the handle of the generator was turned.

When the number of pulses corresponding to the selected letter had been transmitted, the communicator disconnected the generator from the telegraph line. The communicator needle rotated while the generator was transmitting and stopped at the transmitted letter when the generator was disconnected.

At the receiving end, the indicator decoded the pulses from the communicator. The indicator had a circular dial with the letters of the alphabet marked around its periphery and a needle pivoted at the centre of the dial. As the pulses were received the needle moved around the dial and stopped at the appropriate letter.

Provision was made to ensure that the communicator and indicator were properly synchronised, and it was possible to transmit numbers and punctuation marks as well as letters. Apparently, a speed of about 15 words per minute was possible.

(c) Oceanic telegraph cables

After the successful working of the telegraph system the aim was to connect different countries of the world by placing high performance cables under the sea bed. The first undersea cable was laid in the year 1850 between France and England. Soon after that various companies were formed to construct commercial telegraph systems.

The cable across Atlantic Ocean was successfully laid in 1866. Then, the cable connecting India and Australia was successfully laid in 1870 and 1872 respectively. The final phase of laying these high performance cables for telegraph, across the Pacific Ocean, was successfully completed in 1902 thus encircling the world.

With the invention of e-mail, telegraph service is now no longer in use. The last telegraph was sent on 4[th] July 2013.

2. Radio

Definition

Radio is an electronic device which is used to transmit and receive electromagnetic waves of radio frequency. These waves generally carry messages in the form of sound.

(a) History

Telegraph was developed to transmit text messages over long distance using wire, while radio was designed to transmit messages without the use of wires i.e. wireless telegraph. After the successful transmission of text messages, attempts were made in different parts of world, to transmit audio messages with the help of electromagnetic waves. Success was achieved in the year 1900.

Subsequently, radio was mainly used for broadcasting audio messages. It was used for military purposes and proved to be of significant importance during World War-I. The method of broadcasting the audio message is explained below.

(b) Working

Radio consists of two components - a transmitter and a receiver.

(i) Transmitter

A transmitter is an electronic circuit which is used for transmitting the information (audio in this case). The transmitter combines the electronic signal (sound) with radio frequency to generate electromagnetic waves which are transmitted in open space (air) with the help of an antenna. Transmitter consists of three parts:

Transducer: it is used to transform the input signal (audio in this case) to higher voltage electronic signals which are suitable for transmitting.

Electronic oscillator: it is used to generate radio frequency signals which will carry the information. These are also known as Carry signals since they will carry information.

Modulator: it is used to add information to the Carry signals. In this case, the information carried is in the form of audio message. Modulation can be done in AM or FM, depending on the type of modulator. In AM (amplitude modulation) the strength of the carry signal is varied while in FM (frequency modulation) the frequency of the carry signal is varied.

Figure 1: Difference between AM & FM Signals
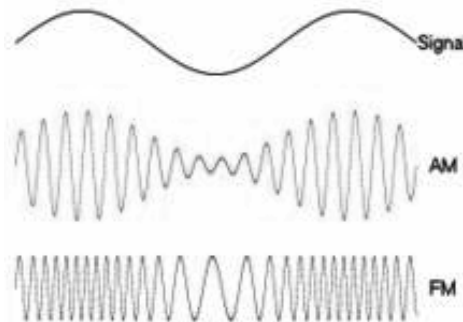
(ii) Receiver

It is an electronic device which converts the radio waves into usable form by converting them back into an audio. Receiver also consists of an antenna which interrupts the electromagnetic waves and converts them into alternating current and then the demodulator extracts information from it.

Figure 2: Radio (receiver)
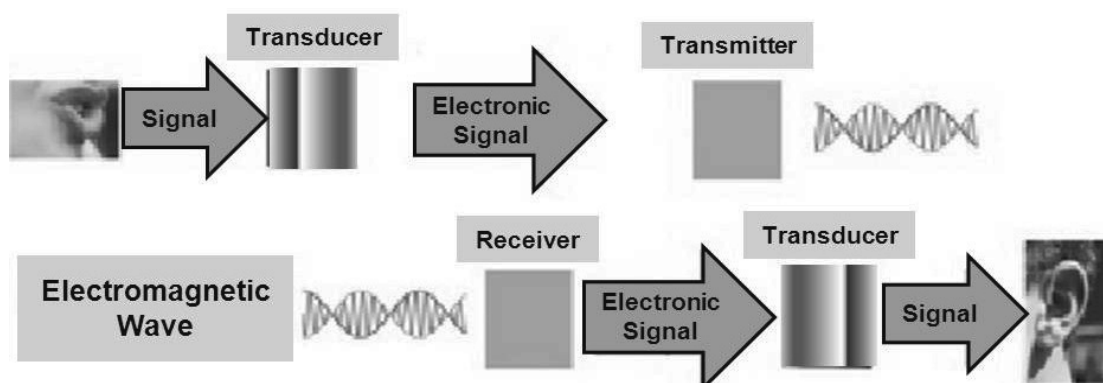
(c) Use of Radio

The reason behind the invention of a radio was the development of a wireless telegraph which was successfully developed by Marconi in the year 1894. Wireless telegraph which used electromagnetic waves for transferring messages was also known as radio telegraph. Later radio was used to transmit audio messages. Apart from this radio is today used for broadcasting. For example - East Africa Radio and Times Fun.

3. Telephone

Definition

Telephone is an instrument that converts voice and other sound signals into a form (mostly electromagnetic waves) that can be transmitted to remote locations and that receives and reconverts waves into sound signals

(a) History

The word **telephone** is **derived from Greek language, where tele means 'far' and phone means 'sound'**. Alexander Graham Bell was the first person who invented the telephone in the year 1876. After 20 years of the 1876 Bell patent, the telephone instrument was modified by Thomas Watson, Emil Berliner, Thomas Edison, and others, to acquire a functional design that has not changed fundamentally in more than a century.

Since the invention of the transistor in 1947, metal wiring and other heavy hardware have been replaced by lightweight and compact micro circuitry. Advances in electronics have improved the performance of the basic design, and they have also allowed the introduction of a number of 'smart' features such as automatic re-dialling, call-number identification, wireless transmission, and visual data display. Such advances supplement, but do not replace, the basic telephone design.

(b) Working

Since it has been invented, the telephone is made of the following basic components: a power source, a dialler, a ringer, a transmitter and a receiver. These components are described below:

(i) Power source: Power is required to run the telephone circuit which consists of a speaker, a transmitter and a receiver. Earlier the batteries were located within the telephone instruments itself; however, since the 1890s current is generated at the local switching office, an office which gives out telephone connections. The standard voltage is 48 volts.

(ii) Dialler: The dialler is used to enter the number of the party that the user wishes to call. Signals generated by the dialler activate switches in the local office, which establish a transmission path to the called party. Diallers are of both, rotary and push-button types.

(iii) Ringer: The ringer alerts the user to an incoming call by emitting an audible tone or ring.

(iv) Transmitter: The transmitter of a telephone serves as a sensitive 'electric ear.' It lies behind the mouthpiece of the phone. Like the human ear, the transmitter has a '14 eardrum.' The eardrum of the telephone is a thin, round metal disk called a diaphragm. When a person talks into the telephone, the sound waves strike the diaphragm and make it vibrate. The diaphragm vibrates at various speeds, depending on the variations in air pressure caused by the varying tones of the speaker's voice.

Behind the diaphragm lies a small cup filled with tiny grains of carbon. The diaphragm presses against these carbon grains. Low voltage electric current travels through the grains. This current comes from batteries at the local switching office. The pressure on the carbon grains varies as sound waves make the diaphragm vibrate.

A loud sound causes the sound waves to push hard on the diaphragm. In turn, the diaphragm presses the grains tightly together. This action makes it easier for the electric current to travel through, and a large amount of electricity flows through the grains. When the sound is soft, the sound waves push lightly on the diaphragm. In turn, the diaphragm puts only a light pressure on the carbon grains. The grains are pressed together loosely. This makes it harder for the electric current to pass through them, and less current flows through the grains.

Thus, the pattern of the sound waves determines the pressure on the diaphragm. This pressure, in turn, regulates the pressure on the carbon grains. The crowded or loose grains cause the electric current to become stronger or weaker. The current copies the pattern of the sound waves and travels over the telephone wire to the receiver of another telephone. For more modern phones that have a telephone answering service, the sound wave is captured on a recording device which allows the user/operator of the phone to playback the message at a later time.

(c) Receiver

The Receiver serves as an 'electric mouth.' Like a human voice, it has 'vocal chords.' The vocal chords of the receiver are the diaphragm. Two magnets located at the edge of the diaphragm cause it to vibrate. One of the magnets is a permanent magnet that constantly holds the diaphragm close to it.

The other magnet is an electromagnet. It consists of a piece of iron with a coil of wire wound around it. When an electric current passes through the coil, the iron core becomes magnetized. The diaphragm is pulled toward the iron core and away from the permanent magnet. The pull of the electromagnet varies between strong and weak, depending on the variations in the current. Thus, the electromagnet controls the vibrations of the diaphragm in the receiver.

The electric current passing through the electromagnet becomes stronger or weaker according to the loud or soft sounds. This action causes the diaphragm to vibrate according to the speaker's speech pattern. As the diaphragm moves in and out, it pulls and pushes the air in front of it. The pressure on the air sets up sound waves that are the same as the ones sent into the transmitter. The sound waves strike the ear of the listener and he hears the words of the speaker.

Example

Telephone is an electronic device which allows us to establish direct communication with the person to whom we wish to convey a message. We simply dial their unique contact number and when the receiver receives our call communication is established.

At the organisation level, when a company wants to place an order, it makes a call to the distributor and gives them a list of its product requirements.

Figure 3: Telephone
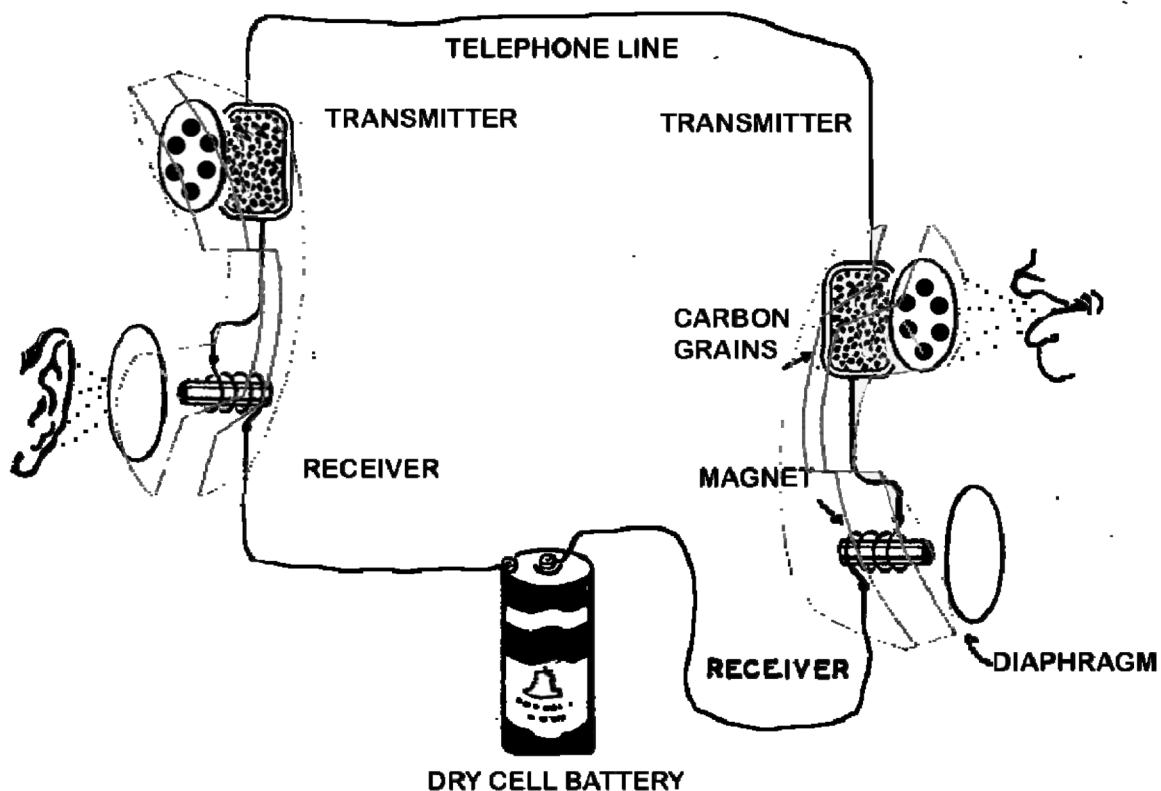
4. Computer

Definition

Computer is an electronic device for storing and processing data, typically in the binary form. Computer performs a variety of tasks according to the instructions given to it.

While, computers are used for multiple tasks, from the point of view of data communication it is a terminal which is used for transferring data. It is the most powerful terminal compared to other terminals. The data transmitted with the help of a computer can be in any form. It can be an audio, video, image, files or any other format. Using the computer as a terminal data can be sent in a wired or wireless form.

There are different types of computers that have different processing and storage capacity. According to their processing power and storage capacity, computers are called either a dumb terminal or an intelligent terminal.

A dumb terminal is the simplest of the computer terminals. It can be something as basic as a monitor and a keyboard plugged directly into a network router. The reason the terminal is considered dumb is because it has almost no processing power of its own and simply sends and receives signals from a larger central computer, which performs all the processing tasks. Dumb terminals are inexpensive.

Example

When we enter the data with the help of a keyboard, it simply accepts the character pressed by the person and sends it to the CPU as an input. The keyboard never checks whether the user has entered the correct data because it does not have any processing power of its own.

Terminals powerful then dumb terminals are the intelligent computer terminals. These are actually functioning computers or laptop systems that have the basic components of a standard personal computer, including a hard drive, memory and peripheral ports. These terminals are networked to a central computer system and can work in one or two ways.

Example

A single computer (intelligent terminal) is capable of sending as well as receiving data, where as it is not possible for a dumb terminal to send or receive data (keyboard).

Test Yourself 1

Name the basic components of a telephone.

Test Yourself 2

State whether the following statements are true or false.

(a) Telegraph is used to send audio messages.

(b) Computer is the most powerful terminal compared to other terminals.

(c) Telephone was invented in the year 1870.

---

2. Compare the capabilities of each type of terminal.
   Explain the capacity (measure) of each type of data communication terminals.
   [Learning Outcomes b and c]

The first telegraph when invented was capable of sending only a few words per minute but with the improvement in technology the capacity went on increasing. Later on the telegraph was made wireless and then we were able to send audio messages in broadcast form also.

Later, with the invention of the telephone we were able to talk directly with a person and later on we were able to send text messages, audio files, video files, images etc. using the most powerful terminal i.e. the computer. Today, with the invention of the computer it is possible to send text messages to any corner of the world within a matter of minutes. Computers provide all the features of the previous terminals and also more advanced options like video conferencing

The table below compares the capabilities of different types of terminals discussed above.

Capabilities of the system:

	Telegraph	Radio	Telephone	Computer
Type of message which can be sent.	Text	Audio	Audio	Text, audio and images.
Type of connection used	Wired or Wireless	Wireless	Wired	Wired or Wireless
Complexity in operating	In earlier day's required skilled persons to operate it but on later dates only a basic training was required.	Broadcasting function has to be handled by a trained person while receiving can be done by any person	Easy to use. No need of skilled person	Basic training is required and then it is easy to use.
Effect of nature	Earlier systems were affected by the atmosphere but later improvements resolved the problem.	Due to bad weather conditions the signals are affected	No effect	No effect
Type of system*	Half Duplex*	Simplex*	Full duplex*	Full duplex*
Capacity of the system:				
Distance covered	All over the world	Depends on the type of broadcasting-can cover the world, a single country, single city or only a particular campus depending on the module.	All over the world	Depends on the way terminals are connected. If connected to internet it is possible to send data all over the world; if connected to local area network then data can be sent only to the terminals connected in the network.
Speed	Slow	Fast	Fast	Fastest

[*Note: Type of system i.e. Simplex, Half Duplex and Full Duplex will be explained in Study Guide D6.]

Test Yourself 3

Telephone was invented by:

A Marconi
B Edison
C Graham Bell
D Charles Wheatstone

Test Yourself 4

The last telegraph was sent in the year:

A 1990
B 2000
C 2005
D 2013

Test Yourself 5

Computer is capable of sending _____ data.

A   Audio
B   Video
C   Text
D   All of above

Test Yourself 6

A loud sound causes the sound waves to push harder on the diaphragm. In turn, the diaphragm presses the grains tightly together. This action results in passing of _____ amount of electric current.

A   Large
B   Moderate
C   Low

Answers to Test Yourself

Answer to TY 1

The basic components of a telephone are:

(i)   Transmitter - to transmit voice
(ii)   Receiver - to receive voice
(iii)   Dialler - to dial the contact number of the recipient
(iv)   Ringer - to alert when an incoming call is coming
(v)   Power source - to supply power to all the devices for functioning

Answer to TY 2

(a)   The given statement is F**alse.** Telegraph is used to send text messages.

(b)   The given statement is T**rue.** It is capable of sending audio messages, text messages, videos and images.

(c)   The given statement is **False.** Telephone was invented in the year 1876.

Answer to TY 3

The correct answer is **C.**

Answer to TY 4

The correct answer is **D.**

Answer to TY 5

The correct answer is **D.**

Computers can send text messages, audio files, images as well as videos.

Answer to TY 6

The correct answer is **A.**

The tighter the grains are pressed together, the larger the current flow through the diaphragm and the looser the grains, lower the current that passes through the diaphragm.

Self Examination Questions

Question 1

Explain the difference between radio and telegraph.

Question 2

Explain the difference between computer and telephone.

Answers to Self Examination Questions

Answer to SEQ 1

Difference between telegraph and radio:

Telegraph	Radio
Successfully developed in the year 1840	Successfully developed in the year 1900
Used to send text messages	Used to send audio messages
Used wired as well as wireless mode for communication	Uses wireless mode of communication
Point to point communication is possible.	Broadcasting is possible

Answer to SEQ 2

Difference between telephone and computer:

Telephone	Computer
Used for talking directly to a person	Multi-purpose use such as sending messages, making audio and video calls.
It is a full duplex system	Also a full duplex systems
Images cannot be sent.	Images can be sent.

DATA COMMUNICATION SYSTEMS

D3

STUDY GUIDE D3: DATA COMMUNICATION CHANNEL

▊ Get Through Intro

In ancient times, when we needed to send messages, it used to be in the form of letters which were carried by a person and delivered to the concerned person. Even today, the postal system provides the service of letter delivery through people known as postmen). Later, the invention of data communication systems replaced the services provided by the postmen to a large extent.

Today, within seconds, data can travel to any corner of the world with the help of data communication channels that carries data to its destination at the click of a button.

The basic components of a Data Communication System are: a message, the sender, the receiver, protocol and the transmission media i.e. the channel. Channels are an important part of data communication systems since they are the medium through which data is transferred. Channels can be wired or wireless and they connect two devices for data transfer

Data transfer can be either in analog or in a digital form. This has already been covered in study guide D1.

Channels are capable of transmitting analog as well as digital signals.

In this study guide, we will learn the details of different communication channels, which are used by data communication systems, for transferring the data along with a comparison of the capabilities of each channel.

▊ Learning Outcomes

a) Explain various data communication channels.
b) Compare capabilities of each type of channel.
c) Explain the capacity (measure) of each of these data communication channels.

1. Explain various data communication channels.

[Learning Outcome a]

1.1 Introduction

Communication channels are the medium, through which data is transferred between two devices. The channels are referred by different names such as transmission media, communication channel or data channel. The performance of data communication highly depends on the performance of data channels used. Depending on the type of data to be transferred or the distance between two communicating devices the channels are selected for optimum performance. A channel can be a guided media also known as 'wired' or an unguided media known as 'wireless.'

The performance of these channels is decided by the following terms:

1. **Bandwidth:** Bandwidth is the frequency range of the channel. It is calculated by taking the difference between the higher and lower frequency available. The maximum speed of transmission is determined on the basis of bandwidth available. Larger the bandwidth, higher is the transmission frequency. Bandwidth is also called as channel capacity for digital signals.

2. **Bit rate:** Bite rate is defined as the number of bits processed per unit of time. It is measured in the unit 'bits per second' or 'bps' or 'b/s.' With the larger data, the unit for representing bits changes to kilo, represented as 'kilo bits per second' or 'kbps', and also to mega which is represented as 'Mega bits per second' or 'giga' or as 'gbps.'

1.2 Classification of communication channels

For better performance of the data communication system many factors are considered before selecting an appropriate communication channel. The communication channels are classified as:

Guided media or Wired
Unguided media or Wireless

Figure 1: Classification of Communication Channels
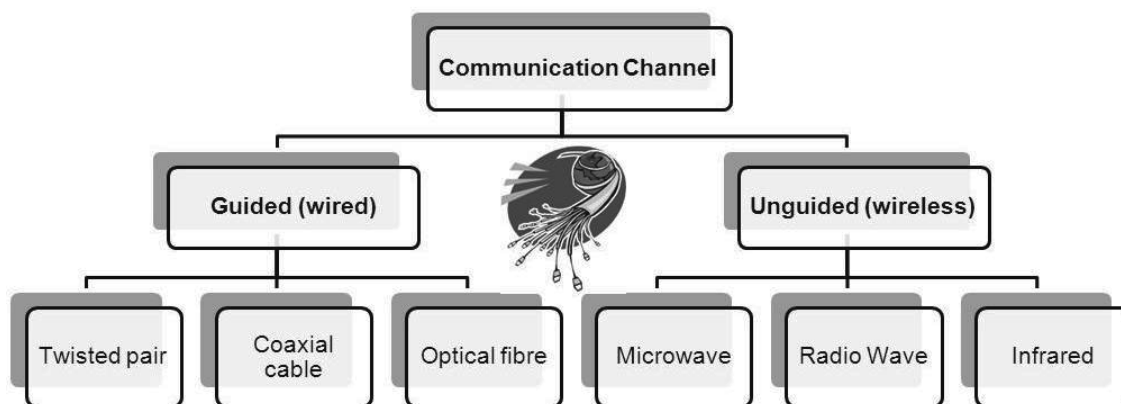
1. Guided media or Wired

Guided media is a communication channel which allows the data to get guided along its path. In this type of channel the devices are physically connected with the help of wires, namely, Twisted-pair cable, Co-axial cable and Fibre Optic.

(a) Twisted-pair cable

A twisted-pair cable consists of two conductors, normally made of copper. Each cable is covered with an insulator. These pairs are twisted together to form a single cable. One of the wires is used to carry signals and other for ground reference. The quality of cable is decided by the number of twists per meter, more the number of twists, better the quality of the cable. If both the cables are parallel to each other, then maybe only one pair will be affected by unwanted signals (noise) which may cause a difference at the receiver's end.

By twisting the pair balance is maintained. For example, in one twist one wire is closer to the noise source and the other one is farther; in the next twist, the reverse is true. Twisting ensures that both wires are equally affected by external influences (noise or crosstalk). This means that the receiver, which calculates the difference will cancel out the unwanted signals. From the above discussion, it is clear that the number of twists per unit of length (e.g. inch) has some effect on the quality of the cable. These cables are generally used to carry data of low frequencies.

Figure 2: Twisted-pair cable
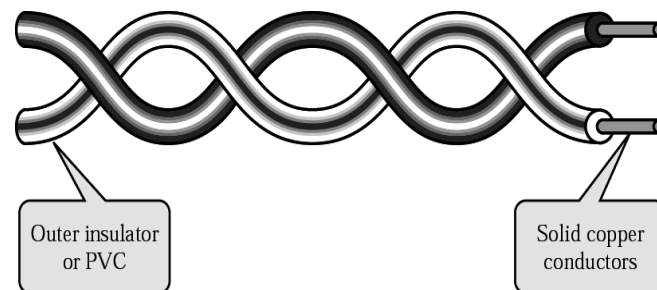
There are two types of twisted-pair cables:

   a)   Unshielded twisted-pair (UTP);
   b)   Shielded twisted-pair (STP).

(i) UTP (Unshielded twisted-pair cable)

   It is the most widely used cable for purposes of networking since it is cheap and easy to install.
   Its major drawback is that it is easily affected by noise.

(ii) STP (Shielded twisted-pair)

   This cable was developed by IBM to reduce the noise effects.
   It comes with an extra coating of metal foil.
   Although, it does reduce noise effects, but because of the metal foil, the cable becomes bulky and is more expensive and thus not widely used.

The Electronic Industry Association (EIA) has classified unshielded twisted-pair cable into seven categories which are determined by the quality of the cables, with 1 being the lowest and 7 the highest. EIA has categorised only UTP cable, because STP is not widely used. The categories are:

Category	Data Rate (Mbps)	Use
1	< 0.1	Telephone
2	2	Telephone
3	10	LAN's
4	20	LAN's
5	100	LAN's
6	200	LAN's
7	600	LAN's

The different categories are used according to the requirement of the system. For example, a LAN consists of 40-50 computers and thus either category 5 or 6 would be used for better performance. Twisted-pair cables are mainly used in connecting telephones and for LAN.

(b) Co-axial Cable

Co-axial cable sometime also referred as *coax* are cables designed to carry high frequency data. The design of coax is completely different from twisted pair. It consists of two conductors known as Inner conductor and Outer conductor which are surrounded by dielectric material. The inner conductor is usually of copper, which carries the data, while the outer conductor is made up of a metallic braid used for providing a shield. Each conductor is covered by an insulator, usually made of plastic, which is then finally covered by a plastic jacket.

Figure 3: Co-axial cable
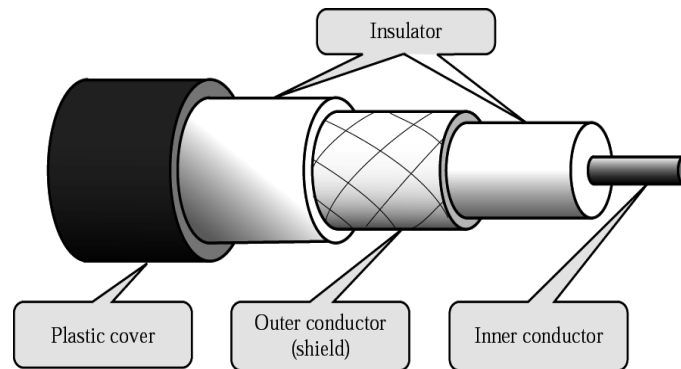
Like twisted-pair cables, co-axial cables are also classified according to their capacity and the type of material used in their design. The Radio Government (RG), have given co-axial cables standard ratings known as RG rating. They are:

Category	Impedance	Use
RG-59	75Ω	Cable TV
RG-58	50Ω	LAN
RG-11	50Ω	LAN

The capacity of Co-axial cable is to transmit data at the speed of 10Mbps and so it is mostly used in televisions. Apart from televisions, it is used in LAN connections and telephone networking. With the invention of fibre-optic cable, the co-axial cables are now being replaced with the fibre-optic cable.

(c) Optical fibre

It is also known as *fibre optic*. Fibre optic cable consists of glass at its core, surrounded by several layers of protective materials. It transmits light, rather than electronic signals, thus, eliminating the problem of electrical interference. This makes it ideal for certain environments, where a large amount of electrical interference is present.

A glass or a plastic core is surrounded by a less dense plastic or glass also known as cladding. The difference in the density of the two materials should be such that, a beam of light, moving through the core, is reflected off the cladding.

Cladding is further surrounded by Kevlar fibre, which strengthens the cables and prevents breakage. The outer insulating jacket is made of Teflon or PVC.

Figure 4: Optical fibre

1. Core = 8µm diameter
2. Cladding = 125µm dia.
3. Buffer = 250µm dia.
4. Jacket = 400µm dia.
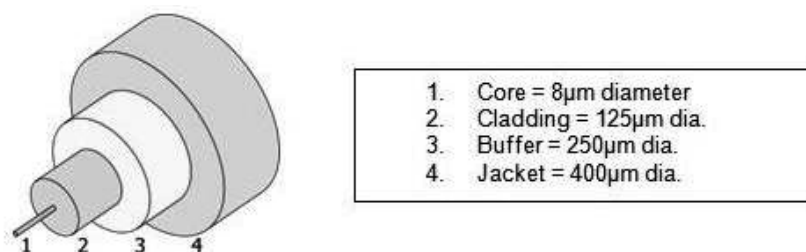
Modes of operation

Fibre optic cable works in two modes, namely

(i) Single mode: in this mode a single beam of light is passed for data transmission. The core has a lesser diameter of 7µm. With this type of cable, the data can travel for a longer distance but is more expensive.

Figure 5: Single mode

Single Mode

Core

Light Ray

Cladding

Source

(ii) Multi-mode: in this mode multiple beams of lights are passed to carry data. The core is made with a higher diameter as compared to single mode. The diameter of this core is between 50 μm to 100 μm.

Figure 6: Multi-mode

Multimode

Light Rays

Cladding

Core

Source
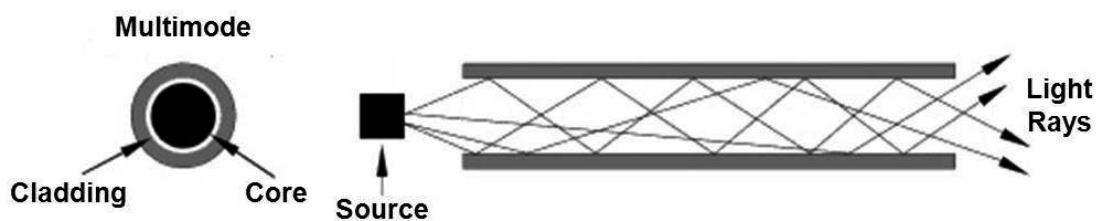
Fibre optic cables are known as the backbone of the networking system because of their high data transfer capabilities i.e. they can transfer data at the rate of 1600Gbps. They are mostly used where large amounts of data are required to be transferred within seconds, more like connecting two servers which are geographically apart. Fibre optic cables have also started replacing co-axial cables in the cable-TV network.

2. Unguided media or Wireless

Unguided media is a communication channel, where there is no physical connection between the devices. Here the medium used for data transfer is air or water. Data is sent in the form of signals, such as microwaves, radio waves or infrared.

(a) Microwaves

Microwaves are a type of electromagnetic waves, with frequency ranging between 1GHz to 300GHz. Because they operate at such high frequencies, microwaves are capable of carrying large data.

Microwaves are unidirectional in nature. These waves are mostly used for point-to-point communication and are thus best suited for satellite communication.

Microwaves cannot penetrate walls and thus, to avoid any interference, the antennae for microwave transmissions have to be installed at high altitudes.

Applications of Microwaves:

   a) Cellular telephone
   b) Satellite network
   c) Wireless LAN
   d) RADAR systems

(b) Radio waves

Radio waves are a type of electromagnetic waves with frequency ranging from 3 KHz to 1GHz. Like all electromagnetic waves, radio waves also travel at the speed of light. Radio waves when transmitted from the source, propagates in all directions and thus are best suited for the purpose of broadcasting. With the use of special antennae, point-to-point communication is also possible using radio waves.

Radio waves are classified according to their frequency range and are used for different purposes. To avoid interference, between different users, radio waves are legally regulated by the organisation named, International Telecommunications Union (ITU).

 The spectrum for Radio waves is divided into the following bands, namely

(i)   Medium frequency radio wave used for AM radio (300KHz-3MHz)
(ii) High frequency radio waves used in aircraft communication (3MHz-30MHz)
(iii) Very high frequency radio waves used in FM radio and TV (30MHz-300MHz)
(iv) Ultra high frequency radio waves used in satellite communication (300MHz-1GHz)

Applications of radio waves:

    a) Cellular communication
    b) Wireless LAN
    c) Radio broadcasting
    d) TV broadcasting
    e) Satellite communication

(c) Infrared

Infrared are types of electromagnetic waves with frequency ranging between 300GHz to 400THz. Because of its very high frequency level, infrared cannot penetrate walls. This characteristic works to advantage by preventing interference between systems. Also due to the high frequency, Infrared have excellent data carrying capability and are used in wireless LAN's.

Infrared is mostly used for short range communication and the most common example is remote control. Moreover, infrared cannot be used in external environment since the Sun's rays also contain infrared and can interfere with communication. This is also one reason why Infrared are not suitable for long range communication.

Infrared uses, both point-to-point, as well as, broadcast method for delivering data. Remote control of TV sets is an example of point-to-point communication, whereas wireless LAN is an example of broadcast communication.

Applications of Infrared

    a) Remote controls
    b) Wireless LANs
    c) Cell phones

Test Yourself 1

Fill in the blanks.

1.   Twisted-pair cable is of _____ type / types.

    A   One
    B   Two
    C   Three
    D   Four

2.   Twisted-pair cable is an example of _____.

    A   Guided media
    B   Unguided media

3.   Radio bands are governed by _____ organisation.

    A   Radio Government
    B   Electronic Industry Association
    C   International Telecommunication Union (ITU)
    D   NASA

4.   Microwave uses _____ type of communication.

    A   Single cast
    B   Multicast
    C   Broadcast
    D   Point-to-point

Test Yourself 2

State whether the following statements are true or false.

(a) Twisted-pair, co-axial and fibre optic are examples of unguided media.
(b) Radio, microwave and infrared are examples of guided media.
(c) The core of fibre optic is in centimetre.
(d) Fibre optic cable operates in two modes.
(e) Infrared can penetrate through walls.

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2. Compare capabilities of each type of channel.
Explain the capacity (measure) of each of these data communication channels.
[Learning Outcomes b and c]

Data communication channels are used for carrying data from one device to another. According to the requirement of the system, the appropriate channel can be wisely selected.

If data is to be delivered to a selected device, then the wired (guided) media is used. If the message has to be broadcast then the wireless (unguided) media is used. A comparison of the capabilities of wired and wireless media are discussed below:

	Wired media	Wireless media
1	It is also known as guided media as the data which is transmitted is guided along a solid medium i.e. wires.	It is also known as unguided media and data travels in open space.
2	Twisted-pair, Co-axial and Fibre optic cables are example of wired media.	Radio waves, Microwaves and Infrared are examples of wireless media.
3	Used for point-to-point communication.	Used for point-to-point as well as broadcasting purposes.
4	Data is transmitted in the form of electrical signal(analog or digital signals). In case of Fibre optic data travels in the form of light.	Data is transmitted in the form of Electromagnetic waves.
5	Installation is less expensive.	Installation is expensive.

Wired media is further classified into three categories of cables. Each cable has different capabilities and is used according to the requirement. If the data is to be transmitted over a short distance i.e. within 2-5 kilometres, then twisted-pair cable is used, whereas, if the data communication systems are located geographically far apart then Fibre optic cables are used because of their high bandwidth. The following table examines the differences between Twisted-pair cable, Co-axial cable and Fibre optic cable.

	Twisted-pair cable	Co-axial cable	Fibre cable
1	Data transmission takes place in an electrical form.	Data transmission takes place in an electrical form.	Data transmission takes place in the form of Light.
2	Noise immunity is low hence more distortion.	Higher noise immunity then twisted-pair cable but less then Fibre optic cable.	Highest noise immunity.
3	Affected due to external magnetic field.	Less affected by external magnetic field.	Not affected by magnetic field.
4	Cheapest	Moderately expensive	Most expensive
5	Used for low data transfer rate.	Used for moderate data transfer rate	Used for very high data transfer rate
6	Low bandwidth	Moderate bandwidth	High bandwidth
7	Used mostly in LAN's	Used in cable TV	Used in high speed networks (internet).
8	Data loss is possible due to radiation and conduction.	Data loss is mostly due to conduction.	Data loss is mostly due to bending of fibre.

For point-to-point communication, mostly wired media is used, but in case of broadcasting, wireless media is used. Point-to-point communication is possible even with wireless media. Also, it is not physically possible to communicate with satellites using wired media, in such cases wireless media is obviously used.

As we have read above, wireless media is also of three types: Radio waves, Microwaves and Infrared. All these waves are types of electromagnetic waves with varying frequency. The following table examines the differences between these three types of waves.

	Radio waves	Microwaves	Infrared
1	Operates in the frequency range of 3KHz to 1GHz	Operates in the frequency range of 1GHz-300GHz	Operates in the frequency range of 300GHz-400THz
2	Used for medium range communication	Used in long range communication	Used in short range communication.
3	Data can travel in the range of 1mbps to 10mbps	Data can travel in the range of 1mbps to 10mbps	Data can travel in the range of 100kbps to 16mbps
4	Cost of installation is high	Cost of installation is very high	Cost of installation is low.

Test Yourself 3

Consider a scenario where you want to connect 20 PCs in LAN. Which media will you use? Also note that the budget to connect PCs in LAN is very low. Give reason to justify your answer.

Test Yourself 4

Match the items in group A with those in Group B:

Group A	Group B
1. Twisted-pair cable	A Can transmit data up to 1600Gbps
2. Co-axial cable	B Operates between 300GHz to 400THz
3. Fibre optic cable	C Can transmit data up to 600Mbs
4. Radio waves	D Operates between 3KHz to 1GHz
5. Microwaves	E Operates between 10Hz to 300MHz
6. Infrared	F Can transmit data up to 1Tbps
	G Operates between 1GHz to 300GHz
	H Can transmit data up to 10Mbps

Answers to Test Yourself

Answer to TY 1

1. The correct answer is **B.**

   Twisted-pair cable is of two types: UTP (unshielded twisted-pair) and STP (shielded twisted-pair).

2. The correct answer is **A.**

   Twisted-pair cable is an example of guided media consisting of three types of cables: twisted-pair cable, co-axial cable and fibre optic cable.

3. The correct answer is **C.**

   Radio bands are governed by International Telecommunication Union (ITU) to avoid interference between the radio bands. The radio spectrum is governed by International Telecommunication Union.

4. The correct answer is **D.**

   Microwave uses point-to-point type of communication because microwaves are very narrow beams.

Answer to TY 2

(a) The given statement is **false.** Twisted-pair, co-axial and fibre optic are examples of guided media.

(b) The given statement is **false.** Radio waves, microwave and infrared are examples of unguided media.

(c) The given statement is **false.** The core of fibre optic cable is in micro-metres (μm).

(d) The given statement is **true.** They are single mode and multimode.

(e) The given statement is **false.** Infrared waves cannot penetrate through walls.

Answer to TY 3

In the given case we can use both wired as well as wireless media. But considering the available budget, wired media is the better solution. Using twisted-pair cable, all the PC's can easily be connected in LAN.

Reasons to select wired media:

(i) Wired media is less expensive compared to wireless media.
(ii) Twisted-pair cables which are used to connect PC's are capable to carry data at the rate of 600mbps which is more than sufficient for LAN purposes.
(iii) Data authentication is more in wired media compare to wireless media.

Answer to TY 4

Group A	Group B
1.	C
2.	H
3.	A
4.	D
5.	G
6.	B

Self Examination Questions

Question 1

Computer is an example of _____.

A Data communication terminal
B Data communication channel
C Data communication hardware
D Data communication software

Question 2

Twisted-pair cable is an example of _____.

A Data communication terminal
B Data communication channel
C Data communication hardware
D Data communication software

Question 3

Briefly explain the following transmission media.

(a) Twisted-pair cable
(b) Co-axial cable

Answers to Self Examination Questions

Answer to SEQ 1

The correct answer is **A.**

Computers are used to send and receive data which is the function of a data communication terminal.

Answer to SEQ 2

The correct answer is **B.**

Twisted pair cable is used to carry data which is the primary function of a data communication channel.

Answer to SEQ 3

Following is the explanation of transmission media:

(a) Twisted-pair cables

(i)   Twisted pair cable is a guided media.

(ii) These are most commonly used cables for data transmission.

(iii) It consists of two conductors which are covered by an insulator for protection purposes.

(iv) One conductor is used for carrying data while the other for ground purposes.

(v) The number of twists determine the quality of the cable, larger the number, the better the cable quality.

(vi) These cables are generally used to carry data of low frequencies.

(vii) Twisted-pair cable is divided into two categories:

   Shielded twisted-pair (STP), and
   Unshielded twisted-pair (UTP).

(viii)Twisted-pair cables are used in LAN and telephone connections.

(b) Co-axial cables

(i)   Co-axial cables are also referred as coax.

(ii) These cables are capable of carrying data at higher frequency.

(iii) It consists of two conductor's i.e. inner conductor and outer conductor.

(iv) Inner conductor is mostly of copper which is used to carry data, while outer conductor is made up of a metallic braid used for providing a shield.

(v) Each conductor is covered by an insulation, generally plastic, and then finally covered by a protection jacket.

(vi) Co-axial cables are mostly used in cable TV.

DATA COMMUNICATION SYSTEMS

D4

STUDY GUIDE D4: DATA COMMUNICATION HARDWAE

■ Get Through Intro

The modern-day businesses do not have geographical barriers and are spread across the globe. However, to co-ordinate and work as a team, these business set-ups need to be networked. The network may be necessary to exchange information, share research or to prepare consolidated financial statements. Therefore, it is important to know the various communication hardware used in communications and the specific role each part of hardware plays in performing the communication.

The purpose of this Study Guide is to introduce you to the different data communication hardware and also understand how various parts of hardware interact with each other to communicate data in a network. Furthermore, we will also compare the communication hardware to examine their relative advantages and disadvantages.

■ Learning Outcomes

a) Explain various data communication hardware.
b) Compare capabilities of each type of hardware.
c) Explain type of data needs to be conveyed in each of the identified data communication hardware.

1.	Explain various data communication hardware.

1. Explain various data communication hardware.
Explain type of data needs to be conveyed in each of the identified data communication hardware.

[Learning Outcomes a and c]

In the previous Study Guides, we already discussed the data communication systems, including the various data communication terminals and the data communication channels. In this Study Guide, we will build upon the knowledge acquired so far and discuss the hardware used in the communication of data through a network.

In any communication network, whether it happens through the internet or LAN or WAN, there are five basic components:

(i)   The sender (Source Host)
(ii) The communication interface devices
(iii) The communication channel (Medium)
(iv) The receiver (Destination Host)
(v) Communication software

The second and third components of the above five components comprise hardware which relays information to and from the source and destination host.

The most common communication interface devices which function in a network communication can be shown pictatorially as follows:

Figure 1: Communication Channel
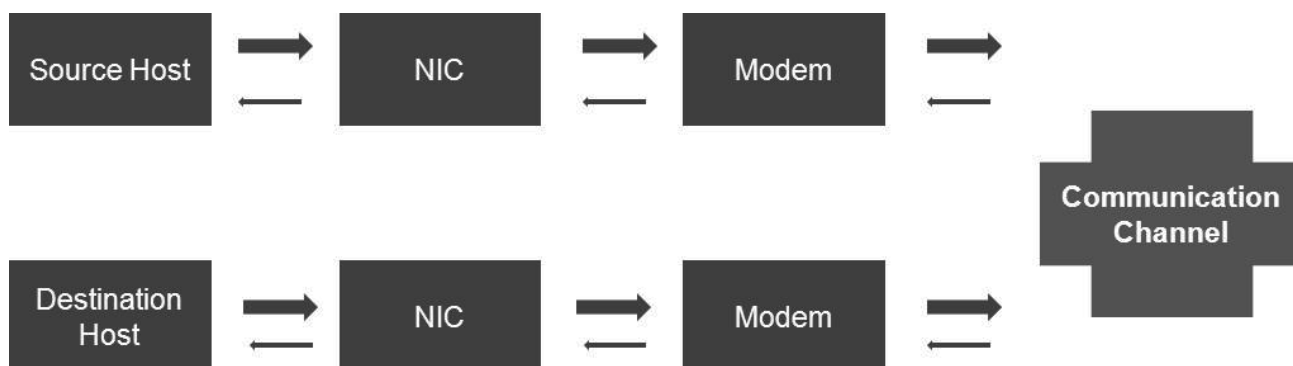
We will now briefly describe the most commonly used communication devices.

1.   Network Interface Card (NIC):

Every computer, whether it is the source host or the destination host, is equipped with a special card called Network Interface Card (NIC). The NIC provides the connector to attach the network cable to a server or a workstation. It provides a physical connection between the network and the computer system.

The computer system recognises these NIC cards after device drivers are installed. The purpose of an NIC is to communicate with the network and it has additional memory for buffering incoming and outgoing data packets. This improves the transmission of data on a network. In simple words, NIC establishes a link between a computer and a network, and then manages that link.

Each NIC has a unique address referred to as Media Access Control (MAC) address. This is to ensure that the inbound communication which happens in a network is picked up by the right computer.

Nowadays, even wireless network interface cards (WNIC) are available in the market. In WNIC, a computer or a device can access data on a wireless network.

Example

Mark wants to access a website and he gives a command to his computing system to open the website. The computer passes the site information to the NIC, which then converts the website address into electrical impulses. The network cables relay this command to the Web server, and the web server responds by sending a Web page back to Mark. Again, this response is in the form of electronic signals. The NIC receives these signals and turns them into data that can be displayed on the visual display unit (monitor) of Mark.

Role of NIC:

The role of NIC is to:

a) Pick up the data, and send it to network cables from the computer
b) Control the flow of data between the computer and the cabling system by dividing data in small transmission packets
c) Receive incoming data from the network and send it further for processing to the CPU.

2. Modem

Modem is a device which transmits data over a telephone or cable line. The function of a modem is to convert digital signals received from a computer device into analog signals to be sent over communication lines (phone lines). Similarly, it also converts the analog signals into digital signals when data is received.

Modems can be classified as internal modems or external modems on the basis of the place where they are installed. Also, nowadays wireless models of modems are available. These modems use Wi-Fi Technology to communicate with the computer system.

The word modem is derived from the words modulator-demodulator. It is a device that transmits and decodes signals to reproduce original data. It converts the Digital signals to Analog signals and vice-versa and transmits them over a channel. Digital means signals in digits or numbers. In digital signals, information is coded and transmitted in a binary form (in 1s and 0s). The digital method of exchanging signals is more advanced than analog signals. In analog systems, even a small fluctuation may change the meaning significantly.

3. Switches and hubs

When computers are networked, they cannot be simply connected to each other through a cable. Instead, a computer is plugged into a separate device referred to as a hub. In a single hub, many computer devices can be connected at one time. The connection to a hub is done through cable (either coaxial or twisted pair) or it may even be done wirelessly. Hubs can also perform the task of repeaters and do not provide intelligent forwarding of data.

A switch, on the other hand, is a sophisticated version of a hub. The switches have now replaced the traditional hub and nowadays computer systems are networked using a switch. A switch is more efficient than a hub in terms of speed and also it keeps a track of data to be sent to the respective computer on receipt of data. A hub sends the data to all the computer systems in the network instead of sending it to a specific computer.
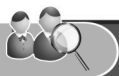
Example

Imagine a computer network in which 8 computer systems are connected to each other through a hub. Suppose computer A is connected to Port 1 on the hub and Computer B is connected to Port 5 on the hub. If computer A sends data to computer B, the hub receives the packet on Port 1, but will relay the information to all the other 7 ports i.e. Port 2 to Port 8.

On the other hand, if the computer systems were connected through a switch, a switch would send the data received from Computer A (Port 1) to Computer B (Port 5) only.

Referring to the above example, we can infer that the data transmission speed is quite high in a switch as data is transmitted to a specific computer. Furthermore, from the security point of view, switches are more secure than hubs, as data is not transmitted to unintended computer systems.

Characteristics of a switch
Usually, switches are installed in a metal box and may also have the functionalities of a modem and routers.
They have a specialised software management system to configure data and security.
Usually, switches are preferred in a star wired and star wired ring network.

4. Repeaters

When data travels from a switch to the computer system, the electrical impulses being transmitted through the cables can get deteriorated. Such loss of signal strength is referred to as attenuation. In such a case, repeaters may be used to amplify the signals and rebroadcast it. These are generally used when the wired network exceeds a limit, due to which there might be attenuation.

5. Multiplexors and concentrators

A multiplexer is a device that allows several terminals to use one line to communicate with a CPU by sending their messages simultaneously. In other words, a multiplexer collects messages from various senders, puts them in order and transmits them to receivers along a broadband channel at a very high speed.

A concentrator is essentially a smart multiplexer. It can be programmed, has more processing capability and is more flexible than a multiplexer.

6. Routers

A router translates information from one network to another. The router selects the best path to transmit data in a network based on the destination address and origin of data. Routers determine addresses of other computers connected to other routers and modems connected to the network. The routers have replaced the hubs and switches that are capable of performing basic functions. Routers are smarter because they can analyse data and even communicate over networks with different protocols. Nowadays, modems possess features of a router. They perform the dual function of routing data traffic and converting signals from analog to digital and vice versa.

Characteristics of a router

a) A router can manage the data traffic in an efficient manner. It can keep a log of network usage statistics, handle security issues and also maintain a log of errors while transmitting data.
b) A router can transmit data between two protocols. For example, it can transmit data from the FTP server to a TCP/IP protocol. (Note FTP and TCP/IP are file transfer protocols used in a network.)
c) Routers are used to transmit data in linear, star, bus and star wired networks.
d) Routers can transmit data through various mediums such as fibre optic, coaxial, twisted pair and even wirelessly.

Example

A company has three divisions: Foundry division, Manufacturing division, and Accounts and finance division. All these subdivisions are linked with a router on the internet. The router here manages the data traffic in this network. If an employee from the foundry division wants to communicate with another employee from the manufacturing division, the router looks at the recipient's address and determines the best possible way to transmit the data to the intended recipient. While connecting the host with the recipient it ensures data safety and also keeps a log of data being transferred.

The following Figure summarises how a computer network uses the hubs and routers to communicate data:

Figure 2: Home Network
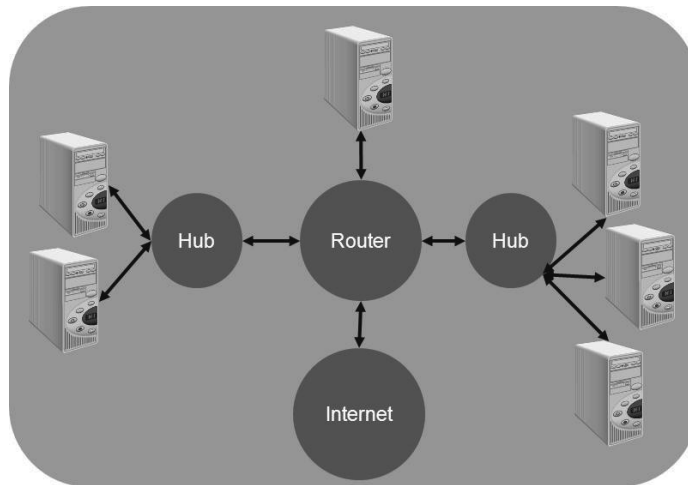
7. Computer network cabling

Cables are popularly used to connect network devices. Cabled networks are generally used in schools, businesses and government facilities. There are several types of cables available for connecting networks and the choice of a proper cable is dependent upon the network topology, protocol and size of the data network. The most commonly used network cables include:

(a) Coaxial cables

Coaxial cables are made up of two parts:

    a) Outer material is made of woven or braided material
    b) Innermost part is a single copper wire
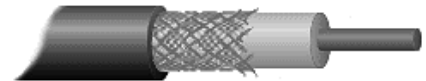
The two parts are separated with a plastic layer which provides insulation between the copper wire and the braided material. These are generally used for cable television broadcast and broadband internet.

Coaxial cable supports 10 to 100 Mbps of data transfer rate and are relatively inexpensive in comparison to other cabling options. The coaxial cables support data transfer over a distance of 500 metres.

(b) Twisted pair cables

Twisted-pair cables are popularly used in telecommunication systems and also for some LAN/WAN connections. These are twisted to provide protection against crosstalk, the noise generated by adjacent pairs.

Twisted-pair wire is the oldest but still the most common transmission media. It is used in established communication networks throughout the world for both voice and data transmission.

Twisted cables come in two varieties: Shielded twisted pair (STP) and unshielded twisted pair (UTP).

The quality of UTP cables ranges from simple cables to high speed cables. Generally, these cables have four pairs of wires for communication. Each pair is twisted differently which helps to eliminate interference from adjacent pairs. The data transfer rate is around 1-100 MBPS in UTP and up to 500 MBPS in STP.

(c) Fiber optic cables

Fibre optic cable consists of a centre glass core which is surrounded by protective layers of materials. These cables are used for high speed communication. It uses a technology which transfers light instead of electronic impulses. This, therefore, eliminates the problem of electrical interferences. The entire cable is surrounded by a strengthening material and covered by a plastic covering. A single cable consists of several glass fibres and each fibre is covered with protective plastic coating.
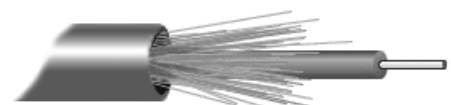
The fibre optic cables support data transfer at a much higher rate than coaxial and twisted pair cables. Furthermore, they carry signals beyond 25 kilometres. Maximum data transfer rate in a fibre optic cable is virtually limitless. The cost of the fibre optic is comparable to coaxial cabling. However, it is more difficult to install and modify.

Test Yourself 1

Which of the following statements is true about the modem?

A   It converts Digital signals to Analog signals and vice-versa and transmits them over a channel.
B   It is not always necessary to connect the computer system to a modem to access internet.
C   It is a telephone communications network.
D   Data communication in modem is always done through the Parallel port.

Test Yourself 2

Each _____has a unique Media Access Control (MAC) address.

A   Network interface card
B   Hub
C   Repeater
D   Port

2.   Compare capabilities of each type of hardware.
[Learning Outcome b]

In this Learning Outcome, we will now compare a few of the types of data communication hardware discussed in Learning Outcome 1 to understand the relative advantages and disadvantages of using a particular hardware.

(i)   Computer network cabling

Twisted pair cable	Co-axial cable	Optical fibre
Transmission of signals take place in an electronic form	Transmission of signals take place in an electronic form	Signal transmission takes place in an optical form
Cheapest medium	Moderately priced	Expensive
Installation is easy	Installation is easy	Installation is difficult
Attenuation is high	Attenuation is low	Attenuation is the lowest
Affected due to magnetic fields	Less affected due to magnetic fields	Not affected by magnetic fields
Bandwidth is better than co-axial cable	Bandwidth is lowest among three	Bandwidth is virtually limitless

(ii)   Switches and hubs

For setting up a small network comprising less than 30 users, a hub may be a more suitable choice. The hub can adequately support the traffic on a smaller network.

In case of a larger network, a switch would be the more desirable hardware. This is because a switch divides the groups of hubs and then smartly manages the data flow in the network. This saves a lot of bandwidth and data is transferred more efficiently.

When adding hubs to the network in order to add more users, there are certain limitations on the number of hubs that can be connected together. In such a case, switches can be used to expand the number of hubs in the network. The most common sizes of switches which are available include 4, 8, 16, 32 and 64 ports.

(iii) Modems and routers

Instead of investing in routers, organisations find it cheaper to purchase modems having the functional capabilities of a router. The modems are smarter and also perform diagnostics checks and maintain logs of network transaction. The modems nowadays also have wireless capabilities due to which multiple users can log onto the network at the same time. Modems with routing capabilities are quite popularly used in small offices to share network and transmit data wirelessly.

Test Yourself 3

The level of attenuation is the lowest in the case of
_.

A   Coaxial cables
B   Unshielded twisted pair cables
C   Fibre optic cables
D   Shielded twisted pair cables

Answers to Test Yourself

Answer to TY 1

The correct option is **A.**

It converts digital signals to analog signals and vice-versa and transmits them over a channel.

Answer to TY 2

The correct option is **A.**

Each NIC has a unique address referred to as Media Access Control (MAC) address. This is to ensure that the inbound communication which happens in a network is picked up by the right computer.

Answer to TY 3

The correct option is **C.**

When data travels from a switch to the computer system, the electrical impulses being transmitted through the cables can get deteriorated. Such loss of signal strength is referred to as attenuation. Attenuation is the lowest in fibre optic cables.

Self Examination Questions

Question 1

Mark wants to set up a network connection in his office. He wants data to be transferred at the highest speed. Which cable should he choose?

A   Coaxial cables
B   Shielded twisted pair
C   Unshielded twisted pair
D   Fibre optic

Question 2

Fill in the blanks

(i)   The _____selects the best path to transmit data in a network based on the destination address and origin of data.

(ii) The function of a _____ is to convert digital signals received from a computer device into analog signals to be sent over communication lines.

Question 3

Briefly explain the following transmission media:

(i) Twisted-pair wire
(ii) Coaxial cable

Question 4

The function of a router is to:

A Screen incoming information
B Distribute information between networks
C Clear all viruses from a computer system
D Provide internet connection to users

Answers to Self Examination Questions

Answer 1

The correct option is **D.**

Fibre optic cables are the fastest medium to transfer data as they use optical technology which is much faster than the traditional cables.

Answer 2

(i) The **router** selects the best path to transmit data in a network based on the destination address and origin of data.

(ii) The function of a **modem is** to convert digital signals received from a computer device into analog signals to be sent over communication lines.

Answer 3

(i) Twisted-pair wire is the oldest but still the most common transmission media. It consists of copper wires twisted into pairs and are used in established communications networks throughout the world for both voice and data transmission. These are popularly used in telecommunication systems and also in some LAN/WAN connections. Twisted cables come in two varieties: Shielded twisted pair (STP) and unshielded twisted pair (UTP).

(ii) Coaxial cables consist of a sturdy copper or aluminium wire wrapped with spacers to insulate and protect it. The insulation minimizes the interference and distortion of the signals that the cable carries. Coaxial cable supports 10 to 100 Mbps of data transfer rate and are relatively inexpensive in comparison to other cabling options. The coaxial cables support data transfer over a distance of 500 metres.

Answer 4

The correct option is **B.**

The function of a router is to distribute information between various networks.

STUDY GUIDE D5: DATA COMMUNICATION SOFTWARE

■ Get Through Intro

Data communication is the transfer or exchange of information from one person to another. For every communication, there is a sender (source) and a receiver.

For any communication to be effective, the medium and the protocol are very critical. Medium is the physical route through which the communication flows. The protocol is the logic or set of rules that guides the communication between the devices used by both the sender and the receiver.

In this Study guide, we shall discuss the various types of data communication software and their capabilities.

■ Learning Outcomes

a) Explain various data communication software.
b) Compare capabilities of each type of software.
c) Explain type of data needs to be conveyed in each of the identified data communication software.

1. Explain various data communication software.
[Learning Outcome a]

1.1 What is data communication software?

The effectiveness of any communication system depends on the following:

    a) Message being transmitted in terms of sound, text, video etc.
    b) Device that sends the message
    c) Device that receives the message
    d) Medium being used by the system
    e) Data communication software being used

Data communication software is the software or set of rules that passes data / information from one system to another. The data may be in any form; e.g. text, sound, video, pictures etc.

1.2 Types of data communication software

Figure 1: Types of data communication software
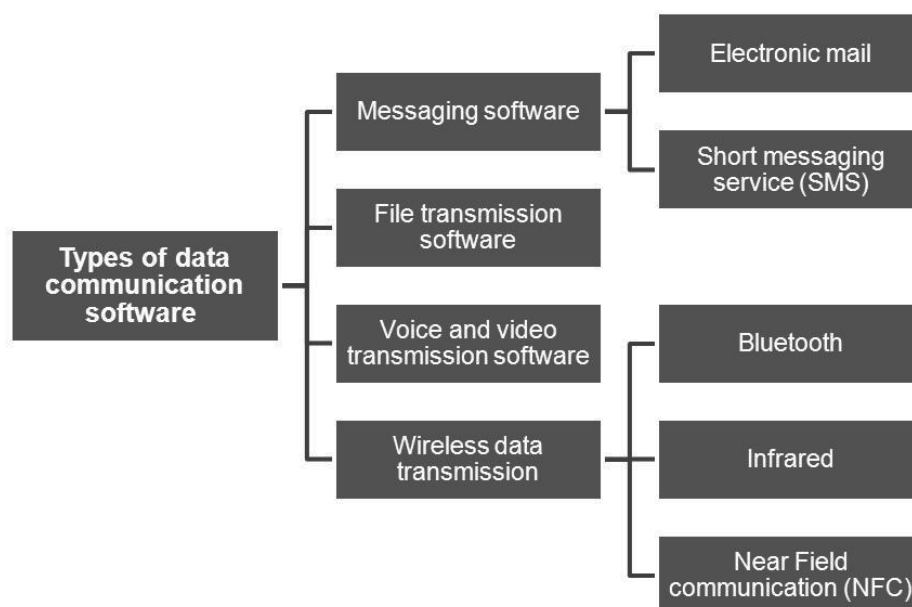
Data communication software comprises the following types:

1. **Messaging software –** this comprises software used to transfer messages in the form of electronic mails (E-mail), short messaging service (SMS) etc.

(a) **Electronic mail** – this is the most commonly used communication software today, where messages are sent electronically over the internet or other network.

Email can be of following types:

    Web based mail – in this case, the mails can be read only with a live internet connection.
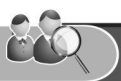
Example

Elliot sends an email from his Gmail account to Yvette who has an email account with Yahoo, by using a compatible web browser.

    Post office protocol (POP 3) email services – in this case, emails are downloaded to the local computer and deleted from the mail server. This ensures more incoming messages. Most email clients using POP3 connect, retrieve and store messages locally and delete them from the server.

IMAP email services – under the Internet message access protocol (IMAP), mail is stored in folders on the mail server. The user can go to the relevant folder and read messages using a device to connect to the server.

(b) Short messaging service (SMS) – SMS has a very wide application for text messaging on the phone, web etc. It allows fixed or mobile phone devices to transfer messages. SMS includes flash SMS (where the message flashes on the device) and silent SMS (to trace the location of the person).

2. File transmission software

This refers to the protocols available to transmit files over the internet. File transmission protocol (FTP) is an application protocol which is used to:

a) download files from the server to the local computer
b) transfer web page files from the sender to the server.

It uses the Internet's TCP/IP protocols. The web browser can make file transfer requests to download certain files / programs from web pages. It allows you to move, copy, delete and rename files. Publicly available files can be downloaded using FTP.

There are numerous types of software available to secure file transfer. SFTP uses secure shell (SSH) to transfer files. It obstructs passwords and other confidential information from being transferred.

Example

Win SCP (Windows secure copy) – apart from securing file transfer, it performs basic file manager and file synchronisation functions. It is a graphic user interface.

3. Voice and video transmission software

Voice over internet protocol (VOIP) is the protocol to deliver voice communication over internet. The methodology in internet telephony is similar to digital telephony. The voice communication is digitized and transmitted over an internal protocol (IP). Examples of VOIP include Skype, Google talk etc. It can be connected to desktops, smart phones, tablets etc.

Skype has built a restricted network of users who login to it. Users benefit through free calls. Advancement over this is Google talk which allows users on different domains on the internet to call and connect. It is a shift from the earlier voice protocols.

4. Wireless data transmission

(a) Bluetooth

This technology primarily supports wireless networking on personal computer devices, cell phones, and wireless headsets. Signals are normally transmitted over short distances, typically 10 meters. Bluetooth was a project started by a special interest group consisting of four entities, IBM, Nokia, Intel and Toshiba. The technology features on network called piconet. It consists of a minimum two and maximum of eight peer devices. The devices use protocols that form part of the Bluetooth specification for communication.

(b) Infrared

This technology communicates over short distances - say 5 metres via short range wireless signals. It can be used to transfer files between personal computers, laptops and mobile handsets.

(c) Near Field communication (NFC)

It is a technology that operates at very small range of about 4 cms. It is based on the technology where two devices establish a peer to peer network. Google is including the technology in Android. NFC uses electromagnetic radio fields for communication.

Test Yourself 1

Match the following

S No.	Software	S No.	Type
1	Skype	**A**	FTP
2	Bluetooth	**B**	VOIP
3	WinSCP	**C**	Messaging software
4	SMS	**D**	Wireless

2. Compare capabilities of each type of software.
Explain type of data that needs to be conveyed in each of the identified data
communication software.

[Learning Outcome b and c]

In the preceding learning outcome, we have discussed the different types of communication software that can be deployed. Depending on the data that needs to be conveyed primarily, the appropriate software can be selected.

Let us now compare their capabilities in terms of their usage, areas of application, advantages, constraints etc.

The following is a comparative table of the different types of communication software:

Criteria	Messaging software	
	E-mail	**SMS**
Primary Usage	Send / receive written communication / confirmations	Send / receive short messages
Applications	Extensive usage for both personal and business communications Product advertising Auto mails is possible Complete communication due to facility of attachment	Notifications Information like weather updates, news, entertainment Mobile chatting Balance enquiries Alerts on email / dues etc.
Technology	Web based mail POP 3 protocol IMAP email services	GSM , CDMA, TDMA
Primary advantage	Speed in communication accompanied with advantage regarding size Easy to use Environment friendly (has assisted the world in reducing the use of paper for communications)	Cost advantage and time saving as compared to calls
Disadvantages	Spam mails Possibility of virus Not possible to authorise documents through email	Lengthy communications not possible Most SMS providers use proprietary protocols, and application developers need to implement different interfaces for making their applications work with different SMS centers.
Message length	10 MB (through web)	160 characters
Type of data that is conveyed	All type of data can be conveyed through emails. However data size needs to be small (up to 20 mb) to ensure that email inbox does not get blocked due to huge files.	Suitable for text data and small resolution graphical images. SMS technology does not support huge data transmission.

Criteria	Voice transmission	
	Skype	**Google talk**
Primary Usage	Voice chat and send / receive messages	Send / receive messages and voice
Applications	Networking Business discussions including interviews Video conferencing Geo locator Education	
Technology	Skype protocol	Extensive messaging and presence protocol (XMPP)
Primary advantage	Free voice and video call Can receive calls from public network	Allows access to Gmail account where emails can be managed
Disadvantages	Security breaches at times Cyber teasing	User requires a Gmail account to operate
Restrictions	Up to 10 persons can video conference, if one has a Skype premium paid subscription	Video chat is possible up to 10 persons
Type of data that is conveyed	Through skype one can send files online to multiple contacts during a voice call / group call or video call. There is no specific limit on size. Similar with receiving files. However one needs to be careful while receiving files and ensure a suitable anti-virus software is in place.	Any sort of file can be sent through google talk. In case of larger downloads, the status is provided by the time to completion.

Criteria	Wireless transmission		File transmission software	
	Bluetooth	**Infrared**	**FTP**	**SFTP , Win SCP**
Primary Usage	Wireless networking	Car locking systems Computer Emergency response systems Radio Headphones	Transfer / download files	
Advantage	Secure since there is an authentication required	Can be used to transfer files between computers Low power consumption	Speed - efficient way to send/copy files Queuing of files for downloading is possible Large files can be copied with ease	Secure, since passwords etc. are encrypted
Disadvantages	Virus possibility Messages from strangers It can work only on devices that have incorporated this technology	Low speed Limited range	Possible leakage of confidential information like user ids / passwords	
Restrictions	Signals are normally transmitted over short distances typically 10 meters	Communicates over short distances say 5 metres via short range wireless signals		

Criteria	Wireless transmission		File transmission software	
	Bluetooth	**Infrared**	**FTP**	**SFTP , Win SCP**
Type of data that is conveyed	• Files • Contact details • Hands free kit where the earpiece uses Bluetooth to send and receive sound from the phone device • Wirelessly control devices – by pairing smart phone to speakers one can play music from phone through speakers and also use phone to adjust volume etc.	• Infrared has been displaced by other wireless technologies viz. WiFi, Bluetooth because they do not require a direct line of sight, and can support hardware such as mice and keyboards. • It is still used in cases where wireless technologies cannot be used due to interference	• Means of exchanging files • Protocol can be considered interactive, since clients and servers converse when they authenticate themselves and negotiate file transfers	Secured transfer of files

Test Yourself 2

List the advantages of E-mail as messaging software

Answers to Test Yourself

Answer to TY 1

1 B, 2 D,3 1, 4C

Answer to TY 2

E-mail is the most widely used messaging software. It has replaced the need for travelling physically between homes and offices. The advantages of email as messaging software are as follows:

a)   Speed in communication

b)   Simple to understand and use

c)   Can be used for surveys

d)   Advertisement of products and services

e)   Files can be sent along with emails

f)   Helps to achieve the aim of paperless offices

Self Examination Questions

Question 1

(a) What are the different types of data communication software?

(b) Which would be the most appropriate to deploy in each of the following situations?

(i) Quick message for action

(ii) Business report with supporting documents

(iii) Voice chat and transfer of video over internet to a resident in a foreign country

Question 2

Fill in the blanks

(i) _____ is an application protocol which is used to download files from the server to the local computer.

(ii) _____signals are normally transmitted over short distances; typically 10 meters.

(iii) _____is the protocol to deliver voice communication over the internet.

Answers to Self Examination Questions

Answer to SEQ 1

(a) Data communication software primarily aims at transmission of data whether in the form of text, voice, files etc. The following are the different types of communication software:.

  a) Messaging software – Email, short messaging service (SMS)
  b) File transmission software like Win SCP, SFTP
  c) Voice and video transmission software like Skype, Viber, Google Talk
  d) Wireless Communication – Bluetooth, infrared etc.

(b) Communication software that will be used in each of the following situations:

(i) Quick message for action

In this case, short messaging service (SMS) is the most suitable to send the required message through a mobile handset or other device.

(ii) Business report with supporting documents

Email would be appropriate since there would be a lot of content in the report along with the supporting documents. Electronic mail over internet or other computer network ensures speedy delivery. It is possible to send all working notes as separate attachment files.

(iii) Voice chat and transfer of video over internet to a resident in a foreign country

This can be achieved through a VOIP – Skype or Viber. Videos can be transferred as attachments, free of cost.

Answer to SEQ 2

(i) File transmission protocol (FTP)

(ii) Bluetooth

(iii) Voice over internet protocol (VOIP)

DATA COMMUNICATION SYSTEMS

D6

STUDY GUIDE D6: EXAMPLES OF DATA COMMUNICATION SYSTEMS

■ Get Through Intro

Data communication system enables us to take business decisions quickly. With the help of these systems, it is possible to send and receive data over long distances and the geographical location of two offices, even when located in different corners of world, is no longer a matter of concern. Communication between them has been made efficient and easy through data communication systems.

This study guide will inform us about the classification of data communication systems and how they are different with respect to each other.

■ Learning Outcomes

a) Explain various data communication systems.
b) Compare capabilities of each type of system.

1. Explain various data communication systems.
   Compare capabilities of each type of system.

                                                        [Learning Outcomes a and b]

Definition

Data Communication System is a collection of hardware and software components, inter-connected either through wires or in a wireless form, with the objective of providing a means of effective and efficient communication between two or many users, irrespective of geographical limitations.

Depending on the way they perform and the technology they use for transmitting data, data communication systems can be classified into two categories:

   a) Direction of communication, and
   b) Nature of information signals

Figure 1: Data communication system
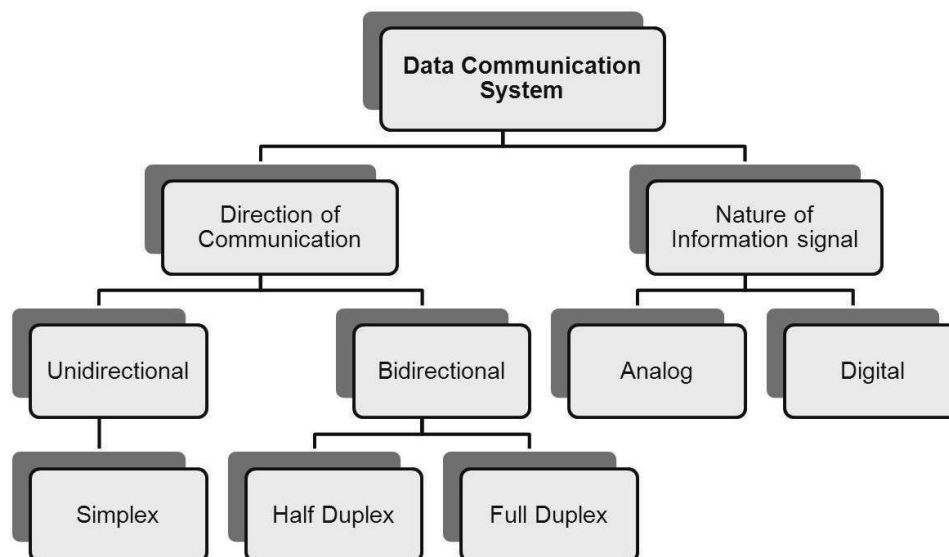
1. Classification based on the direction of communication

Under the classification on the basis of direction of communication, data communication system can be divided into two types:

   a) Unidirectional, and
   b) Bidirectional.

A unidirectional system is a system in which information or data can travel in only one direction and these systems are called 'Simplex system'. In a bidirectional system, information or data can travel in both directions and these systems are called 'Duplex system.'

However, generally the data communication systems categorised under direction of communication are said to be of three types:

   a) Simplex system
   b) Half Duplex
   c) Full Duplex

(a) Simplex system

Simplex system is an example of unidirectional system i.e. information or data can travel only in one direction. When two devices are connected to each other, only one device is capable of transmitting data while the other device receives the transmitted data. Simplex systems are capable of transmitting data in both analog and digital form.

Example

Radio broadcasting is an example of simplex system. Here a radio transmitter transmits the data and the receiver, receives it. Another example of a simplex system is the inputting of data using a keyboard.

Radio broadcasting (simplex system)
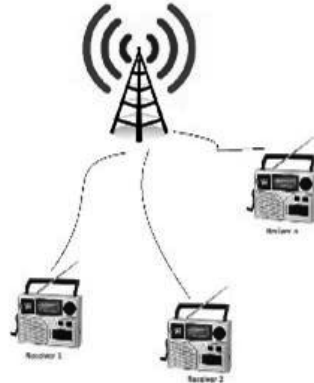
(b) Half Duplex

Half duplex system is an example of bidirectional system i.e. information or data can travel in both the directions but one at a time. This means that when one device is transmitting data the other one has to receive it and vice-versa. Here both devices are capable of transmitting and receiving data. Half duplex systems are also capable of transmitting data in both analog and digital forms.

Example

Walky-talky is an example of half duplex system in which if one device is transmitting data then the other device has to receive it.

Half duplex System-Walky-talky

(c) Full Duplex

Full duplex system is an example of a bidirectional system i.e. information or data can travel in both directions. Here both the devices are capable of transmitting and receiving data simultaneously. Full duplex systems are also capable of transmitting data in both analog and digital forms.

Example

Telephone is an example of a full duplex system where we can transmit data in both the directions simultaneously.

Comparison between Simplex, Half Duplex and Full Duplex system:

Having studied the working of the simplex, half duplex and full duplex systems, let us now study them in comparison using the following table:

Simplex System	Duplex System	
	Half Duplex System	Full Duplex System
Data can be sent only in one direction.	Data is transferred in both the directions but only one at a time.	Data is transferred in both the directions simultaneously.
Devices are designed to either only send or receive data.	Devices are designed for sending as well as receiving data.	Devices are designed to send as well receive data.
A receiving device is dependent on the transmitting device i.e. a receiver can only receive data when the transmitter sends it.	When one device is sending the data the other one has to wait and vice-versa.	Devices need not wait for the other device to complete its task. Transmission and receiving can go on simultaneously,
Uses analog as well as digital signals for data transmission	Uses analog as well as digital signals for data transmission	Uses analog as well as digital signals for data transmission
Radio broadcasting is an example of a simplex system.	Walky-talky is an example of a half-duplex system.	Telephone is an example of a full duplex system.

2. Classification based on the nature of information signal

That data can be transferred in an analog or digital form has been already covered in study guide D1. We are aware that when data is sent, it is transmitted either in the form of an analog signal or a digital signal. Based on the type of signals the systems used for data transmission are classified as:
   a) Analog communication system
   b) Digital communication system

(a) Analog communication system

In this system data is transferred in the form of analog signals. The biggest advantage of using an analog system is that these systems are easy to design and the cost of these systems is less compared to digital systems. The disadvantage of these systems however, is that the effect of noise is very high. Analog systems can be unidirectional or bidirectional.

Example

Radio broadcasting is an example of an analog system since it uses analog signals for transmitting data. Telephone also is an example of an analog system.

(b) Digital communication system

In this system data is transferred in the form of digital signals. Digital systems were designed to overcome the drawback of the analog systems. The biggest problem of noise that was faced in analog systems, was overcome by the digital system. Apart from this, digital systems also have the capability of sending data in an encrypted form. The drawback of digital systems is that they are complicated to design. Digital systems can also be both, unidirectional and bidirectional. Satellite communication, inputting data from a keyboard to the CPU are both examples of digital systems.

Comparison between analog communication system and digital communication system:

Analog communication system	Digital communication system
Uses analog signal for data transmission.	Uses digital signal for data transmission.
Are easy to design	Are complex to design
The cost of these systems is high compared to digital communication system.	The cost of these systems is reducing due to technological advancements.
These systems are easily affected by noise.	The effect of noise in these systems is less.
These systems are suitable for short distance communication.	Long distance communication can be easily done using these systems.
Data encryption is not possible in this system.	Data encryption is possible in this system.
Radio, TV broadcasting are examples of analog communication.	Satellite communication is an example of digital communication.

Example

Explain in one sentence, what you mean by Simplex, Half duplex and Full duplex system.

Test Yourself 2

State whether the following statements are true or false.

(a) In simplex system data can be sent in both directions.
(b) In analog system data is transferred in the form of a digital signal.
(c) Digital systems are complex to design.
(d) Telephone is an example of a full duplex system

Test Yourself 3

A simplex system uses:

A   Analogy signal for data transmission
B   Digital signal for data transmission
C   Both (i) & (ii)
D   None of above

Test Yourself 4

Walky-talky is an example of:

A   Simple system
B   Half duplex system
C   Full duplex system
D   None of above

Answers to Test Yourself 1

Answer to TY 1

(a) A **simplex** system is a system in which a device can only send or receive data.
(b) **Half duplex** system is a system in which a device can send and receive data but only one at a time.
(c) **Full duplex** system is a system in which device can send and receive data simultaneously.

Answer to TY 2

(a) **False.** In simplex system we can send data only in one direction.
(b) **False.** Digital system uses digital signals for data transmission.
(c) **True.**   .
(d) **True.**

Answer to TY 3

The correct answer is **C.**

Simplex system can transfer data in analog as well as digital form.

Answer to TY 4

The correct answer is **B.**

Walky-talky is an example of half duplex system.

Self Examination Questions

Question 1

Explain the different type of data communication systems based on the direction of data.

Question 2

Differentiate between an analog communication system and a digital communication system.

Question 3

What are the advantages of a digital communication system over the analog communication system?

Answers to Self Examination Questions

Answer to SEQ 1

Based on direction of data, data communication systems are either Unidirectional or Bidirectional and they are called:

(a) **Simplex system:** in this the device can send data only in one direction and hence it is called a unidirectional system. The device can either send data or receive data. For example - radio broadcasting.

(b) **Half Duplex system:** in this the device can send as well as receive data in both the directions and hence it is called a bidirectional system. The device can send and receive data but not simultaneously. For example - walky-talky.

(c) **Full Duplex system:** in this the device can send as well as receive data in both the directions and hence it is called a bidirectional system. The device can send and receive data simultaneously. For example - telephone.

Answer to SEQ 2

The difference between analog communication system and digital communication system is:

Analog communication system	Digital communication system
Uses analog signal for data transmission.	Uses digital signal for data transmission.
Are easy to design	Are complex to design
The cost of these systems is high compared to digital communication system.	The cost of these systems is reducing due to technological advancements.
These systems are easily affected by noise.	The effect of noise in these systems is less.
These systems are suitable for short distance communication.	Long distance communication can be easily done using these systems.
Data encryption is not possible in this system.	Data encryption is possible in this system.
Radio, TV broadcasting are examples of analog communication.	Satellite communication is an example of digital communication.

Answer to SEQ 3

Advantages of digital communication over analog are:

(a) Using digital communication system helps us in sending data over long distances with minimal effect of noise. Although, it is possible to send data over long distances using an analog communication system as well, but in that we need to amplify the signal at a certain distance to reduce the noise effect.

(b) The digital communication system reduces data redundancy. Data redundancy means, storing of similar data at multiple locations in the same database.

(c) Digital communication is cheaper.

(d) Data encoding is possible in digital communication systems.

INTERNET AND E-BUSINESS

E1

STUDY GUIDE E1: INTERNET, INTRANET AND EXTRANET

■ Get Through Intro

Internet is the new infrastructure of the business world today. Due to the internet, the world has come closer and it is possible to do business across borders very easily. We can send important messages and documents within a fraction of a second in any corner of the world. We can also have important meetings and chat through the internet using Skype.

Lots of information is available through different search engines like the most used one "Google". It has the answers to all your questions.

There is an information explosion - all you want to know is just a click away.

It is cheaper, faster and a very easily accessible and usable way of sending and receiving information. Today's businesses, small or big, are completely dependent on the internet. It also is environment friendly; now you don't have to use paper and ink and can store information in e-format.

In this Study Guide, we will see how we can use the internet to get the desired output.

■ Learning Outcomes

a) Define the terms internet, Intranet and extranet
b) Explain various tools available in internet (www, email, blogs, social networks and any other tool).
c) Explain usage each of the available tools in internet.
d) Explain the differences between Internet, Intranet and Extranet (How are they related/how do they differ?)
e) Search information on the internet.
f) Evaluate information available in the internet.

1. Define the term internet.

Internet

Definition

Internet is a means to connect a computer to any other computers that are placed anywhere and everywhere in the world through dedicated routers and servers.

In other words, internet is a means by which two computers are able to send and receive all types of information like videos, audios, computer programs, messages and pictures.

The name internet originated from the world ARPANET i.e., the Advanced Research Projects Agency's Wide Area Network. It was established in 1960s by the US Department Of Defense, initially to collaborate in military research by businesses and government laboratories. When universities and other US institutions later on got connected to it, it resulted in ARPANET growing beyond everyone's expectations and acquiring the name 'Internet'.

The internet enables computers all over the world to connect to each other. This connectivity enables information and resources to be shared between people and companies.

Features of internet

1. Geographic distribution

The coverage of the internet is global. It is not restricted to a particular country or region. Once a computer is connected to the internet, it can communicate with any computer or device connected to the internet throughout the world. Various internet technologies such as web, newsgroup, blogs, emails, etc. enable geographically distributed users to communicate.

2. Robust architecture

The internet is a robust architecture as it is not affected by damages or outages to individual sections. The internet is a robust architecture which is not affected by any damages to individual sections. There is no central control and the network is so large that it cannot be hijacked as a whole.

3. Near light speed

The internet makes it possible to communicate on real time basis throughout the globe. In the internet, data can be transmitted from one user to another at the speed of light. Due to the constant development in technology, this speed barrier is broken on a daily basis.

4. Universal access

Internet provides universal access to all the users irrespective of their locations. The capabilities of the internet can be harnessed by using powerful computing devices. All computing devices connected on the internet generally use a protocol called Transmission Control Protocol/Internet Protocol (TCP/IP) network protocol to perform communications.

5. Popularity among masses

The internet is the most preferred technology preferred by masses. The internet revolution has witnessed a growth rate in terms of users and also bandwidth. Many applications and software require internet to communicate and capture data.

6. Freedom of speech

Internet provides a global platform to everyone to express themselves and share ideas. In other word, it provides freedom of speech and no one community or country can control the content on the internet.

Test Yourself 1

TCP/IP stands for:

A   Transmission Control Protocol/Internet Protocol
B   Transmission Control Procedures/Internet Procedures
C   Translation Computing Procedures/International Protocols
D   Transaction Computing Printing/Internet Processing

---

2. Explain various tools available in internet (www, email, blogs, social networks and any other tool).
Explain usage each of the available tools in internet.

[Learning Outcomes b and c]

Internet and www

Although internet and www are used interchangeably, they are different. Internet is the hardware part which connects the computers through copper wires, fibre optic cables, and wireless connections. WWW is the software part which brings the web pages through hyperlinks and Uniform Resource Identifiers (URIs).

Therefore WWW is one of the services provided by the internet. The other services include emails, chats, video conference services, cloud services and file transfer services.

Internet tools and their usage

1. Websites

The network of computers all over the world is called the World Wide Web, more popularly known as www.

The web is made of web pages which are text documents. This is linked to other web pages, graphics, audios and video files. It also includes other internet services like file transfer protocols and emails.

Every business organisation or a high-profile person creates his own information pages giving details about the business, products and services, online transfer or payment details, contact details and address etc., which are made available on the internet. Anybody can enter key search letters, for example, if a person wants to buy a book on Macroeconomics, he would type 'Macroeconomics books or publications' in the Google search engine, and it will give him the list of sites where these books are sold like **www.amazon.com, www.bookrenter.com, www.learn4good.com** or **www.ebay.com**. These links are referred to as **websites.** Thus each website has a unique name which is helpful in identifying them on the internet. In technical terms each website has a unique IP address.

The various search engines and keywords give the users the website addresses. Therefore an organisation can use the keywords in its website often to optimise their search engine utility.

Functional components of a website

The major functional components of a website are:

(i) HTML (Hypertext mark-up language)

It is the main mark-up language for a webpage. It helps to specify and display the text, and links it to other webpages, files and internet services through hypertext links. A hypertext link is activated when the user clicks on some specific text or pictures on the webpage - these are specifically on drop down menus.

(ii) HTTP (Hypertext transfer protocol)

It is the main and common communication standard that all the computers in the web use to communicate with each other. It is the set of rules that should be used while transferring files on the World Wide Web, which can be in the form of text, graphics, audio files, video files or any other multimedia files.

(iii) URIs (Uniform resource identifiers)

To locate a resource by its name or address or both, a sequence of characters are used which are known as uniform resource identifiers. A URI, if identified by the name, are called URNs i.e. Uniform resource name and if identified by its location, they are called URLs i.e. uniform resource location. It shows the webpage where specific information is displayed. For example, if a person is searching for a macroeconomics book and knows that he can buy it from 'Amazon', then he would type the URL **http://www.amazon.com/shoppingcart.html**

(iv) Web hardware and software

(a) Web server hardware and software

(b) Web client hardware and browser software

There are thousands of web servers that are connected to the internet. The web pages are put on the web servers so that the users can access the web page. The web servers run special software that allows the users to access the web page and use links that take them to other web pages and internet services. This process makes a Web of links and so it has derived its name - World Wide Web. The users of the web are called "web clients" and the program by which they view the web pages is called "web browser".

Examples of web browsers are:

Internet explorer

Mozilla

Google Chrome

The web browser gets the web page that the web client is looking for by request through http which contains the URI of the web page i.e. **http://www.name.com**. Once the page opens up the content of the page is read by using html commands. HTML specifies the position of the text, font, size of the font etc. Different browsers have different html specifications. Therefore, a web page in one browser may show the text in bold and the same webpage seen in another web browser may show the same text in italics instead of bold.

(v) Search Engines

An index is prepared of the World wide net with the use of Search Engines. Search Engines are created from the web documents, taken from the content of the text and also the keyword that a user of the document could use to search the website. There are different search engines which work in different ways. Some of them search for the keywords typed by the web client in the heading of the information and some search for the words that are emphasised by using bold or italics. The most commonly used search engine is Google and there are some others like **Yahoo, HotBot etc**.

The result of every search engine could be different, therefore a web client must always use more than one browser when searching for specific information and he also should use more than one server. The Worldwide net links the computers on the internet network like a spider's web, which allows the web clients to move from one computer to another. This process of using other computers is called "surfing".

Pieces of information are available on more than one web page, so it is important to use various keywords to form a link to those pages and gather information. Usually there is so much information that there can be an information overload and then it is important to collate only that information which is required by the web client.

Functions of a Website

A website performs several functions. Some of the important functions of a website include:

(i) Give complete information about the business

A website helps the business to advertise their products and to portray the brand. It is also used to sell the products online. In some cases the websites may give information about the dealers / branches where the products or services can be availed by the customers. Websites are also used to publish financial statements and annual business information for the stakeholders. In short, a website gives complete business information to the users.

(ii) Frequently asked questions

A website answers the frequently asked questions about products and services offered to the potential clients. This ensures customers can resolve their doubts without delay and company personnel are saved from the task of asking repetitive questions from customers.

(iii) Collects database of potential clients

A website can help in gathering personal data of potential customers / clients. Personal data may include phone numbers, email addresses, possible inquiry, location of customer, etc. This customer database can be used as a means to reach out to the prospective clients.

(iv) Business location and contact information

Websites provide the addresses of their various business setups. Clients can locate the business entity from the website. Therefore, it becomes easy to locate the business offices, showrooms, warehouses etc. This again saves employees time in giving directions. Website also provides contact details of the relevant officials in case a customer or a prospective customer wishes to get in touch with a specific individual in the organisation. Also, escalations can be made by disgruntled customers higher up in the matrix.

(v) Mirror image of the organisation

A clear and organised website speaks volumes to the visitors of the organisation. The website forms the first impression of the organisation to the users. A professional website gives an impression of the business to be very professional and anybody would like to deal with such an organisation. Therefore, a website is also known as a mirror image of the organisation.

(vi) Reach out to the world

The website brings in and gives out information to large customer base. The sales staff will not be able to reach out to so many as the website can. Search engine optimisations are innovative marketing techniques to reach to the potential customers who have been searching for you.

(vii)Make profits

The main purpose of a website is to help business to make profits. A convenient way is to reach out to masses through the business website and provide easy services and have a larger market share.

Test Yourself 2

State whether each of the following statements is true or false.

(a) Internet is the software part and World Wide Web is the hardware part of the computer.
(b) The major functional components of a website are HTTP, HTML, URI, Search engines.
(c) The result of every search engine is always the same.
(d) The users of the web are called "web clients" and the program by which they view the web pages is called "web browser".

2. **Email**

Email is mail composed and exchanged through computers and computer networks.

Email is short for 'Electronic Mail'. Email is an **electronic medium** of exchanging information. It is a method of writing, sending, receiving and storing messages in an electronic form. Computer files can be sent as attachments with emails.

(a) Features of Email

(i) Email is drafted using word processing software e.g. Microsoft Office Word 2003.

(ii) A central computer provides storage space to the email account holder. The email account holder can access his storage space (email account) by entering the matching username and password.

(iii) The message received from the sender is stored in the **Inbox** i.e. in the storage area earmarked for the email account holder.

(iv) The storage space consists of the Inbox (contains emails received), Outbox (contains emails sent) and various folders (to sort and save mails) of the email account holder.

The email address of the user is divided into two parts by '@' character. The first part is the local name (name to Identify user) of the user and the second part is the domain name (host name) where email is sent. The size of an email address and the characters which can be used in an email address depend upon the email service provider.

Email address: Joelanger@Knighttravles.com

Joelanger is the local name whereas Knighttravels.com is the domain name.

(b) Parts of Email

(i) From: it contains the email address of the sender.

(ii) To: the email address of the receiver is typed here. The message can be sent to several people by including their names in this part. If an incorrect email address is typed in this part, the message will be returned to the sender.

(iii) CC: the email addresses of people receiving a copy of the message are typed here.

(iv) Subject Line: it contains the topic of the message. The recipient obtains an idea about the message from the subject line.

(v) Body: it contains the actual message. This size of this part depends upon the type of message.

(vi) Attachment: it contains the computer files sent along with the message.

(c) Advantages of email

(i) The **speed** of delivery of email is very high. An email gets delivered to the recipient within a few seconds of sending.

(ii) The receiver can immediately reply to the message.

(iii) Message can be delivered to several people at one time easily.

(iv) It is a low cost medium of communication. No paper or stamps are needed to deliver email.

(v) It is **eco-friendly**. Paper (which is made from trees) is not used for delivering email.

(vi) Computer files can be exchanged as **attachment**.

(d) Disadvantages of Email

(i)   It is not a suitable format to confirm a **contract**.

(ii) Time is wasted in deleting **spam** (unwanted emails containing advertisements).

(iii) It is not a secure medium of communication. Hackers can guess email passwords and gain access to the Inbox. Confidential information cannot, therefore, be sent.

(iv) Emails can introduce **viruses** into the computer.

Example

Below is the format of a standard email
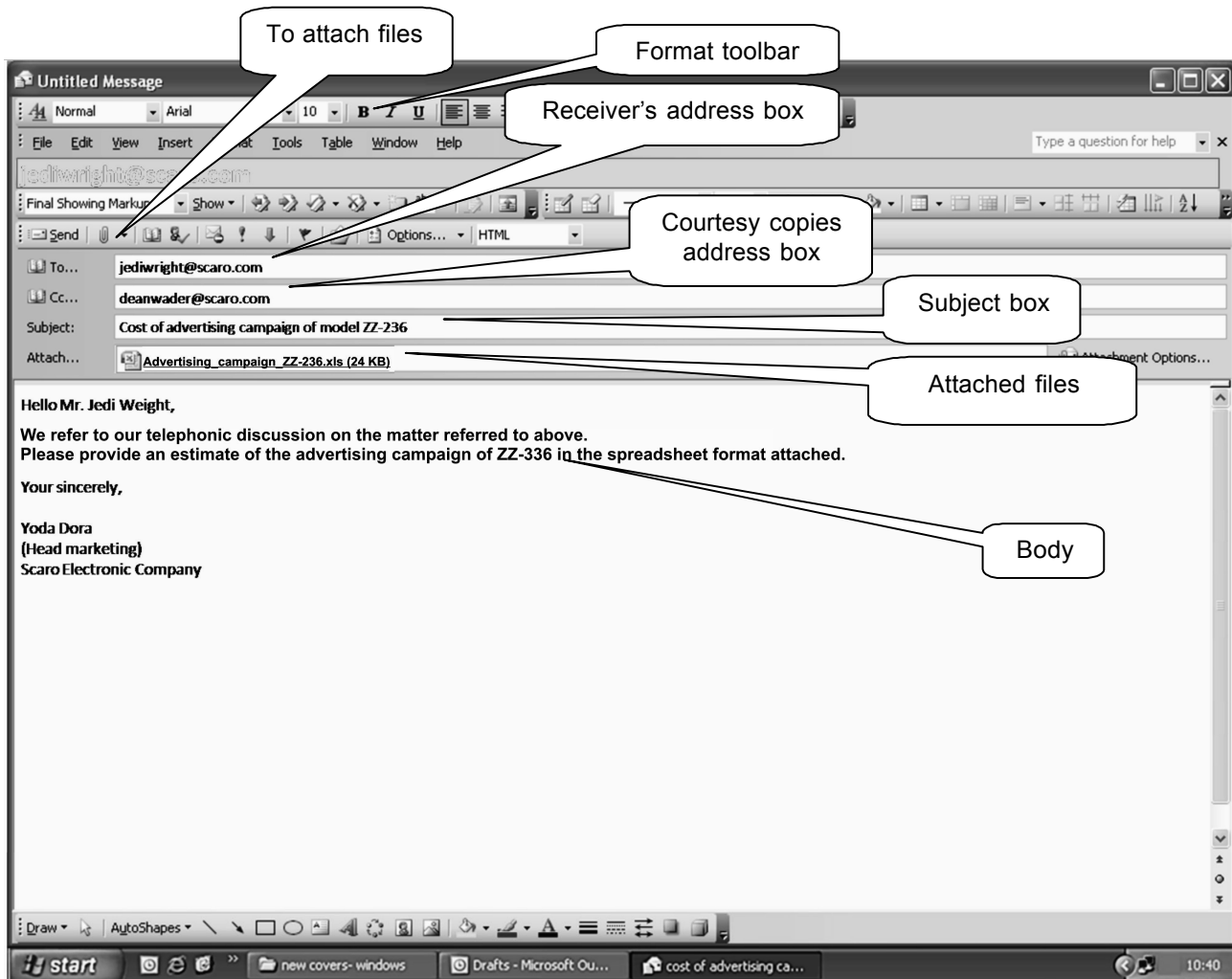
Test Yourself 3

Which of the following is not true about emails?

A   The receiver can immediately reply to the message
B   Emails cannot introduce viruses into the computer
C   Computer files can be exchanged as attachment
D   Confidential information can be sent by email.

3. Instant Messaging (IM)

Instant message, as the name suggests, is a message which two or more people can share instantly as soon as the text is typed by one and sent, it is received by the others in a fraction of a second.

The features of Instant Messaging

(a) Two or more people can contact each other directly and communicate with each other live. It is like a conference call. However, here it is in the form of typed text instead of voice. The web client needs to register with an instant messaging server and then add the list of his contacts.

The moment the web client connects to the internet, the messaging server gets the indication from the special software that the web client is online and in turn all the contacts on the list are informed that the web client is online. The web client too receives information on who from his contact list is online. The web client then can send and receive messages directly to the contacts that are online.

(b) Video conferencing can also be used on instant messaging where files and presentations could be used. The most commonly used instant messaging is Google chat, Yahoo messenger etc.

(c) The user who is registered with one messaging server, for example, Yahoo messenger, cannot send a message to a contact using Google chat. However some messaging servers have removed this limitation as well.

4. Social Networking

The internet has become more popular with many users signing up to use social networking. A social networking is a site developed to bring individuals together to connect with each other. These sites are used for the following:

(a) **Reuniting:** unite people who have lost touch with each other. The web client registers to a reuniting site and puts down his details like name, age, high school name, college etc. This information gets added on the reuniting site's member's database and searches and matches for you the information that is common in its database, thus enabling you to locate some of your batch mates at school and college. Whenever a new member joins in with the same details of the web client's profile, it will be intimated immediately to you. The most commonly used reuniting site is Facebook.

(b) **Friend of friend:** two people unknown to each other share a common link through a common friend know s each of them. A web client can open his account by registering his profile and then adding his list of friends, who can in turn have their list of friends. Now there could be some common and some uncommon friends. The uncommon friends can become the web client's friends through a common friend. Therefore he can access the list of friends of his friend and send them invites if he wants to be friends with them and they can accept his invite and thus can then take the friendship forward. The two well-known friends of friend sites are Friendster and MySpace.

(c) **Common interest:** two people with common interests and hobbies can find each other on the social sites and share their findings, research and developments. For example YouTube, LinkedIn and Meet up. While uploading information on a social networking site the user needs to be extremely careful of the level of personal information put there, as other could access that information due to the above features mentioned of a social networking site like Facebook.com.

Example

Facebook is social networking website which is one of the most popular platforms across the world. It was started by Mark Zuckerberg with his college roommates and fellow Harvard University students. It was limited to Harvard students, but later expanded to colleges in the Boston area, the Ivy League, and Stanford University. They gradually started adding support to various other universities high schools and everyone aged above 13 years could become a registered user of this website. It allows the user to create a personal profile, add other users to their friends list, exchange messages and received messages with automatic notifications. They can join common interest groups for e.g. students studying law can group in, people related to a common profession or organisation, close friends, etc.

5. Blogs

In addition to the social networking sites, many people create their own web sites called blogs, through which they can share information with the users. Blogs can be written on a different topics based on the writers topic of interest. Blogs are posts, which are similar to journal entries coming from a person or a group of people; they are dated and listed in a chronological order. Other people can comment on these posts as well give more information through links to related sites, photos, videos, audios etc.

Feature of a blog page

Features of a blog page include:

(a) It is arranged in a sequence of the newest message first.

(b) The users of this message can comment on the message.

(c) They are written by individual bloggers or group blogs with multiple contributors.

(d) It can become a chain of personal information like a personal diary or common interest, hobby, theme, electronic devices or good books.

(e) Blogs are used as a quick publishing medium and are nowadays used by most of the businesses and newspapers.

(f)   Micro blogs are short and quick sentences which take a few seconds to put down. This is only meant for friends and family to update them of your latest activity or hobby. The most commonly used micro blogging site is Twitter.

Example

The following is a sample blog page. It consists of an article with the option to provide comments;

6. Wikis

This comes from the word "Wikipedia", where thousands of readers can add, edit and use information on this site. Similarly, Wiki is a site designed for the users and visitors to fill up missing information or correct information or add more or new information, therefore creating a community of interested people who build up knowledgeable content over a period of time. It has millions of entrants and can contribute in 20 different languages.

Thus, blogs and Wikis are examples of Web authoring enabled by special software. Blogs and wikis share information quicker than a website without using advanced tools or expertise. This is easy for people to update than using formal or traditional documents of a website.

Distinguish between blogs and wikis

Both blogs and wikis can help user collaborate without the use of advanced tools or specialized knowledge. However, there are some differences in how the user can use them:

Blogs are posted by specific groups for providing information and insight whereas Wikis are created by a team as a process to create information and other members would keep adding or editing it to make it more accurate.

The role of bloggers is important as some managers would use this blog site to explain a policy change. However, in a wiki the information can keep changing with edits and more updates coming up.

The blogs are in a chronological order and one can scroll down to see the posts just like reading a journal. Wikis are collected in a version of history and is organised in a chronological order.

Test Yourself 4

A social networking site is a site developed to bring individuals together to connect with each other by:

A   Reuniting
B   Friend of friend
C   Common interest
D   All of the above

3. Explain the differences between Internet, Intranet and Extranet (How are they related/how do they differ?)

The Internet is the most commonly and widely used computer network, but it isn't the only type of computer network for sharing information digitally.

The Internet, an intranet and an extranet are three similar, but distinct types of networks. While the Internet is open to anyone and everyone, intranets and extranets are designed for smaller groups of people. Think of the latter two as larger versions of a personal home network.

A. The Intranet

An intranet is a private, secured network designed to facilitate collaboration and make it easier to communicate and share documents in real time.

An intranet network is only available to a small group of people. Intranets are mainly used within businesses and organizations to provide access to files and applications among networked computers and servers. Intranets may or may not have access to the Internet. If an intranet does connect to the Internet, a firewall is used to prevent outside access to the intranet. The purpose is to allow people within the same company to share information over a local area network. It is sometimes referred to as a private Internet.

The intranet is protected from the global internet by firewalls and by the need to log on with a secure password. Staff working outside the organisation may be able to access the intranet by using a VPN (virtual private network). This means all communications between the intranet and the user's personal computer are encrypted.

Example:

Businesses use intranets for a variety of reasons:
a) Intranets can help streamline day to day activity
b) help organize people and data
c) improve internal communications, and
d) increase employee engagement.
e) They are very effective for remote employees, as they will never lose the ability to collaborate with each other like they could in a traditional office setting.
f) As companies become more and more decentralized, intranets hold more importance in the business landscape than ever before.

B. The Extranet

"Extra," for example, refers to anything that is crucial to your business, yet exists outside of it — such as clients, vendors, and suppliers.

An extranet is basically a private network designed specifically to allow these individuals (clients, vendors, suppliers, partners, etc.) to communicate with you and your employees in a closed virtual space. Extranets serve an extremely important role, as they allow for private communication, collaboration, knowledge sharing, document sharing, and data transfer between organizations.

An extranet is similar to an intranet, but is accessible via a Web portal. An extranet may be accessed from anywhere if the user has a valid user name and password. The purpose of this type of network is to allow collaboration and sharing of resources not only in-house but with a select group of outside users. For instance, businesses will use an extranet to allow customers to log in to provide input on projects. Another example is using a virtual private network to allow employees to log in to the network when they're are not in the office.

Example:

For example, a company could provide access to a supplier for online ordering, order tracking and inventory management. Instead of sending information to suppliers, it lets them fetch it on a self-service basis. Another example would be a hospital providing local GPs with access to a booking system so they can make appointments for their patients.

The Benefits of Implementing an Extranet.

There are a great deal of reasons why it might be beneficial for your business to implement an extranet.

a) **An extranet can streamline repetitive business processes:** Let's say you order from a particular vendor on a regular basis, often using email or phone as a conduit. With a well-designed extranet, all of your ordering can take place via your secured private network in a virtual space. Any interactions with vendors occur in real time, and you can store invoices along with any other pertinent information in one place.

b) **It can increase customer satisfaction:** One of the key benefits of an extranet is that it can be accessed from any computer at any time of the day or night. 24/7 access means that your clients and customers can upload documents, ask questions, or approve designs/concepts whenever they have the time to do so, thus breaking down the barriers often caused by a more rigid work schedule.

c) **Extranets are beneficial because they are highly secure when properly designed:** In many ways, email and other tools that are often used to transfer documents lack the type of security necessary to avoid a potential breach. When care is taken in designing an extranet, these concerns are no longer an issue.

C. The Main Differences (Internet, Intranet and Extranet)

The main difference between the three is accessibility. The Internet is public while the other two are highly restricted. Home users, if they use one at all, would only use an intranet to share files between computers and typically use the Internet when searching for and sharing information. Businesses and organizations are the main users of both intranets and extranets in order to restrict access to confidential data.

An extranet is like an intranet, but also provides controlled access to authorized customers, vendors, partners, or others outside the company.

The major difference between the two, however, is that an intranet is typically used internally. While an extranet allows businesses to communicate with clients and vendors, an intranet allows employees and colleagues to work with each other in a virtual space — no outside parties are involved.

Tip

An intranet allows for restricted access to only members of an organization; an extranet expands that access by allowing non-members such as suppliers and customers to use company resources. The difference between the Internet and extranets is that while the extranet allows limited access to non-members of an organization, the Internet generally allows everyone to access all network resources.

4. Search information on the internet.

[Learning Outcome d]

You can find a treasure of information on any topic that you want to explore on the Web. For example, if you want to plan a holiday to any part of the world or in Tanzania itself, which are the best places to visit, what transport can you hire? Which are the best places to stay and the related costs?

Or if you are planning to study Microbiology, a certain plant or animal, you will find all the information with pictures, details of people researching them so on and so forth. Or if you need to reunite with a friend that you have lost touch with from your college days, you may find him/her on the web. Name it and the web has everything for you from recipes to exercise, from art, dance to science and fiction.

The web is a collection of over 20 billion pages, and yet more pages are getting added to the pool of information. There is so much information available that it becomes difficult for anybody to get the accurate information that one is looking for.

There are search service providers, who have a massive collection of data from the Web and the internet and they help to locate the exact information. Special programs called "Spiders" locate new information that gets added to the Web and adds to the data collection of the search service providers. The search service providers create search engines that help to locate the right information by identifying the key words used on the web pages.

3.1 Search Engines

To find information, the web client goes on the search service's website and uses its search engine. The search engines, with their specialised programs, help in locating that information.

Every search engine provides two approaches to search for particular information:

Keyword Search

A keyword is a word that can lead your search. For example, you are looking for Salsa dance class in Singida. You would type "Salsa dance class in Singida" and the search engine compares your keywords with its database and gives you a list of sites or 'hits' where these words appear.

Each hit will have a brief of that website with the web site linkage, which will take you to that page if you click on it.
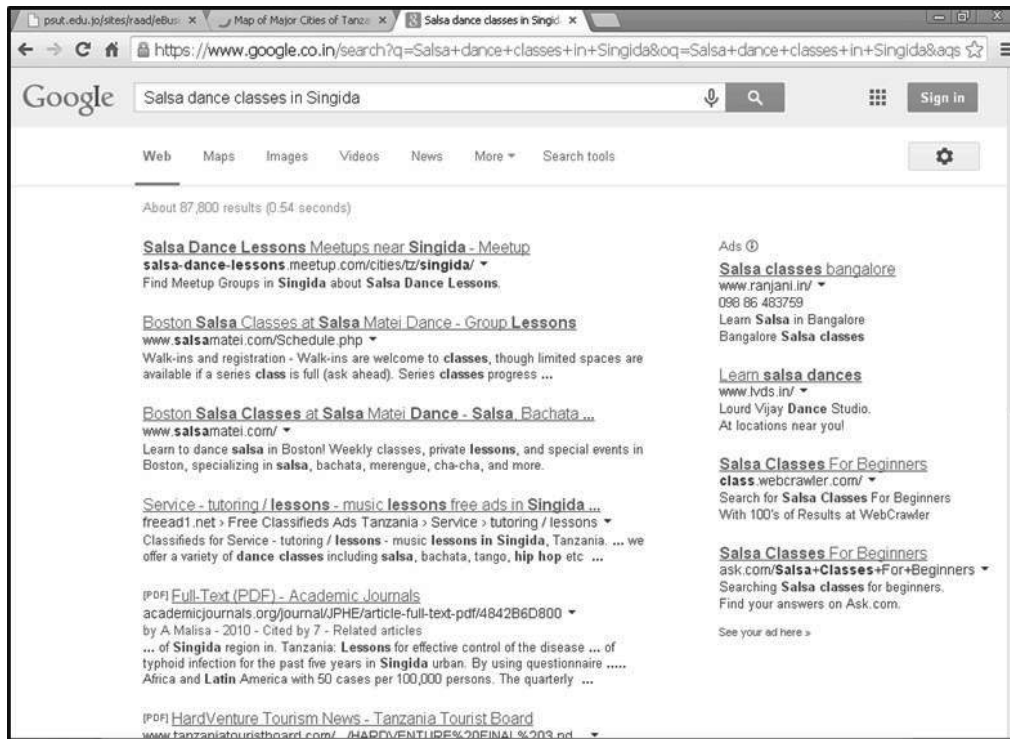
Directory Search

A directory, as the name suggests, gives a web client many options on the search engine's web page itself. For example: travel, games, books, flowers, greetings, property, tax, colleges etc.

The web client can select one of them which will further give him another list, he clicks further till his search narrows down and gets him the appropriate list of the websites for the information he is looking for.

For example if he clicks on property, it will ask him further information on the location, whether on hire or rent. Then the size of the property and its budget and thus finally after narrowing down he will get the websites where his required specifications for the property are available.

Tip

How to search for some particular information?

When we are looking for general information like Salsa dance, then we must use directory search by selecting dance and then selecting the subtopic Salsa.

When we are looking for specific information like "best doctor for Thyroid in Tanzania" then use the Keyword Search.

Use the right and very specific key words that have a direct relation to the information or topic.

Use more than one key word and use quotation marks to locate a key phrase.

Use words such as "and", "or", "not", these are known as Boolean operators.

Always check spellings, an error in the spelling can lead to a wrong search.

Do not get stuck at one search page, keep searching. Use only the first page of the search and try and use other keywords and other search engines

However, a particular search engine cannot give you all the information, therefore a web client must use multiple search engines to get maximum information, or else use a special search engine called Metasearch.

3.2 Metasearch engines

Generally, when you want to search a topic, you type the keyword in a search engine and then click on the links of the list of hits provided. You can use multiple search engines, but mostly some links are duplicated. This becomes a very time-consuming process.

In a Metasearch engine, your search criteria is submitted to several search engines by the Metasearch engine and then it collects all the lists, puts them in order, removes duplication and then provides the list to you. This saves your time to a great extent, without missing out searching on any search engine. Example of a Metasearch engine is "Dogpile".

3.3 Specialised search engines

Specialised search engines are only for special topics, so for a topic like environment you can go and search on Yahoo and Google, the general search engines, or go on specialised search engines which only deal with environment and get your search results soon for example www.eco-web.com.

Test Yourself 5

Which of the following approach does a search engine adopt to search for information?

A   Keyword approach
B   Directory approach
C   All of the above
D   Neither of the above

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4.   Evaluate information available in the internet.
[Learning Outcome e]

Not all the content available on the internet is true or authenticated by an authority. Many people can author webs, like Wikipedia, without putting their details; therefore you need to be careful while using this information.
The internet is a rich mine of information to research on any subject. However, while searching for specific information, you may get irrelevant information along with relevant information. Sorting and evaluating proper information consumes a lot of time.

It may happen that you may not find all the information at the same location; you will have to surf and compile the information from different sites. You may also have to pick pieces of information from different sites to make your search complete.

This information is not structured, that means the bits and pieces that you have gathered from all over the net, you will have to arrange them in a proper order, word them properly etc. This involves a lot of work. If you are looking for some statistics or the current status of census i.e. population of a particular city - the information on the net may be out dated. You may have to be careful while using this information and check the authenticity i.e. source of this information and the status of the information.

Information on the internet can be available from various sources such as personal blogs or articles; some would be published financial statements or copyright information. Copyrighted information cannot be used without taking permission from the source creator. Sometimes permission may not be received and in case one needs to be careful in identifying copyrighted information.

Other than permission one needs to be careful in how correct and accurate this information is before using them. You need to validate this information using various sites and then apply your judgement to identify the authentic information.

The information on internet is available by two methods:

1. Paid information

Paid information is generally are more relevant and authentic as you pay for the information received and it would therefore be properly researched. However, there are chances that the information received may not be complete or relevant, if the website selling the information is bogus. Therefore, you must carefully select websites which are popular and have track record of providing authentic information. Sometimes paid information may be copyrighted and will restrict the user regarding the use of information.

2. Free information

There are a lot of sites that give free information and this free information could be collected through blogs or wikis where authenticity of the information could be questionable. Therefore, before using this information, one should verify it very carefully. Most of us use free information sites as it saves money. However, authenticity and copyright should be checked before blindly relying on such information.

Important

To check the correctness of the information, you may do the following checks:

Source of information: is the person who has written the content, an expert in the subject matter or the website on which the information is available is an official website or personal website.

Correctness of information: does the site state the correctness of the information and is there a feedback option on the site where feedback on the information can be given to the author.

Approach to information: has the author put down the information without any bias or is it written with a personal objective to change the readers' points of view.

Dates and currency: check the dates to see if the information is up to date to make it relevant for the kind of information you are looking for.

Test Yourself 6

Which one of the sources of information is more authentic and reliable to obtain information compared to other sources?

A   Wikipedia
B   Free websites
C   Paid research articles
D   Blogs

Answers to Test Yourself

Answer to TY 1

The correct option is **A**.

TCP/IP stands for Transmission Control Protocol/Internet Protocol.

Answer to TY 2

(a) Internet is the software part and World Wide Web is the hardware part of the computer. – **False.**

(b) The major functional components of a website are HTTP, HTML, URI, Search engines. – **True.**

(c) The result of every search engine is always the same.- **False.**

(d) The users of the web are called "web clients" and the program by which they view the web pages is called "web browser". – **True.**

Answer to TY 3

The correct option is **B.**

Emails sometimes can introduce viruses in the computers.

Answer to TY 4

The correct option is **D.**

The social networking sites bring individuals together by reuniting friends who have lost contact with each other, connecting with friends of friends and people with common interest.

Answer to TY 5

A search engine adopts both the methods of searching for information i.e. by keyword search approach and directory search approach.

Answer to TY 6

The correct option is **C**.

Wikipedia is updated by many people based on their knowledge which may or may not be correct.

Information offered on free websites may have copyright issues and also may not be complete.

Blogs are articles written by a subject matter expert, but lack completeness.

Self-Examination Questions

Question 1

Claire wants to attend accounting classes in Dar Es' Salaam, and she wants to study only specific topics. Using the internet, she wants to search for a coaching centre which would provide her with this service.

Required:

Guide Claire on how she can find the relevant information on the internet if she searches for a coaching centre which provides accounting classes for specific topics and if she is looking for a specific tutor who teaches those topics.

Question 2

Distinguish between wikis and blogs

Question 3

In the e-mail address sales@smartkart.com, "sales" is the:

A   Password
B   Server name
C   User name
D   Domain name

Question 4

The protocol that should be used while transferring files on the World Wide Web is known as:

A   HHTP
B   FTP
C   URL
D   HTML

Answers to Self Examination Questions

Answer to SEQ 1

When Claire is looking for a coaching centre which provides accounting classes for specific topics, she must use the directory search in the following steps:

Select the criteria Education

Then select Coaching classes

Select Accounts and Finance

Type the topics in accounts

Enter the location and timings of the class

Enter fees structure expected

However if Claire was looking for a particular tutor or best tutor to teach accounts then she must use the Keyword search approach and search in the following steps:

Claire must type in the tutor's name in the search option.

She can write the tutor's name with the subject name he teaches with a quotation mark or she can write a phrase, e.g. "Mr Martin expert in teaching business combination accounting".

Claire must use words such as "and", "or", "not", which are known as Boolean operators.

Claire must check spellings, because if she makes a spelling mistake, it could give her a completely different search result.

Claire must visit different pages and not get stuck at one search page.

Answer to SEQ 2

1. Blogs are personal posts. The views or opinions expressed on a given subject are the personal opinion of the author and therefore cannot be classified as right or wrong. Whereas Wikis are a set of information on subject which needs to be accurate and that's why is constantly updated by users who feel that the information is incomplete or incorrect.

2. Blogs are journals that are chains of posts of personal opinions, views which are arranged in a chronological order. Whereas Wikis create history of information first available and the number of changes or amendments or updating happening to it, it is also organised in a chronological order

3. The role of a blogger is important here to keep the chat lively and continue the chain. In a wiki page, the role of the editor and updater is important here who keeps uploading latest information.

Answer to SEQ 3

The correct option is **C**.

"Sales" is referred to as the user name and "Smartkart" is referred to as the domain name.

Answer to SEQ 4

Hypertext transfer protocol **(**HTTP) is the main and common communication standard that all the computers in the web use to communicate with each other. It is the set of rules that should be used while transferring files on the World Wide Web, which can be in the form of text, graphics, audio files, video files or any other multimedia files.

E2

STUDY GUIDE E2: E-BUSINESS AND E-COMMERCE

■ Get Through Intro

Electronic commerce is most commonly known as E-commerce. E-commerce, as the name suggests, is buying and selling of goods and services through an electronic medium. With the advancement in technology and innumerable applications which can be used by the buyers, it has made the vision of conducting business electronically come into reality. In today's world, every business, from a small home tutor to a giant company have their website, giving information about the goods and services they provide with images, videos and audios which give the buyers all the information they seek online. A company's website is the first step to advertising and promotion; it has become an inevitable part of business.

If a business does not have a website, it is not regarded as a credible business. To increase awareness, the website is an essential part of every business today.

If a customer wants to immediately avail of the services, he can do that by choosing to buy online. In this study guide we will study the trade developments with e-commerce, the infrastructure required to make it possible and the advantages and disadvantages of e-commerce.

■ Learning Outcomes

a) Define the term e-Business and e-commerce
b) Trace developments of e-Business and e-commerce.
c) Explain how E-Business differs from e-commerce.
d) Explain infrastructure for e-Business and e-commerce.
e) Explain advantages of e-Business and e-commerce to firms.
f) Explain challenges of both e-Business and e-commerce.

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1. Define the term E-Business and E-commerce.

[Learning Outcome a]

E-Business

E-business is broader than e-commerce; including the transaction-based e-commerce businesses and those who run traditionally but cater to online activities as well. An e-business can run any portion of its internal processes online, including inventory management, risk management, finance, human resources. For a business to be e-commerce and e-business, it must both sell products online and handle other company activities or additional sales offline.

e-business is not confined to buying and selling of goods only, but it includes other activities that also form part of business like providing services to the customers, communicating with employees, client or business partners can contact the company in case if they want to have a word with the company, or they have any issue regarding the services, etc. All the basic business operations are done using electronic media.

There are two types of e-business, which are:
  a) **Pure-Play:** The business, which is having an electronic existence only. Example: Hotels.com
  b) **Brick and Click:** The business model, in which the business exists both in online i.e. electronic and offline i.e. physical mode.

E-Commerce

E-commerce is "any transaction completed over a computer-mediated network that involves the transfer of ownership or rights to use goods and services. It refers to any activity involving an organisation's interactions and business dealings either with clients within the organisation or between various organisations through electronic means.

In simpler terms, e-commerce refers to any kind of business transaction in which the parties interact electronically rather than through direct contact.

1.1 Features of e-commerce

1. E-commerce is usually associated with buying and selling over the Internet, or conducting any transaction involving the transfer of ownership or rights for using goods or services through a computer-mediated network.

2. E-commerce encompasses electronic ordering of goods and services which are delivered using traditional channels such as couriers, online ordering, electronic share trading and electronic fund transfers.

3. E-commerce is sometimes classified as buy-side e-commerce and sell-side e-commerce. Buy-side e-commerce refers to transactions relating to the procurement of resources by an organisation from its suppliers, whereas sell-side e-commerce refers to transactions relating to the selling of products by an organisation to its customers.

1.2 Types of e-commerce

Figure 1: Types of e-commerce
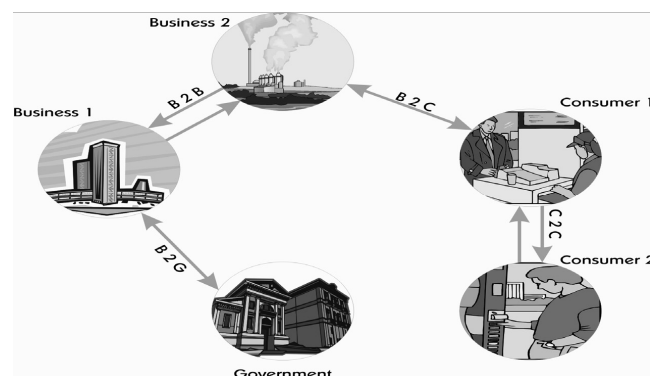
The e-commerce activity can be activated either by organisations or their customers. The main types of e-commerce are:

i) Business-to-business (B2B)

B2B e-commerce is the e-commerce that exists between companies. It deals with relationships between and amongst businesses. It forms the majority of the transactions conducted through e-commerce when compared to the B2G and the B2C segments.

Example

A commonly used example of B2B e-commerce is Dell Inc, which deals in computer hardware and software. It offers a range of products including laptops, desktops and printers and has a diversified client base which includes many multinational companies and retail clients. It receives a large majority of its orders over the Internet. The dealings between Dell and the companies represent B2B e-commerce.

Most B2B applications are in the areas of:

(a) supplier management (e.g. purchase order processing)

(b) inventory management (e.g. managing order-ship-bill cycles)

(c) distribution management (e.g. transmission of shipping documents)

(d) channel management (e.g. information dissemination on changes in operational conditions)

(e) payment management (e.g. electronic payment systems or EPS)

2. Business-to-consumer (B2C)

Business-to-consumer e-commerce is the commerce that exists between companies and consumers. The more common B2C business models are the online retailing companies such as Amazon.com and E-Trade for information regarding goods.

Common applications for this type of e-commerce deal with the purchasing of products and information.

3. Business-to-government (B2G)

Business-to-government e-commerce or B2G is generally defined as the commerce between companies and the public sector. It refers to the use of the Internet for public procurement, licensing procedures, and other government-related operations. This kind of e-commerce has two features:

The public sector assumes a leading role in establishing e-commerce.
It is assumed that the public sector has the greatest need for making its procurement system more effective.

4. Consumer-to-consumer (C2C)

Consumer-to-consumer e-commerce or C2C is simply commerce between private individuals or consumers. This type of e-commerce is characterised by the growth of electronic marketplaces and online auctions.
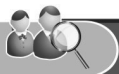
Example

Many people trade on www.eBay.com and use the website as a source of secondary income. Trade occurs mainly by way of an auction. Since the trade takes place through a website, only a computer and access to the Internet is required. After the deal is finalised over the Internet, the physical exchange of the product takes place through courier or postal services. Therefore, the need for having a showroom is eliminated.

5. Mobile commerce (M-commerce)

M-commerce is the buying and selling of goods and services through wireless technology i.e., handheld devices such as cellular telephones and personal digital assistants (PDAs). Financial services and telecommunications are examples of industries using M-commerce.

6. Government-to-Government (G2G)

G2G e-commerce is the online non-commercial interaction between government organisations, departments, and authorities within a country or between the governments of different countries.

7. Government-to-business (G2B)

G2B e-commerce is the online non-commercial interaction between the government and the commercial business sector (excluding private individuals).

8. Not-for-profit to consumer (NFP2C)

This refers to the e-commerce between not-for-profit organisations and the customer. Examples include donations by individuals to the Cancer Research Institute, UK.

Important

The three most commonly used B2C applications are banking, financial trading and shopping.

Banking: customers can operate their bank accounts online to transfer funds, make payments, apply for loans etc.

Financial trading: investors can research, buy and sell shares and stocks online.
Shopping: there are thousands of websites offering innumerable goods and services that can be bought online.

Test Yourself 1

The E-commerce initiated by the consumer with a business is known as:

A Business to Business (B2B)
B Business to Consumer (B2C)
C Consumer to Consumer (C2C)
D Consumer to Business (C2B)

Test Yourself 2

A _____ is a B2B trading network that links a particular seller with its own trading partners.

A Web community
B Virtual network
C Private trading network
D Bitstream

2. Trace developments of e-commerce.

[Learning Outcome b]

In the 1960s, the internet was first developed by the U.S. government's team of scientists. The U.S. defence then recognised the need to create a network that could handle a single computer's network malfunctions.

In the 1970s, the Advanced Research Projects Agency (ARPA) developed the network further which has evolved into today's internet. This net was known as ARPANET.

The objectives of ARPANET were:

Even if one or many computer network connections fail, the internet will still work for the other computers connected to the network.

The wide network can be used between different computer hardware and software models.

The network can re-route traffic to the non-functioning sections of the network.

The network of computers has to grow to become the network of networks rather than remaining only the network of computers.

The term e-commerce during the time was to execute commercial transactions by an electronic medium with the help of Electronic data interchange (EDI) and Electronic funds transfer (EFT). This enabled the buyers and sellers to exchange business information and complete business transactions. Commercial documents could be sent electronically between businesses, companies and organisations.

In 1991, the U.S. government made internet available for commercial use recognising the need for a quicker way of making business possible, to have quicker communication and information. The availability of electricity, cables, computers, modems, internet and the intention to buy and sell brought in the existence of e-commerce. Businesses since then have a website address in addition to their mailing addresses, contact numbers and email addresses.

In 1994, the Internet became more popular among the general public and thereafter the security protocols like HTTP and DSL were developed which took over four years to develop. This enabled quick access and good connections to the internet.

In 2000, business companies in the United States and Western Europe started using World Wide Web to promote their services and businesses. This is the time when the term E-commerce meant the process of buying and selling of goods and services over the Internet by using connections that are secured and make payments by electronic payment services. There was a major setback to many ecommerce companies that disappeared as result of the dot-com collapse.

However, the "brick and mortar" retailers could not disregard the advantages of electronic commerce and added better capabilities to their web sites that could enable buyers to buy groceries online.

By the end of 2001, the Business-to-Business (B2B) model had around $700 billion in transactions, which is today the largest form of E-commerce. Buyers got a lot of choice and an overload of information on products and services available. They could choose from a large database suitable to their requirement. They could see the prices, compare prices and then choose the best price by just clicking the mouse.

Sellers or businesses can find their customers easily by using the web and its search engines; this reduces their advertising costs and costs related to maintaining a huge sales team. Even small shops can have global reach through the web.

Example

Amazon and ebay were among the first Internet companies that used electronic transactions. Now, there are 5 largest and most famous worldwide Internet retailers: Amazon, Dell, Staples, Office Depot and Hewlett Packard. The most popular categories of products sold online are music, books, computers, office supplies and other consumer electronics.

Amazon lost its position as a successful business model due to the dot-com collapse but regained its position by making its first annual profit in 2003. Amazon today also is considered an online bookstore as it started with book sales but extended its services to a variety of goods like electronics, software, DVDs, video games, music CDs, MP3s, apparel, footwear, health products, etc.

The most amazing E-commerce affiliate marketing program was first established by Amazon and almost makes 40% of its sales from affiliates and third party sellers who list and sell goods on the web site.

E-commerce has evolved since according to the customer's requirements, to make business more attractive. It is a new way of creating a virtual world, removing geographical distances and barriers and bringing the world together, thus creating a strong and secured foundation for generations to come.

Test Yourself 3

Which of the following statements is not correct?
The objectives of ARPANET were:

A Even if one or many computer network connection fail the internet will still work for the other computers connected to the network.
B The wide network can be used between similar computer hardware and software models.
C The network can re-route traffic to the non-functioning sections of the network.
D The network of computers has to grow to become the network of networks rather than remaining only the network of computers.

---

3. Explain how e-commerce differs from e-business.

[Learning Outcome c]

E-Business and E-Commerce

In the emerging global economy, e-commerce and e-business have become an essential component of business strategy for organisations. The relationships within organisations and between organisations and individuals have been revolutionised by integrating the information and communication technologies (ICT) in business. Besides reducing costs, the use of ICT in business has enabled:

higher client participation

enhanced productivity

mass customisation: i.e. delivering customised content to a group of users through web pages or e-mail

With recent developments in Internet and web-based technologies, the differences between traditional markets and the global electronic marketplace have lessened gradually. Apart from providing a level playing field, e-commerce, coupled with the appropriate strategy and policy approach, enables smaller organisations to compete with their large-scale counterparts.

IBM has defined e-business as the transformation of key business processes by an organisation through the use of Internet technologies. E-business refers to the application of ICT to business processes in order to reduce costs, improve customer value and to find new markets for products and services.

The terms e-commerce and e-business are often used interchangeably. However, e-commerce involves buying and selling transactions which are conducted online, whereas e-business is a broader concept because it encompasses the integration of ICT into the business processes of companies. Moreover, e-business involves varied business dealings which can be done over the Internet, whereas e-commerce is more specialised and encompasses things such as ordering, invoicing, payments and receipts for goods or services.
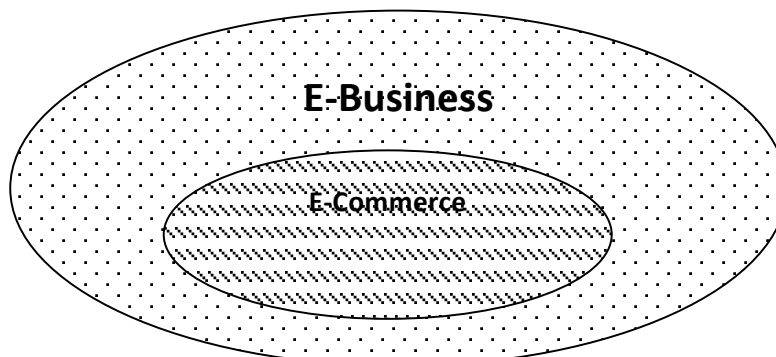
E-business and e-commerce are terms that are sometimes used interchangeably, and sometimes they are used to differentiate one vendor's product from another. However, the terms are different, and that difference matters to today's companies and the way services and business are carried out..

In both cases, the e stands for "electronic networks" and describes the application of electronic network technology - including Internet and electronic data interchange (EDI) - to improve and change business processes.

E-business includes e-commerce but also covers internal processes such as production, inventory management, product development, risk management, finance, knowledge management and human resources. E-business strategy is more complex, more focused on internal processes, and aimed at cost savings and improvements in efficiency, productivity and cost savings.

E-commerce covers outward-facing processes that touch customers, suppliers and external partners, including sales, marketing, order taking, delivery, customer service, purchasing of raw materials and supplies for production and procurement of indirect operating-expense items, such as office supplies. It involves new business models and the potential to gain new revenue or lose some existing revenue to new competitors.

Figure 2: E-business (using ICT)

E-BUSINESS

External processes
➢ B2B
➢ B2G
➢ B2C

Other processes
➢ servicing customers
➢ collaborating with business partners etc.
➢ Supply Chain Management (SCM)
➢ Enterprise Resource Management (ERM)
➢ Customer Relationship Management (CRM)

E-COMMERCE

E-commerce is a subset of e-business
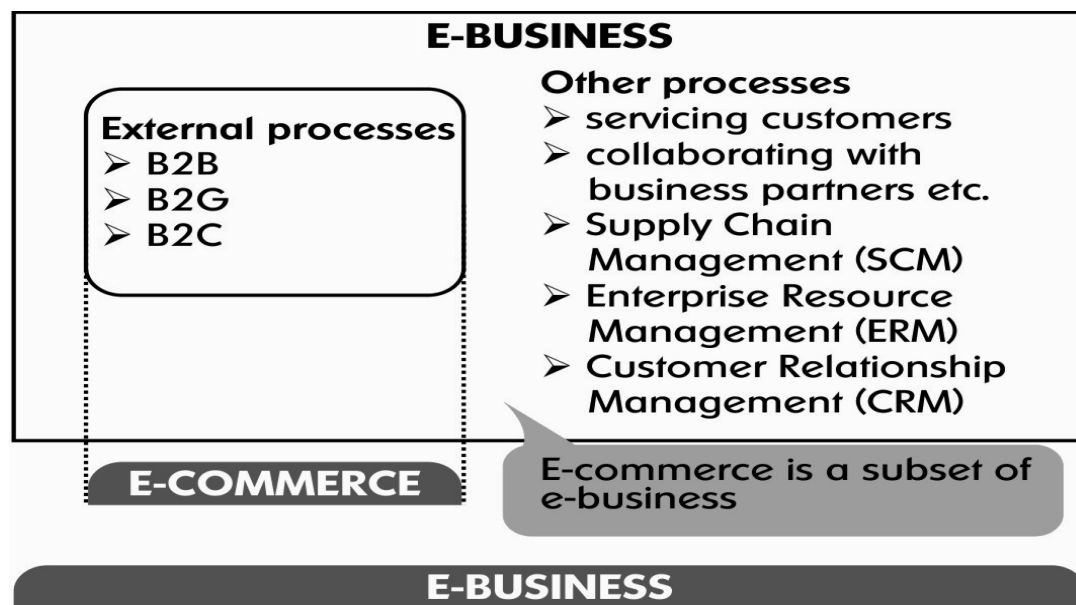
E-BUSINESS

Test Yourself 4

Which of the following statements represents e-business?

A   It includes buying and selling transactions which are conducted online
B   It encompasses the integration of ICT into the business processes of companies.
C   It is more specialised and encompasses things such as ordering, invoicing, payments and receipts for goods or services

4. Explain infrastructure for e-commerce.
[Learning Outcome d]

Traditionally, commerce was limited to specific business hours and days only. However, e-commerce can happen any time, 24 hours a day and all seven days of a week. Buyers no longer have to visit the seller's premises physically; they can buy online from the comfort of their homes or at work. The sellers don't have to keep a physical retail outlet, all the displaying and taking orders can be managed through the web.

E-commerce is an outcome of technologies, processes and business strategies that exchange information instantly between customer and business, business to business and others. Technologies like Electronic data interchange, bar coding, scanning, email, fax etc. makes e-commerce possible.

E-commerce does not involve paper documents, physical locations or visits; the infrastructure required for E-commerce is internet, websites, intranets, extranets, telecommunications and any other technology advancements that emerge.

4.1 Hardware and software technologies required for e-commerce infrastructure

E-commerce infrastructure is the design outline, or the hardware, software, content and data used by an organisation to deliver excellent services to the customers, employees and other businesses. Therefore, every business organisation aims to have adequate e-commerce infrastructure so that it is able to deliver service with excellence with regards to the time required to process orders and respond to every order.

The infrastructure is divided into two elements:

(a) Managed within the organisation

(b) Managed by third parties such as applications, data servers and networks

An organisation should always be aware and updated of new technologies coming in and replacing the old ones.

The following five components are required to form the e-commerce infrastructure:

1. E-commerce services application: applications like Customer Relation Management (CRM), Data mining, supply chain management are some examples of e-commerce services applications, which are popularly used to manage the customer's database, their orders and record of delivery of services.

2. Systems software: web browsers, server software and standards, networking software and database management system are some of the system software that an organisation should install in their computer networking system.

3. Transport or network: physical networks and transport standards (TCP/IP) must be installed

4. Physical storage: permanent magnetic storage on web servers with optical backup or temporary storage in memory (RAM)

5. Content and data: web content for Intranet, Extranet and internet site, customer data, transaction data, click stream data etc. must be maintained and recorded.

4.2 Intranets and Extranets

Figure 3: Intranets and Extranets
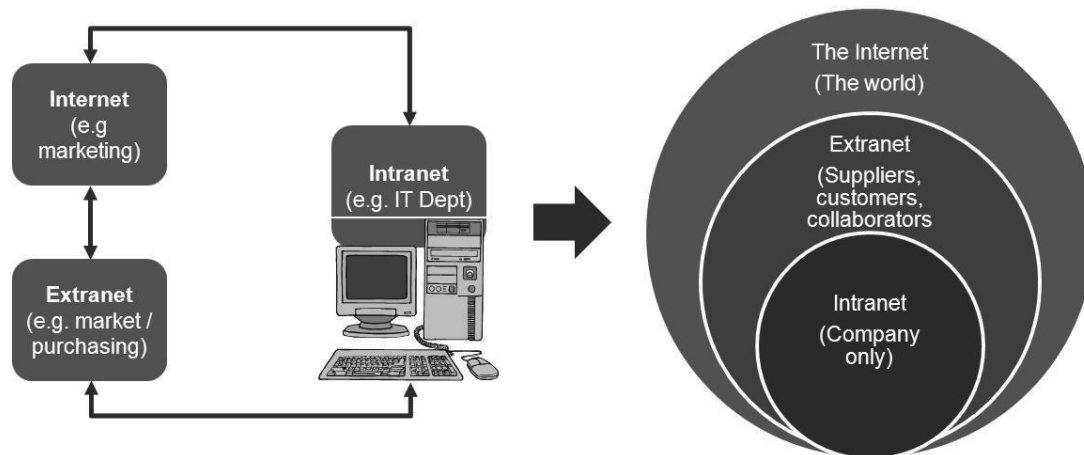
We have studied how intranets and extranets work in detail in Study Guide E1.

Intranets are used for internal marketing function and supply chain management activities. The following are the advantages of intranets:

1. The products can be obtained faster

2. Costs can be reduced due to this and documentation is reduced

3. They can provide better customer service, as the customer gets an immediate response for his orders and enquiry

4. Information can be made available to the remotest areas globally and nationally.

5. Intranet can contain the staff phone directories, procedures or quality manuals, price list, discount structure etc.

6. It can provide staff newsletters, training schedules, staff programmes

7. With content management system, the staff can maintain their web pages and always display up to date information on the website.

Extranet is used for external parties i.e. customers, suppliers and business partners

1. Online services are provided to customers only

2. Information is shared with suppliers only as they are provided with secured login access

3. Cost is reduced considerably as the staff required to process orders is very less

4. The stock level can be maintained according to the orders received which decreases the storage cost and lost order cost

5. Suppliers and business collaborators can get vital information such as pricing, services available etc. easily.

4.3 Firewalls

Firewall is mounted at the point where the internet is connected to the organisation to prevent unauthorised access to confidential and vital information by outsiders.

4.4 Demilitarised Zone (DMZ)

This is a configuration in which computers with LAN connection run behind a firewall connected to a public network e.g. internet.

4.5 Web Browsers and Servers

Web browsers and servers store and present web pages used by a web browser. These are made up of:

1. Static web page: this page is invariant

2. Dynamic web page: it is the most updated page with regards to a query settlement or response to an enquiry received.

3. Transaction log file: this page records all the requests or clicks received.

4.6 Web Communication

1. Interactive applications like blogging, Google maps etc

2. Wikis for user generated content

3. Gmail, Ymail, Yahoo for neutral communications and organisation emails

4. Data exchange between sites through XML based data standards

5. Rapid application developing with AJAX – e.g. Google maps

4.7 Web Address

The organisation has to develop a web address in the standard format i.e.

http;//www.domainname.extension/filename.html.

4.8 Web Presentation and Data Exchange Standards

1. **HTML** (Hypertext markup language): this is a standard language used to define the text and layout of the web pages

2. **XML** (Extensible markup language)L this is a standard language to transfer structured data

4.9 Media standards

1. **GIF** (Graphics interchange format). This is used for simple graphics.

2. **JPEG** (Joint photographs expert group). This is used for photographs.

3. **Streaming media**. This is used to download audio and video clips on the web.

4. **MPEG** and .AVI for video standards.

5. **MP3** and **WMA** for audio standards.

4.10 Managing Infrastructure

1. **Managing hardware and software**

The infrastructure related to technology is made up of hardware, software, networks and connections. An organisation has to assess its needs and the available resources and then work out a proper infrastructure plan. The infrastructure would be more complex for bigger organisations, and simpler and smaller for smaller organisations. The following components have to be maintained for managing hardware and software:

(i) Systems software: management has to standardise the software throughout the organisation to reduce number of maintenance contacts and support. It is also done to reduce the purchase price by using multi user licenses. There are choices for systems software for the clients, server and the network. The following are some considerations:

    a) Client – which browser to standardise, standardise plug ins and system software
    b) Server – web server standardisation
    c) Network – which networking software to use

(ii) Transport or network: after studying the internal organisation network, the e-commerce intranet to be taken is decided. Similarly, the external network has to be understood for extranet to perform for the organisations and third parties accordingly. The internal and external network can be managed by the organisation itself or can be outsourced to a third party. All the hardware is standardised to optimise service.

(iii) Storage: data can be managed internally by the organisation or externally.

2.   Managing the applications infrastructure

For larger businesses, the applications and services are very critical; thus, complex, multilevel application infrastructure needs to be managed. The problems that may be faced are:

(a) Cost containment: the cost of the infrastructure should not be more than the benefits derived from it.

(b) Application downtime: higher availability of applications reduces cost and thus the availability of applications must be compared with the cost to the organisation.

(c) Virtualisation management: the server configuration management in the virtual server world should be properly planned and performed to consider the latest trends which will require changes in the physical environment.

(d) Troubleshooting configuration discrepancies: the configuration parameters are set for each environment, server instance and layer of software. They have to be managed comprehensively without any automated tools. Therefore, they become out-dated very quickly and the organisation has to find new ways of resolving this.

There are can be two types of applications:

(i)   E-commerce applications – the applications that provide services internally e.g. for employees and directors and externally e.g. for clients, business collaborators and suppliers.

(ii) Enterprise resource planning applications (ERP) – the applications for major business functions provide integrated functions such as production, sales, dispatch, finance and accounts, human resources management etc.

Now let's see how a customer order process takes place with the help of the Figure given below:

Figure 4: E-commerce
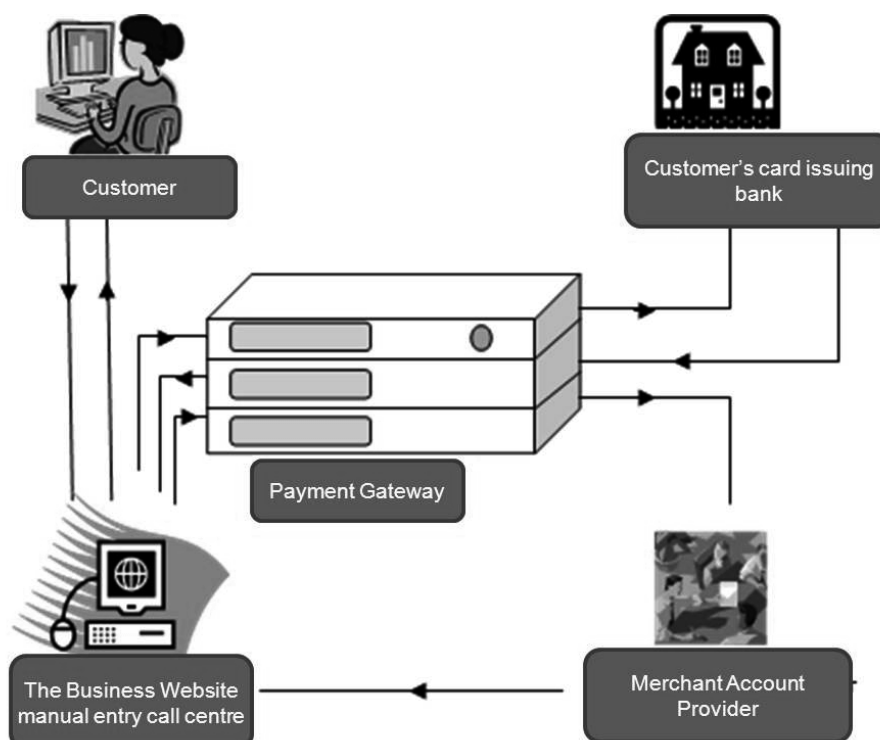
Step 1: Customer places order: customer gets connected to the seller by a secure connection on the website and clicks on the items that he or she wants to purchase or manually enters the transaction.

Step 2: Authorisation request: the message regarding the order placed by the customer is received by the payment gateway, it encrypts it and passes on the message to the credit/debit card issuing bank.

Step 3: Authorisation response: the credit/debit card issuing bank will either accept the request or decline it. This message goes back to the payment gateway which in turn sends it to the relevant website.

Step 4: Order processed: if the order is accepted by the bank then the order is processed by the merchant account provider and they send the consignment to the customer.

Step 5: Payment settlement request: the payment gateway then sends a request to the customer to settle the payment to the merchant account provider each time the transactions are processed.

Step 6: Payment settlement done: the merchant account provider makes payment towards the transaction into the merchant's bank account which takes about 24 to 48 hours.

Tip

To shop online you must take care of the following:

(a) **Product review sites**: you must look at the review of the product that you decide to buy on sites which provide these reviews such as www.customersearch.com, www.eopinions.com to evaluate the product.

(b) **Use shopping bot:** after selecting a product to buy, compare the prices available; this can be done by using a shopping bot to avail of the best prices. The most well known shopping bots are www.mysimon.com and www.pricegrabber.com

(c) **Vendor review sites**: these sites will give you information about the vendor from whom you have decided to buy to confirm their authenticity and track record. Some of the vendor review sites are www.resellerratings.com and www.bizrate.com

Test Yourself 5

Rearrange the following in the proper sequence of transactions done online:

(a) Customer places order (b) Authorisation response (c) Payment done
(d) Order processed

---

5. Explain advantages of e-commerce to firms.

[Learning Outcome e]

There are a lot of advantages of e-commerce, not only for the firms but also for the customers, society and the government as a whole. Some of the advantages to the firms in particular are listed below:

1. Reduced cost to the firms as the cost of a sales team is eliminated and a physical retail outlet is not required.

2. Compete for best prices as the firms can get the information of the prices made available by other competitors in the market.

3. Saves time in completing a business transaction from the time the order is placed to the payment settled.

4. The firms can enter into newer markets easily as there is no geographical restriction and size of the organisation does not matter here.

5. The marketing process is faster and cheaper through the website as business processes are linked, which enables seamless processes with no delay in time.

6. Firms are able to match the customer's requirement to the product available with them within no time and give all the information immediately which again reduces time and leads to optimum usage of resources.

7. Firms can follow the just in time inventory, thus reducing the cost of warehousing and manage their manufacturing according to the orders received.

8. Overall overhead costs are reduced through uniform and integrated management processes.

9. Costs such as advertising costs, delivery costs, design and manufacturing costs etc. are reduced, the benefits of which can be passed on to the customers thus making the prices more competitive.

10. Firms can get direct feedback from the customers, which enables them to innovate newer service and products

11. All documents and transactions can be maintained electronically rather than having physical files and papers, which saves paper and helps firms to go green.

This list is endless with more benefits getting added for companies of every size. Therefore we can summarise the benefits of e-commerce to all the businesses as follows:

(a) **Universal:** with the internet any business can connect with any other business in any part of the world, as internet has brought the world closer, removing geographical barriers.

(b) **Global reach**: internet is available in every corner of the world, from big cities to small towns and villages, so it enables any business to market their products in every corner of the world.

(c) **Multifunction:** the internet gives all the information through text, graphics, videos, audios of various businesses; there are demonstrations, testimonials, price comparisons, all available to handle networking tasks and emails.

(d) **Reliability:** the technology of the internet is highly reliable and robust as the design concept of the internet initially was developed by the U.S. department of defence.

(e) **Cost:** from the points above we have seen how a lot of costs can be curbed with the use of internet and website, and thus can allow the firms to have competitive prices.

(f) **Rapid growth:** there are already millions of individuals and businesses connected to the internet and use them increasingly. With time becoming more precious, many would opt to buy online so that they do not have to take out time from office or work for buying regular consumption items. For firms, it can reduce the size of the purchase team and the sales team.

Test Yourself 6

List any three advantages of e-commerce.

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6. Explain challenges of e-commerce.
[Learning Outcome f]

The advantages of e-commerce are too many, compared to the disadvantages. However, although the disadvantages are fewer, they can have a greater impact on our environment and business.

The greatest challenge for E-commerce is to have a secured payment mode. Payment in e-commerce is mainly made by using cheques, credit/debit cards and digital cash. Each has a challenge:

(a) **Cheque**

This is the old form of making a payment, but takes a longer time for the transaction to complete. The buyer sends the cheque electronically, after which the seller deposits the cheque in his account, and after the amount is credited to his account, he sends the goods or services.

(b) Credit/debit card

Credit/debit card fraud is a major concern for buyers and sellers. Criminals can steal the card details and use them for purchasing over the internet, which would be a dangerous situation for the bankers who make payments on behalf of the buyer to the seller.

(c) Digital cash

It represents actual cash. Buyers buy digital cash from bankers and use to purchase goods. Sellers then present the digital cash to the bankers and convert them into regular cash. This process is time consuming but more secure than credit cards.

(d) Other challenges

i.   **Consumer remorse:** Buyers are not educated on what to expect from ecommerce websites and therefore often are not satisfied with the goods that is actually delivered and prefer to return them. This is a high cost for ecommerce players.

ii. **Buyers prefer cash on delivery**: Many do not have credit card facilities and so opt for cash on delivery. The buyers find it more authentic then. Manual cash collection is very expensive and risky for the ecommerce players.

iii. **High failure rate at payment gateways**: The customer if sees a error in transaction process, he does not want to reattempt to successfully complete the transaction and as a result the ecommerce players lose a lot of customers due to failure of payment at the payment gateways.

iv. **Internet usage**: Not many people in the world still are connected to the internet and use it. There are several regions where the internet connectivity is very low, thus restricting the usage of internet and ecommerce.

v.   **Outdated phones**: Not many use smart phones to be able to be access internet all the time.

vi. **Postal addresses**: To deliver the goods on time is a big challenge due to the postal addresses of different region are different. The y are not in a standard format.

vii. **Logistics** : infrastructure, courier services etc are a major problem in metros as well as many other regions which makes it difficult to reach out and give better services

Test Yourself 7

The greatest challenge for E-commerce is:

(a) Having a secured payment mode
(b) Goods cannot be delivered immediately
(c) Hard to find the right buyer
(d) Cannot navigate and find information

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

E-commerce initiated by the consumer with a business is Consumer to Business (C2B)

Answer to TY 2

The correct option is **D.**

A Bitstream is a B2B trading network that links a particular seller with its own trading partners, which is not the case in other options.

Answer to TY 3

The correct option is **C.**

The objectives of ARPANET were:

1. Even if one or many computers network connections fail, the internet will still work for the other computers connected to the network.

2. The wide network can be used between different computer hardware and software models.

3. The network can re-route traffic to the non-functioning sections of the network.

4. The network of computers has to grow to become the network of networks rather than remaining only the network of computers.

Answer to TY 4

The correct option is **B**.

E-business encompasses the integration of ICT into the business processes of companies.

Answer to TY 5

The correct sequence is:

(a) Customer places order
(b) Authorisation response
(c) Order processed
(d) Payment done

Answer to TY 6

1. Reduced cost to the firms as the costs of a sales team is eliminated and a physical retail outlet is not required.

2. Compete for best prices as the firms can get information regarding the prices made available by other competitors in the market.

3. Saves time in completing a business transaction from the time the order is placed to the time the payment is settled.

Answer to TY 7

The correct option is (a).

The other options are also challenging to e-commerce but option (a) poses more risk to the buyer and the seller.

Self Examination Questions

Question 1

How can the business have competitive prices by using e-commerce?

Question 2

What are the three basic types of E-commerce?

Question 3

State any three challenges to E-commerce?

Question 4

State any three advantages of E-commerce to the firms?

Question 5

State any three advantages of E-commerce to the customers?

Answers to Self Examination Questions

Answer to SEQ 1

E-commerce eliminates or reduces a lot of cost on the following, thus passing on the benefit to the customers:

1. Cost of maintaining a big sales and purchase team
2. Cost of advertising
3. Cost of maintaining warehouses and retail outlets
4. Cost of excess manufacturing; they can follow the just in time approach
5. Saves time on transaction completion

Amazon.com is the best example which made its first annual profit by using e-commerce and even today 40% of its sales are online.

Answer to SEQ 2

The basic types of E-commerce are:

1.   Business to Consumer (B2C)

This type eliminates all middle agents like the wholesalers and retailers and allows direct business between the manufacturers and consumers. This saves time and removes the extra costs of the middle men. This benefits the consumers. The manufacturers get direct feedback from the consumers, which enables them to create innovative products and services.

2.   Consumer to Consumer (C2C)

This is selling from one individual consumer to another e.g. quikr.com or olx.com where a person can directly sell his used things such as furniture, vehicles etc. to others or can auction or rent his property or furniture.

3.   Business to Business (B2B)

In this type, a supplier supplies raw materials to a manufacturer. Here this transaction is done online between two business parties.

Answer to SEQ 3

1. Buyers are mostly not happy with the goods delivered and find they are not according to their specifications while ordering and want to return the goods. This increase the cost of logistics to the ecommerce players.

2. Cash on delivery is preferred as most of them do not have credit or debit cards and they find this is more authentic way of payment, as one does not get cheated. Manual cash collection is very expensive and risky for the ecommerce players.

3. Once a transaction is not completed successfully the buyer loses interest in buying and does not try again thus due to the failure of the payment gateway the customer is lost.

Answer to SEQ 4

The advantages of E-commerce to the firms are:

1. Any business can connect with any other business in any part of the world removing geographical barriers

2. Everybody can access internet from any corner of the world from big cities to small towns making it easy to reach to a wider crowd and masses

3. Through internet information can be given out in the form of text, graphics, videos, audios , testimonials, price comparisons making it very attractive and informative to the customers thus getting more business.

4. Customer data could be collected, and targeted sales could be done

Answer to SEQ 5

The advantages of E-commerce to the customers are:

1. the internet gives all the information through text, graphics, videos, audios of various businesses; there are demonstrations, testimonials, price comparisons, all available to handle networking tasks and emails, which makes it easy for the customers to get all the information.

2. Goods can be purchased from the comforts of the home and is delivered within two or three days

3. Goods can be returned, and the full refund or replacement is available

4. You can pay by credit card if you do not have cash right then.

5. The cost benefit is passed on to the consumers through discounts and sale offers.

COMMONLY USED APPLICATION PACKAGES

F1

STUDY GUIDE F1: WORD PROCESSING

▊ Get Through Intro

A business organisation is essentially made of people, and communication is the most important tool it has for providing and receiving information, which is essential to its development.

Written communication is most commonly carried out by organisations using a word processor.

In fact, word processors have brought about office automation due to the innumerable advantages which they bring about, like:

a) quick and efficient creation of text documents
b) production of documents which are grammatically correct and readable
c) preparation of easily editable documents
d) preparation of well laid out documents

In this Study Guide we will discuss the definition of the term word processing and understand the application of various word processing tools which will definitely benefit you both personally as well as professionally.

▊ Learning Outcomes

a) Define the term word processing.
b) List and explain various examples of word processing.
c) Use various tools in word processing (text management, paragraph management, page management, language management, letter writing tools, and any other tool).

1. Define the term word processing.
   List and explain various examples of word processing.
                                                    [Learning Outcomes a and b]

1.1 Application Software — Application software is discussed in Study Guide C1

Application software performs specialised tasks for the computer user. Application software is used to perform several tasks in the office such as typing a document, performing calculations and making presentations.

A few examples of these are:

Task	Applications software used
To draft documents	MS-Office Word®
To perform spreadsheet calculations	MS-Office Excel®
To prepare presentations	MS-Office PowerPoint®
To read and print documents	MS-Office Word®, Adobe reader®
To browse the Internet	Internet explorer®, Mozilla Firefox®
To check emails	MS-Outlook®
To watch movies, listen to songs	Windows media player®, Real media player®,

1.2 Word processing

Word processing consists of two words 'word' and 'processing'. Word processing is a software which carries out some processes on matters which are typed (i.e. words) on a computer.

For example the word processing software edits text, suggests grammar correction, facilitates quick and accurate compilation of information, etc.

As discussed in section C, a software can function only if it is complimented with a hardware, similarly word processors can function only if the software is supported with hardware like a computer, monitor, printer, modem, etc.

The word processor software and the hardware together make up the word processing system.

Microsoft Office Word is the predominant word processor used by most of the personal computers in the world. It is a vital tool used by publishers, newspapers and various organisations. All organisations use it as a communication media.

The screen of word processing software looks like a blank piece of paper with various toolbars acting as perimeters. The word processing software is usually used for drafting, editing, formatting and printing documents.

A word document looks like this:
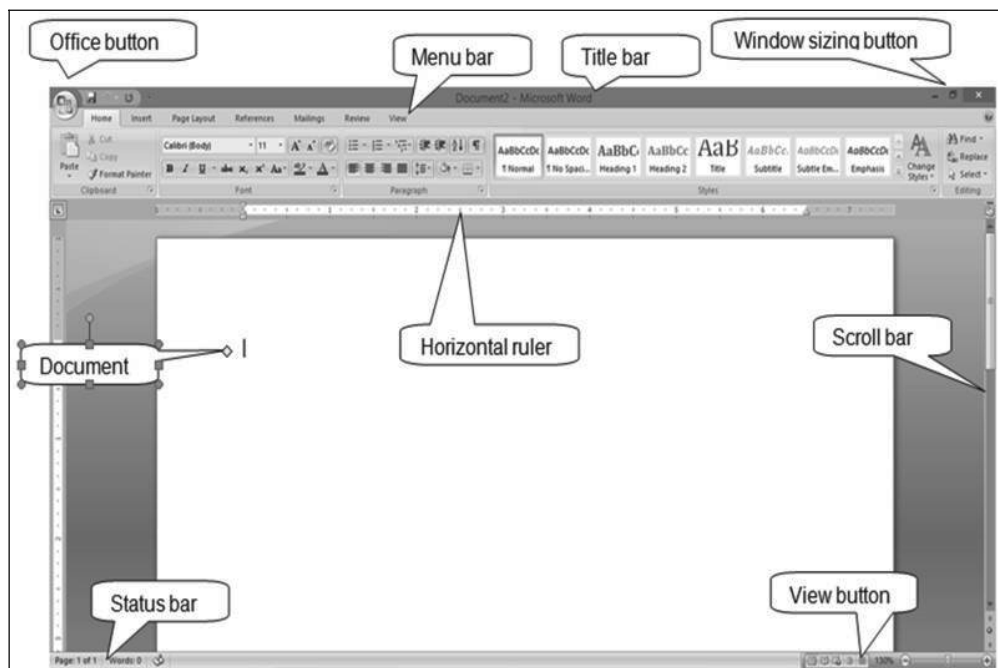
1.3 Examples of word processing

The following are some of the most commonly used functions of MS-Office Word 2003:

1.   To draft variety of documents

The user drafts documents like letters, reports, legal documents, text files containing operating procedures, legers, executive summaries, etc. using the word processing software. The user opens a new Word document and types the required information. The user needs to save the document before exiting from the word processing software. If the user exits without saving the document, the data stored in the document will be lost.

2.   To edit the document

The user can edit an existing document using word processing software. Editing involves adding some text to existing file, adding some pictures, symbols, deleting existing matters, etc. The user needs to open an existing document and type in the required changes and save the changes made before closing the document. If the user fails to save the document after making the desired changes, the document will revert to its original format.

3.   To format text

The user can format text with the help of word processing software. The user needs to select data (mentioned above) to be formatted. The user can format the text in several ways by accessing the **'Format' option** on the menu bar. The user can format fonts (change the font's style, colour, size, space between characters) or paragraphs (change alignment or space between lines).

4.   To check for spelling and grammatical errors

Most types of word processing software have an in-built spelling and grammar check. The word processing software is able to detect spelling and grammar mistakes and give suggestions to correct them.

5.   To provide margins using rulers

The margin is the white space on the document where no text or images can be inserted. Every new Word document opens with the default margins of the word processing software. The user can change margins according to his requirements by moving the slider of the ruler bar.

The user needs to hold the mouse over the triangular sliders and drag the slider left or right depending upon the user's requirement. Another way to change the margin is by clicking on 'File' and selecting 'Page setup'. The user needs to select the Margin tab and input the desired margin requirements such as the top margin for the document and select 'OK'. By selecting a portion of a document, any changes in the margin are made applicable to only that portion.

6. To find and replace words

A user can search for a specific string of characters (in Word) with the help of the 'Find' function. The 'Replace' function allows a user to find a word and replace it with another word. These features allow computer users to save time by quickly searching and replacing words in lengthy documents. The user can access the 'Find and replace' function from the 'Edit' option available at the menu bar. The short-cut key to open the 'Find and Replace' dialogue box is **'Ctrl+F'**.

7. To insert comments

Word processing software allows the user to insert comments at various places in the document. This helps the users to insert **working notes** in the document. Comments are useful when two or more than two users collaborate on a single document. Comments allow different users to address each other's queries without altering the actual contents of the document.

Test Yourself 1

Word processing software is not used _____.

A To draft a document
B To edit a document
C To format text
D To browse the Internet

---

2. Use various tools in word processing (text management, paragraph management, page management, language management, letter writing tools, and any other tool.
[Learning Outcome c]

In this Learning Outcome, we will illustrate the methodology of using the word processing tools to carry out the commonly used word processing techniques which are carried out.

2.1 Text management

The user can 'Cut', 'Copy' and 'Paste' textual data using a word processing program.

The user needs to select the data to be pasted by left clicking and dragging the mouse over the data or with the help of the **Shift+Arrow** keys. The data is highlighted as the user selects the data.

1. The user can copy data by using any one of the following four ways

(a) by pressing **Ctrl+C**
(b) by clicking on the copy icon present on the Standard toolbar.
(c) by right clicking on the selected data and choosing 'Copy' from the menu.
(d) by clicking 'Edit' on the menu bar and selecting 'Copy' from the menu.

2. The user can 'Cut' data by using any one of the following four methods

(a) by pressing **Ctrl+X**
(b) by clicking on the cut icon present on the standard toolbar.
(c) by right clicking on the selected data and choosing 'Cut' from the menu.
(d) by clicking 'Edit' on the menu bar and selecting 'Cut' from the menu.

2.2 Paragraph management

The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out according to the needs of a user.

The tool is located here:
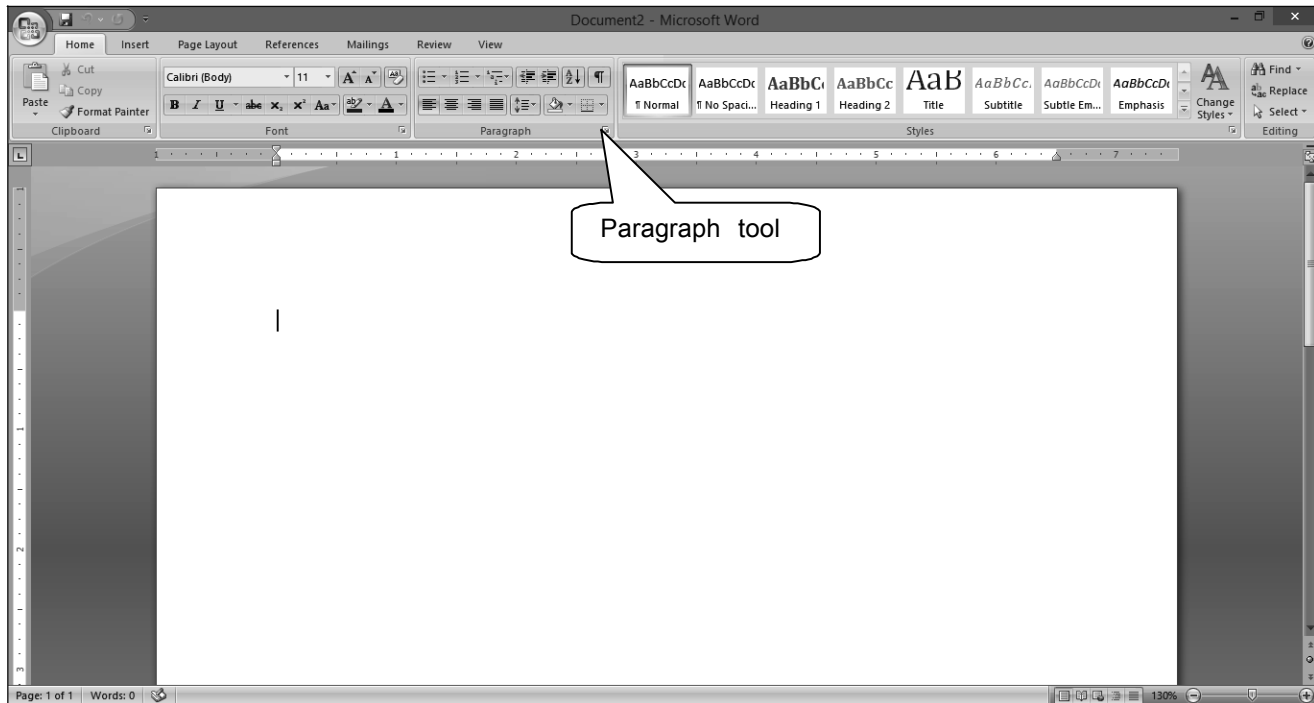
On clicking the paragraph tool (indicated in the call out above), the following is displayed:
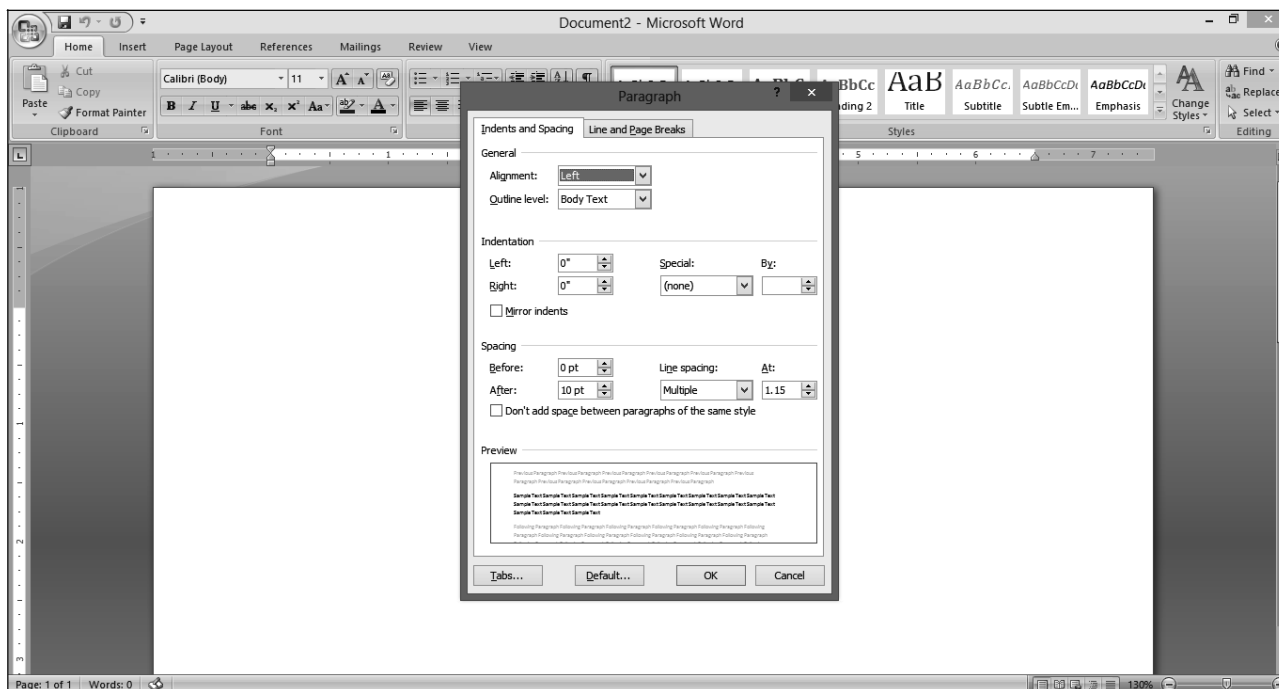
This tool has two sections; indent and spacing; and line and page breaks.

1. Using the **indent section**, we can fix the alignment of the text as follows.

Example

The following lines are typed in a word document.

"The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out according to the needs of a user."

(a) If the user wants to make it left aligned, the text will look as follows.

The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out in according to the needs of a user.

Here the text will be aligned flushed to the left margin of the paragraph. This is a default paragraph set-up.

(b) If the user wants to make it right aligned, the text will look as follows.

The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out in according to the needs of a user.

Here, the text will be aligned flushed to the right margin of the paragraph.

(c) If the user wants to make it aligned to the centre, the text will look as follows.

The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out in according to the needs of a user.

Here, the text will be between the left and right margin of the paragraph.

(d) If the user wants to justify the text, it will look as follows.

The word processor has a 'paragraph' tool which enables text in paragraphs to be aligned, indented and spaced out in according to the needs of a user.

Here the text will be aligned flushed with both margins (left as well as right) of the paragraph.

Step 1: Open the paragraph tool by clicking here

Step 2: Click the drop down box against 'Alignment'

Step 3: Select the left option by clicking here

Step 3: Click ok
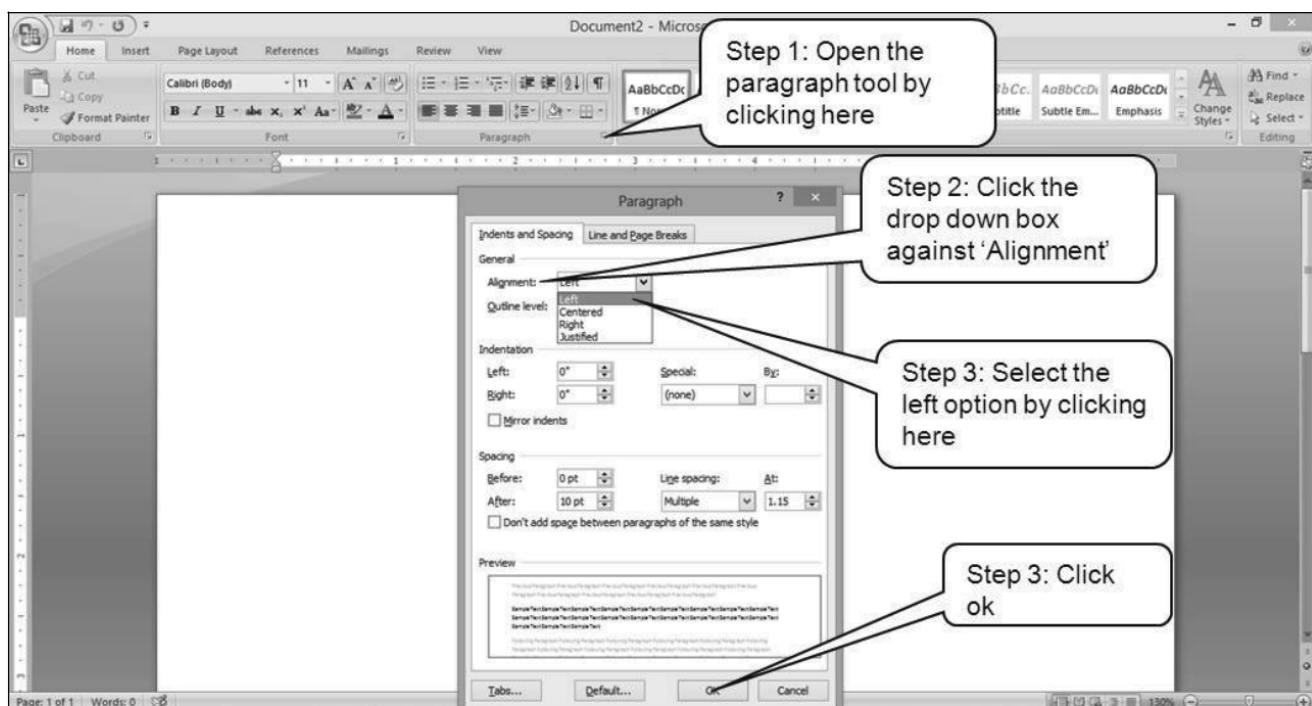
Let us now understand how the alignment is to be done:

2. Alignment of specific paragraphs

Example

The following information is typed by a user:

Word processing has two words 'word' and 'processing'. Word processing is a software which carries out certain processes on text typed on a computer.

For example, the word processing software edits text, suggests grammar correction, facilitates quick and accurate compilation of information, etc.

As discussed in section C, software can function only if it is complemented with hardware. Similarly, word processors can function only if the software is supported with hardware like a computer, monitor, printer, modem, etc. **The word processor software and the hardware together make up the word processing system.**

The user wants to make the passage look like this:

Word processing has two words 'word' and 'processing'. Word processing is a software which carries out certain processes on text typed on a computer.

    For example the word processing software edits text, suggests grammar correction, facilitates quick and accurate compilation of information, etc.

As discussed in section C, software can function only if it is complemented with hardware, similarly word processors can function only if the software is supported with hardware like a computer, monitor, printer, modem, etc. **The word processor software and the hardware together make up the word processing system.**

The below steps should be followed to make the passage look like what is shown above:
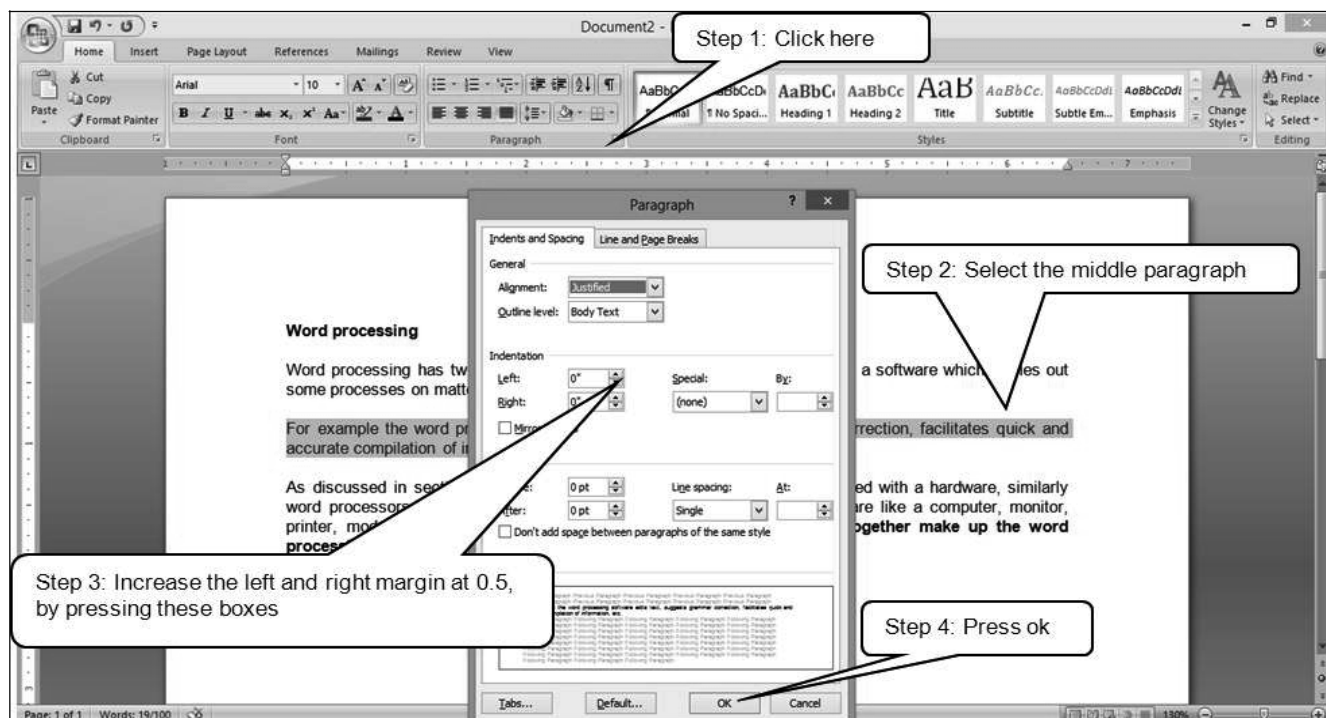
The document will now look like this.
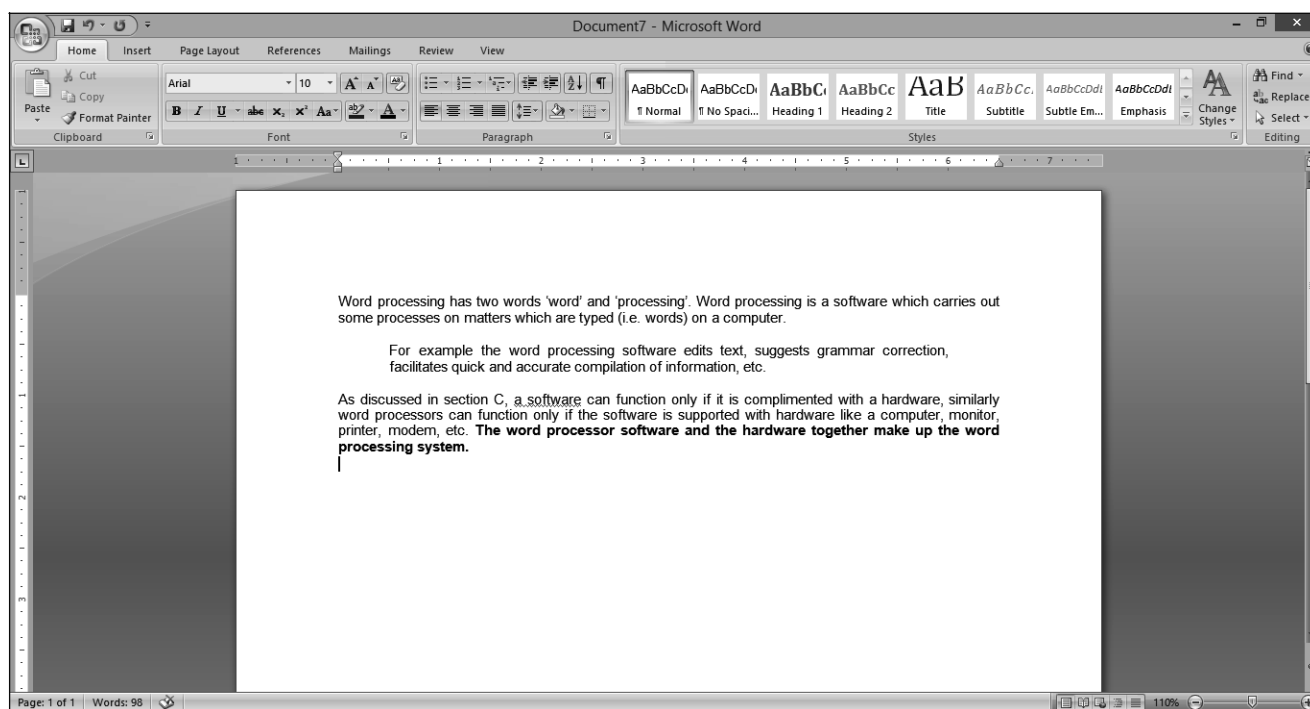
(a) **Spacing before and after paragraphs can be adjusted as follows.**

Example

The following information is typed by a user.

Word processing has two words 'word' and 'processing'. Word processing is a software which carries out some processes on matters which are typed (i.e. words) on a computer.
For example, the word processing software edits text, suggests grammar correction, facilitates quick and accurate compilation of information, etc.
As discussed in section C, a software can function only if it is complimented with a hardware, similarly word processors can function only if the software is supported with hardware like a computer, monitor, printer, modem, etc. **The word processor software and the hardware together make up the word processing system.**

The user wants to increase the spacing before and after each para and make it look as follows:

Word processing has two words 'word' and 'processing'. Word processing is a software which carries out some processes on matters which are typed (i.e. words) on a computer.

For example, the word processing software edits text, suggests grammar correction, facilitates quick and accurate compilation of information, etc.

As discussed in section C, a software can function only if it is complimented with a hardware, similarly word processors can function only if the software is supported with hardware like a computer, monitor, printer, modem, etc. **The word processor software and the hardware together make up the word processing system.**

The following steps should be followed.
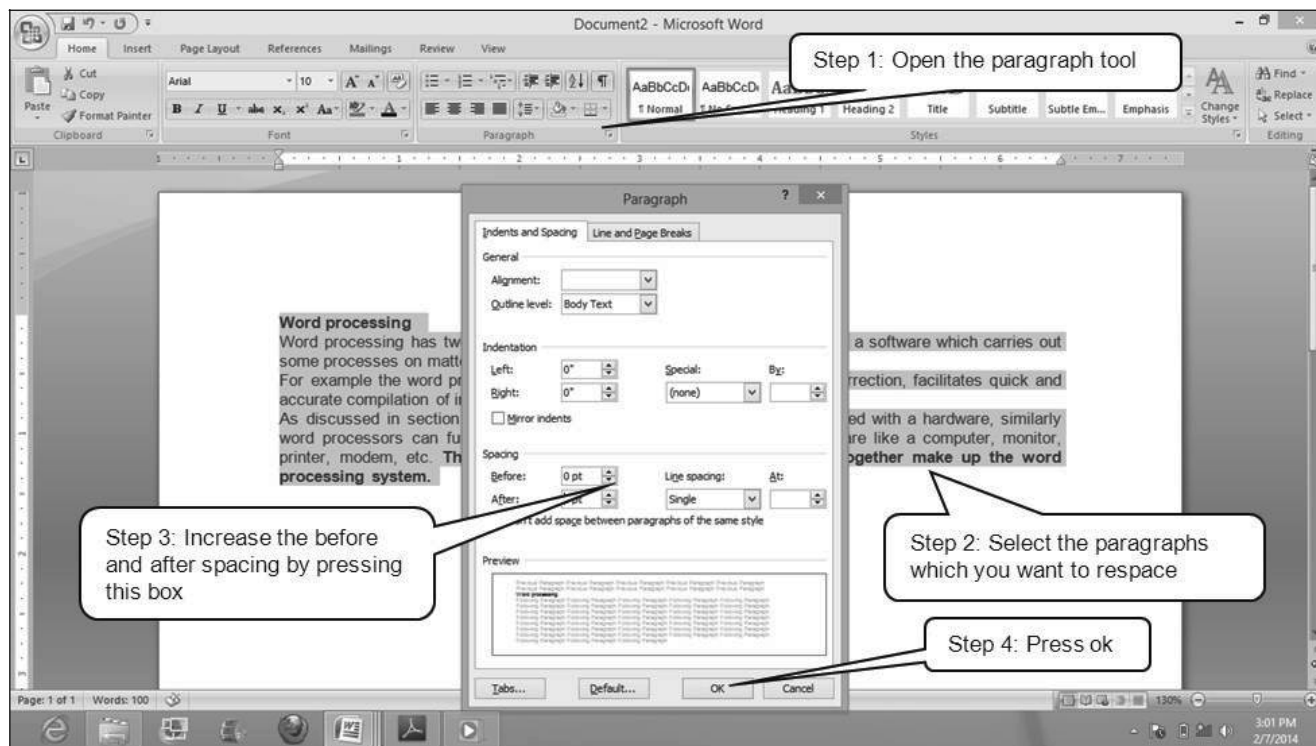
2.3 Page management

Legal contracts, standard letters, small letters, envelopes, statements, ledgers, folios, notes, books, etc. are typed on word documents. However, these documents have different standard sizes. Furthermore, some of these documents are printed on A4 size or A3 size papers, letters, envelopes, etc. and also printed as a portrait or as a landscape format.

Word provides the facility of changing the page margins to match the purpose of the document. The following illustrates its application:

Example

The following information is typed by a user:
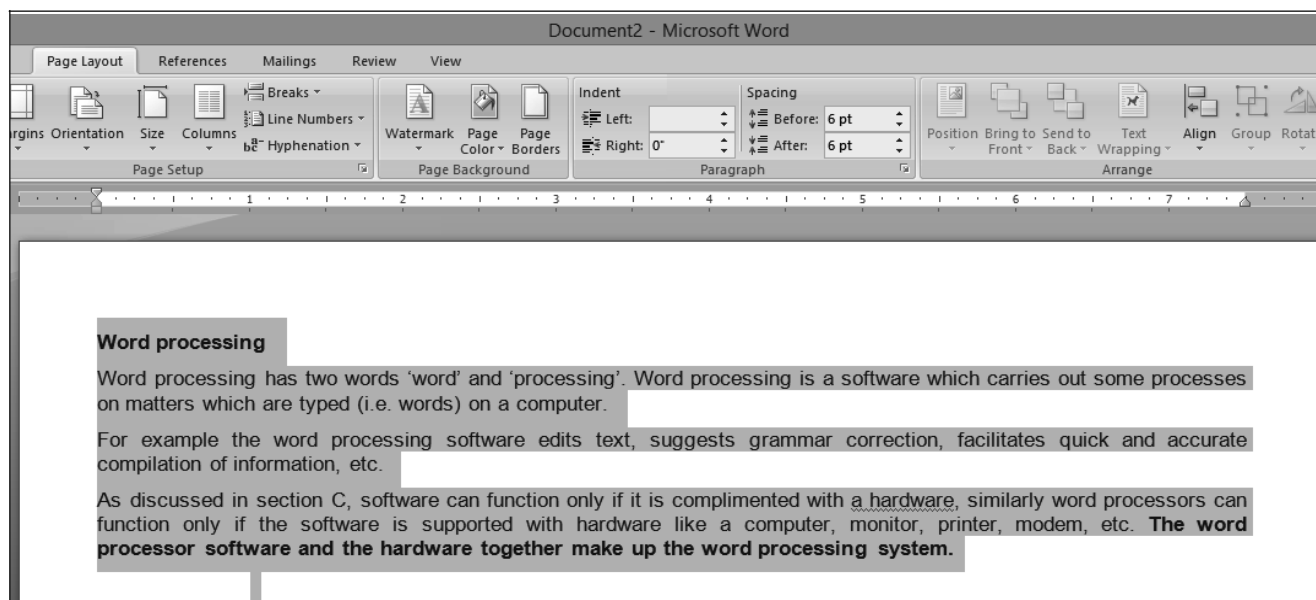
The above document has very less margins and therefore looks cluttered.

Therefore the user wants to change the margin and make the document appear as follows.
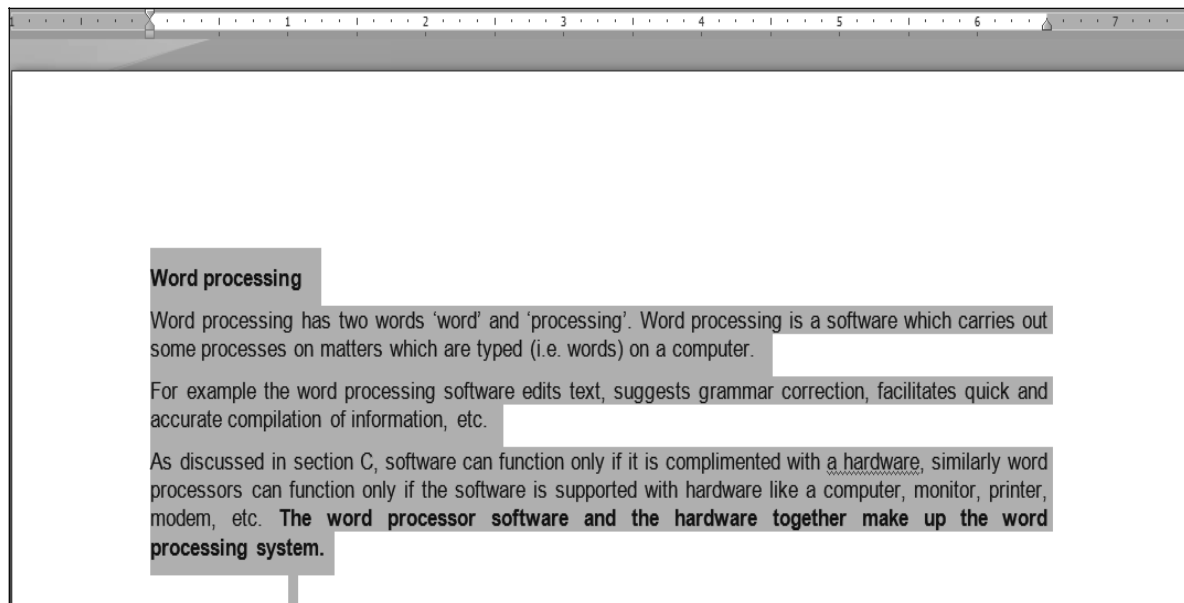
The above change can be made as follows:

Step 6: Click Size

Step 7: Click A3

Step 8: Click Column

Step 9: Click Two
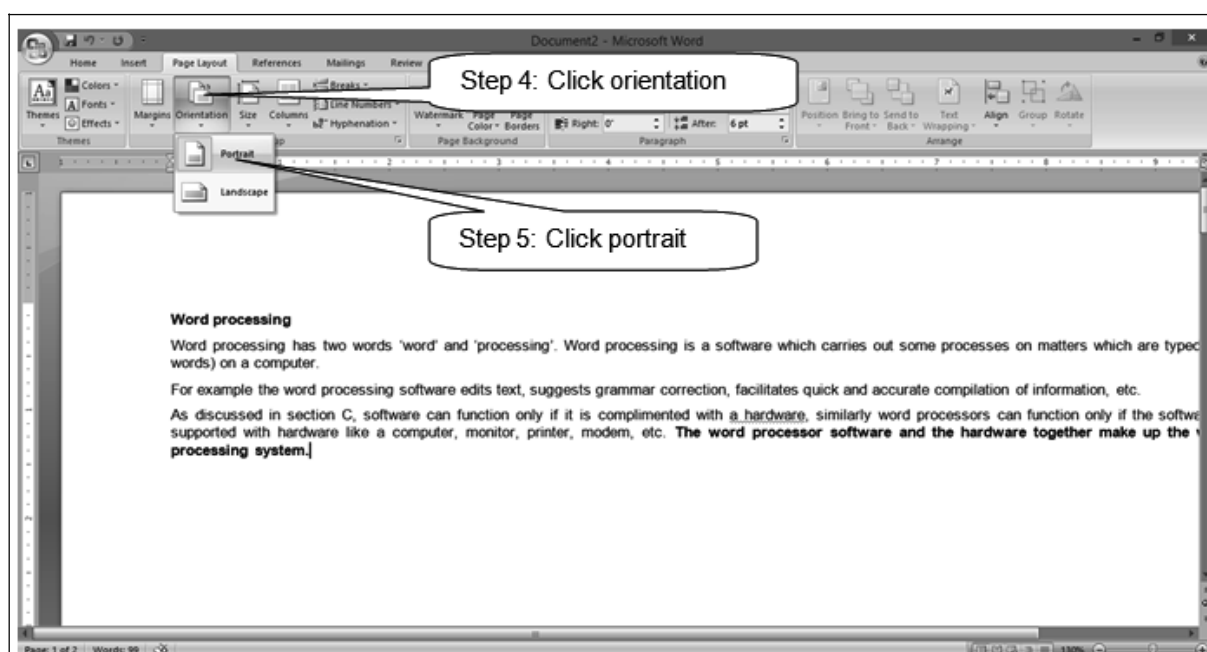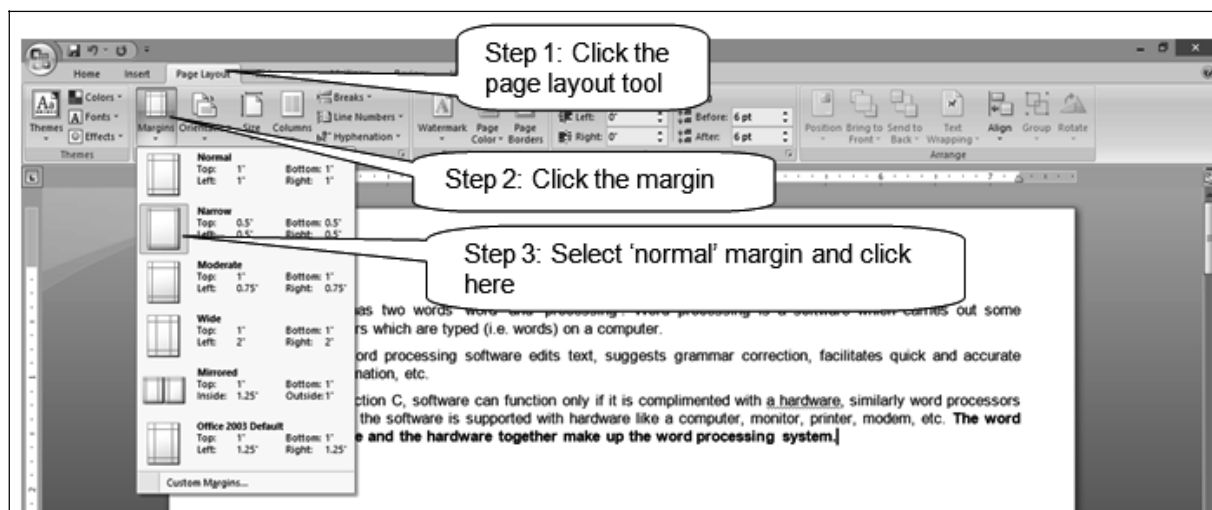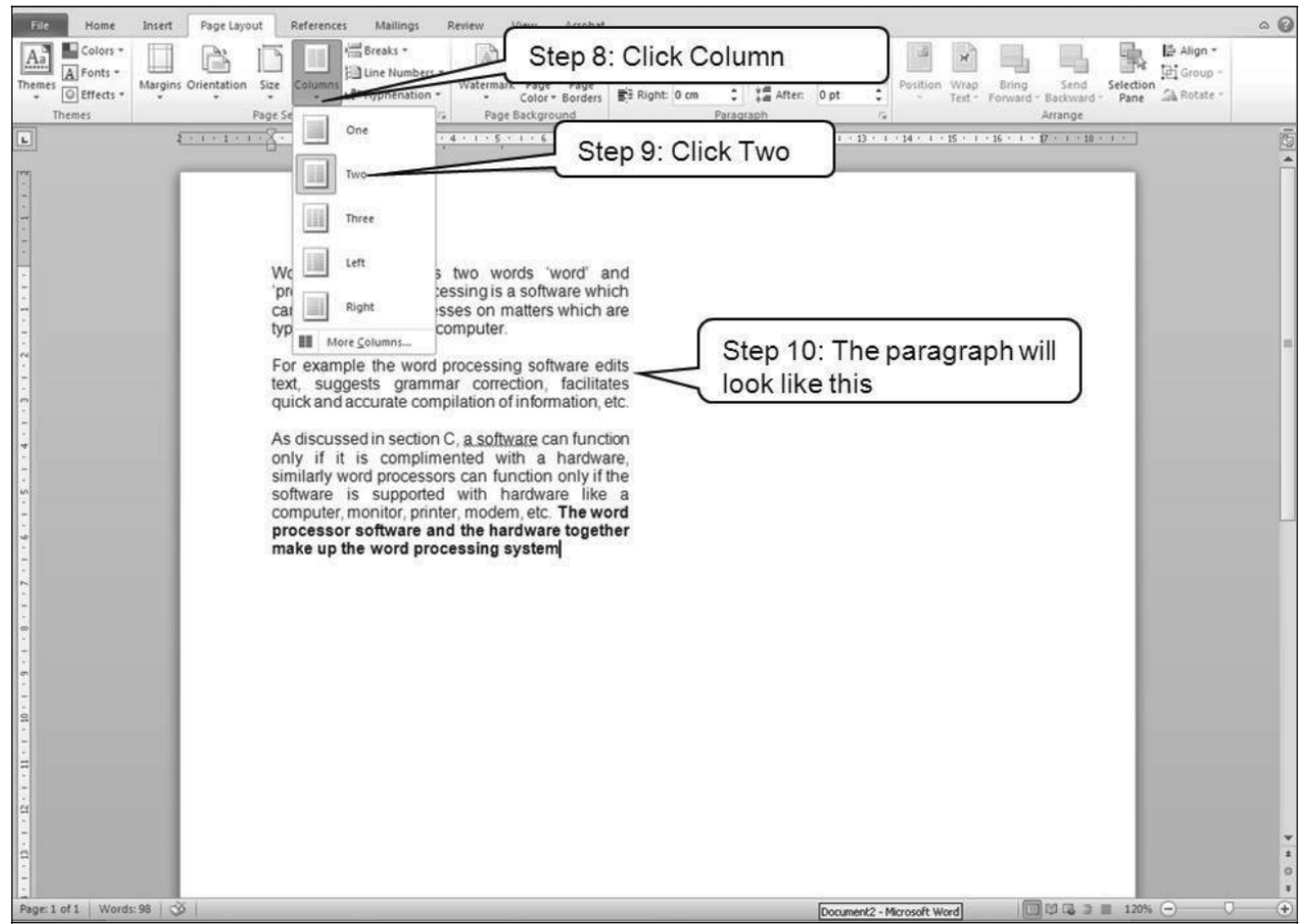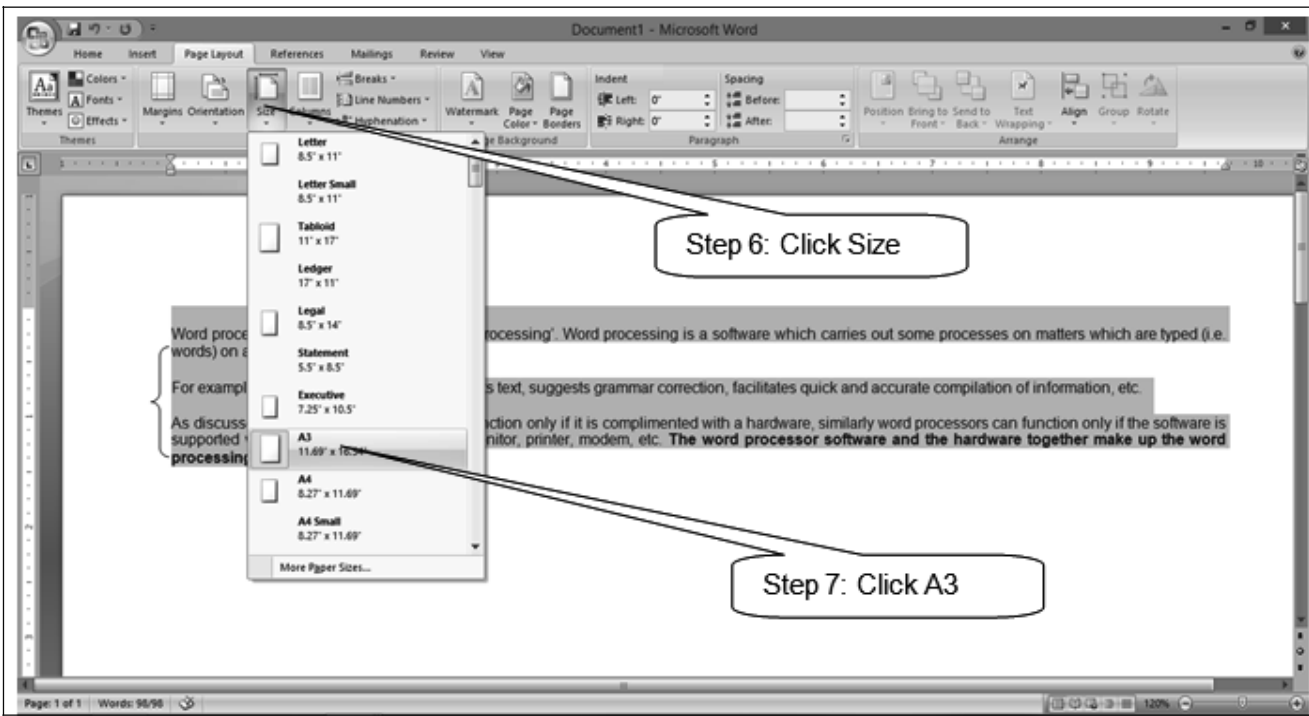
Step 10: The paragraph will look like this

2.4 Language management

Word processors have an inbuilt tool to check spellings as well as grammar for text which is typed in a word document. For example, if a word is misspelt, the word processor flags it with a red wavy underline. However, if the word, sentence or phrase has incorrect grammar the word processor flags it by underlining the incorrect parts with a green wavy line. Furthermore, to facilitate correction of errors, Word also suggests the correct spellings which can be accepted by the user.

Example

The methodology of correcting language errors is as follows:
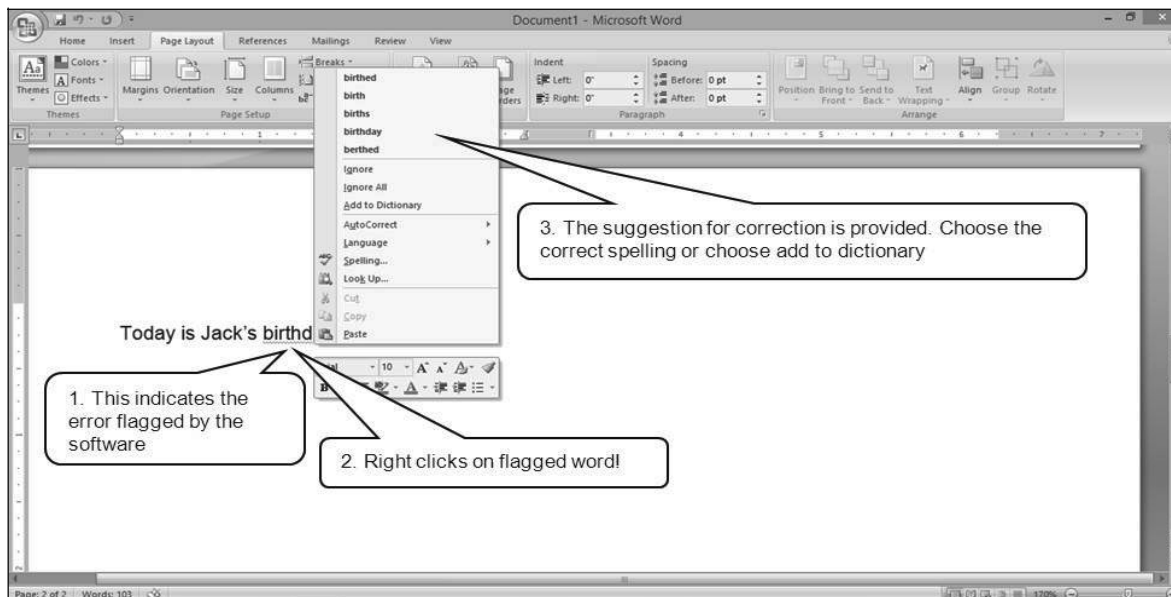
Users sometimes correct each error that is highlighted individually or correct all the errors together, after typing the entire document.

This can be done by either of the following ways:

1. Pressing F7 or
2. By following these steps:
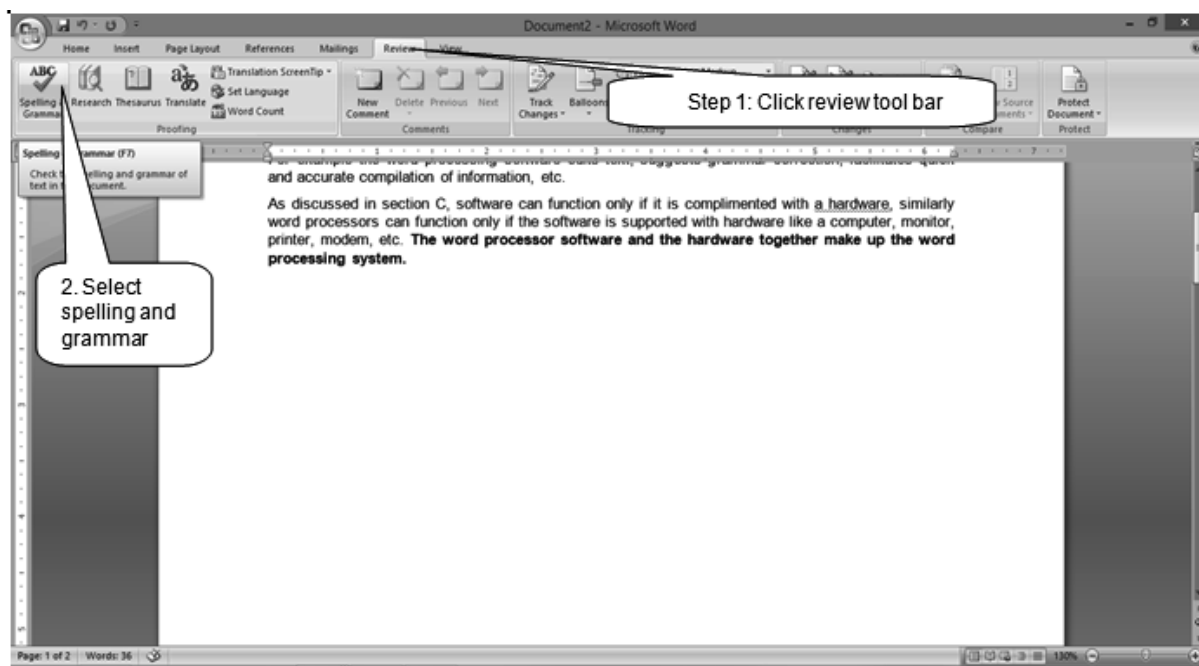
3.   The screen which will appear is as follows:
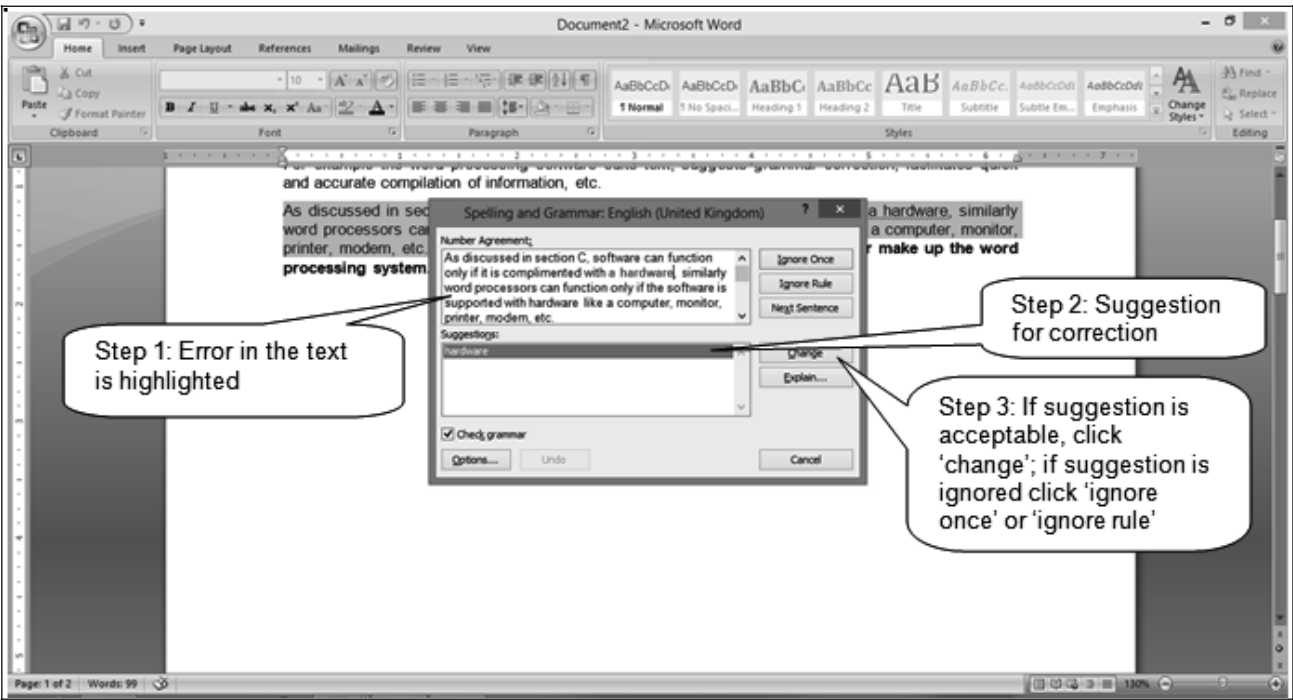
When the spell check is completed, the following screen will appear:
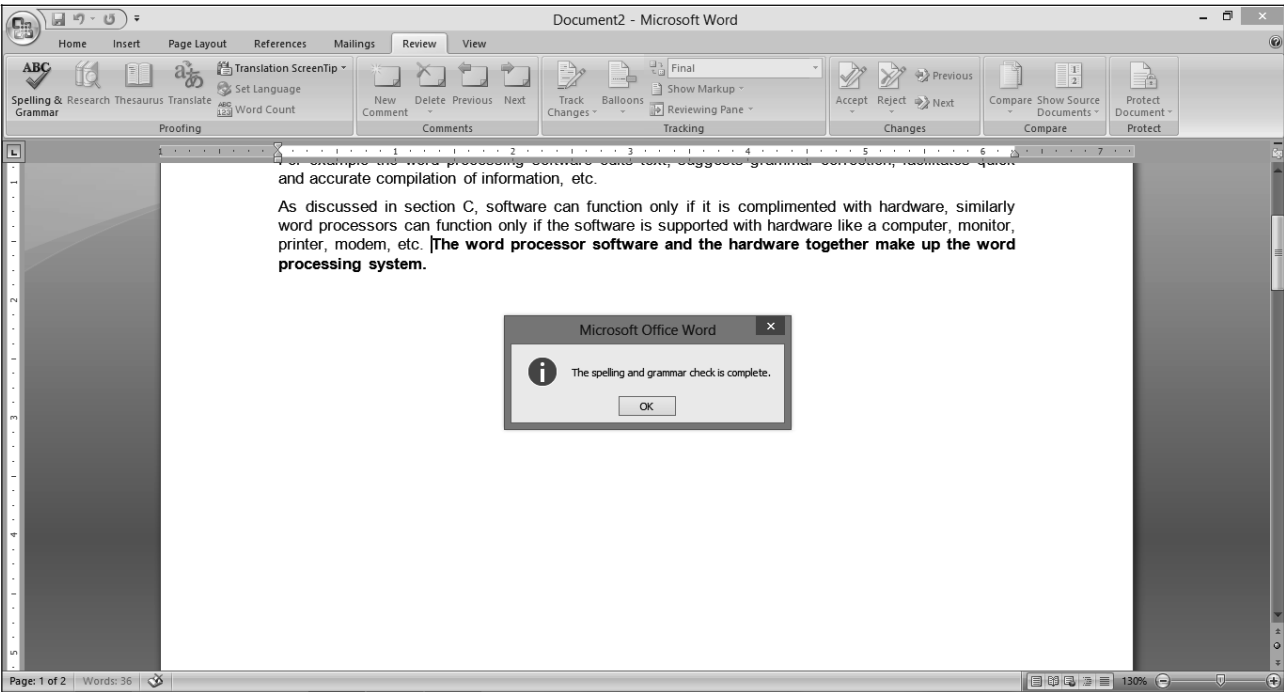
2.5 Letter writing tools

As already discussed, letters can be created using the word processor. The mailings tool of word processor, contains a feature called mail merge. This feature enables a user to send out letters, notices, etc. to various recipients simultaneously i.e. when the document sent to various recipients is same but the names and addresses of recipients are different, mail merge is used. For example, auditors use mail merge to send out latest circulations on regulatory changes, accounting standards, etc. to their various clients,

Mail merge comprises the following three steps:

Step 1: Creation of document / letter

The first step involves creation of the 'main document' or 'form letter' which is required to be mailed. This document should contain the text, graphics like the company logo, the body of the message, etc.

Step 2: Add mail merger fields

Mail merge fields called as placeholders are added to the 'form letter' or 'main document'.

Step 3: Creation of database of list of recipients

This can be created in word document or in an electronic spreadsheet (discussed in detail in Study Guide F2) or in Microsoft outlook through a contact list or address book.

Here we will illustrate how it is created in a word document.

The word document should be in a tabular format having the following features:

First row: should contain the headings like 'name', 'address', zip code
Other rows: should contain the details of the names and addresses of the each recipient

The method of creating a table as described above is as follows:
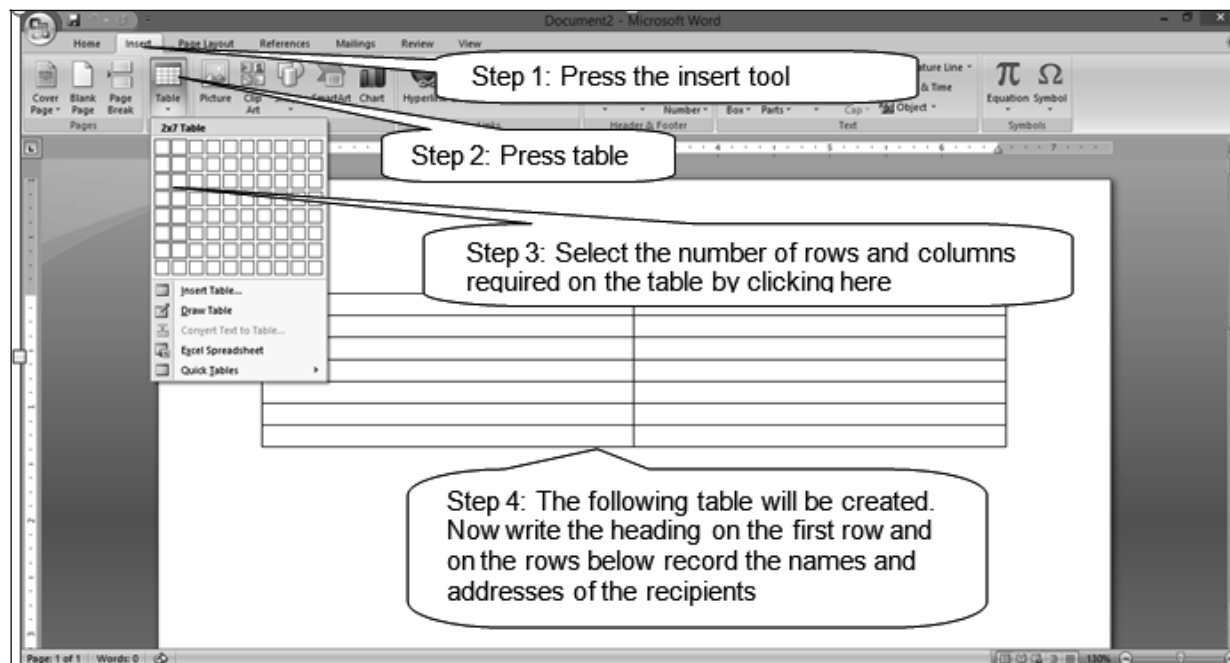
2.6 Other tools

1. To save documents

(a) To save a file for the first time:

click File on the Toolbars and select the 'Save as' option or Press **Ctrl+S** on the Keyboard.
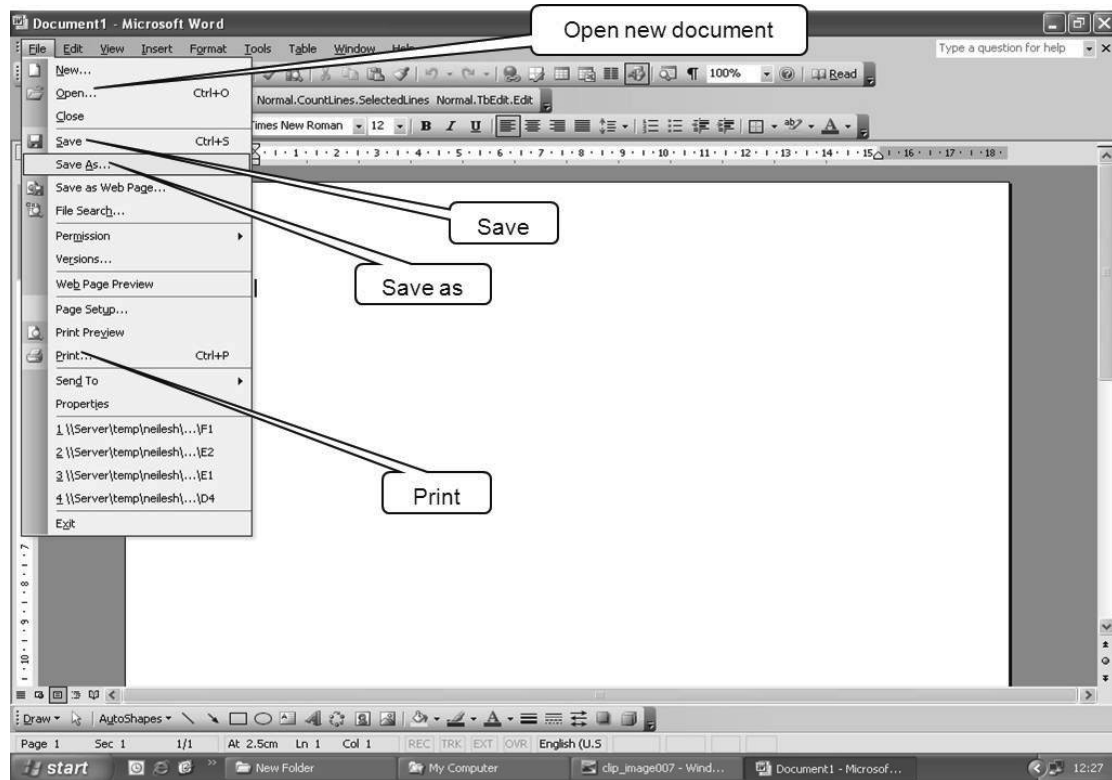
A dialogue box will open
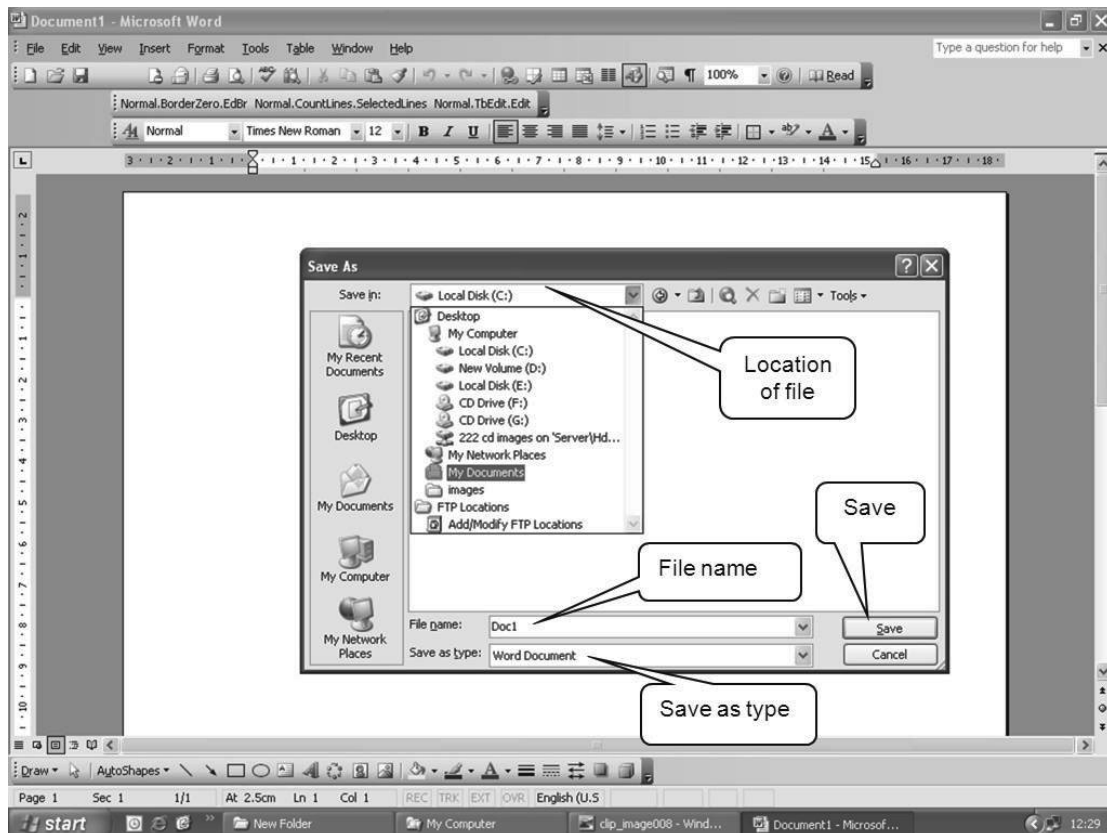
The following information is required to save a file

Information	Details required
Name of the file	Type the desired name of the file. Check that no file with the same name is present at the location (folder) where the file is to be saved.
Save In	The computer will ask for a location to save the file. Browse and select the location to save the file.
Save as type	This will determine the application which will open the file. The user is allowed to save the file in the format of his choice. The default extension is of the application, in which file has been created or edited.

The user can switch between information by using the tab key.

(b) To save a file, (not for the first time):

click on the save icon and the file will be saved where it was saved previously.
press **'Ctrl+S'** and the file will be saved in the same location.
click 'File' on the toolbar and select the save option, this will save the file where it was previously.
click 'File' on the toolbar and select the 'save as' option, a dialogue box similar to when the file was first saved will be opened. Type the necessary information and Click save.

If the user exits Microsoft Office Word without saving the file, then three options will be offered:
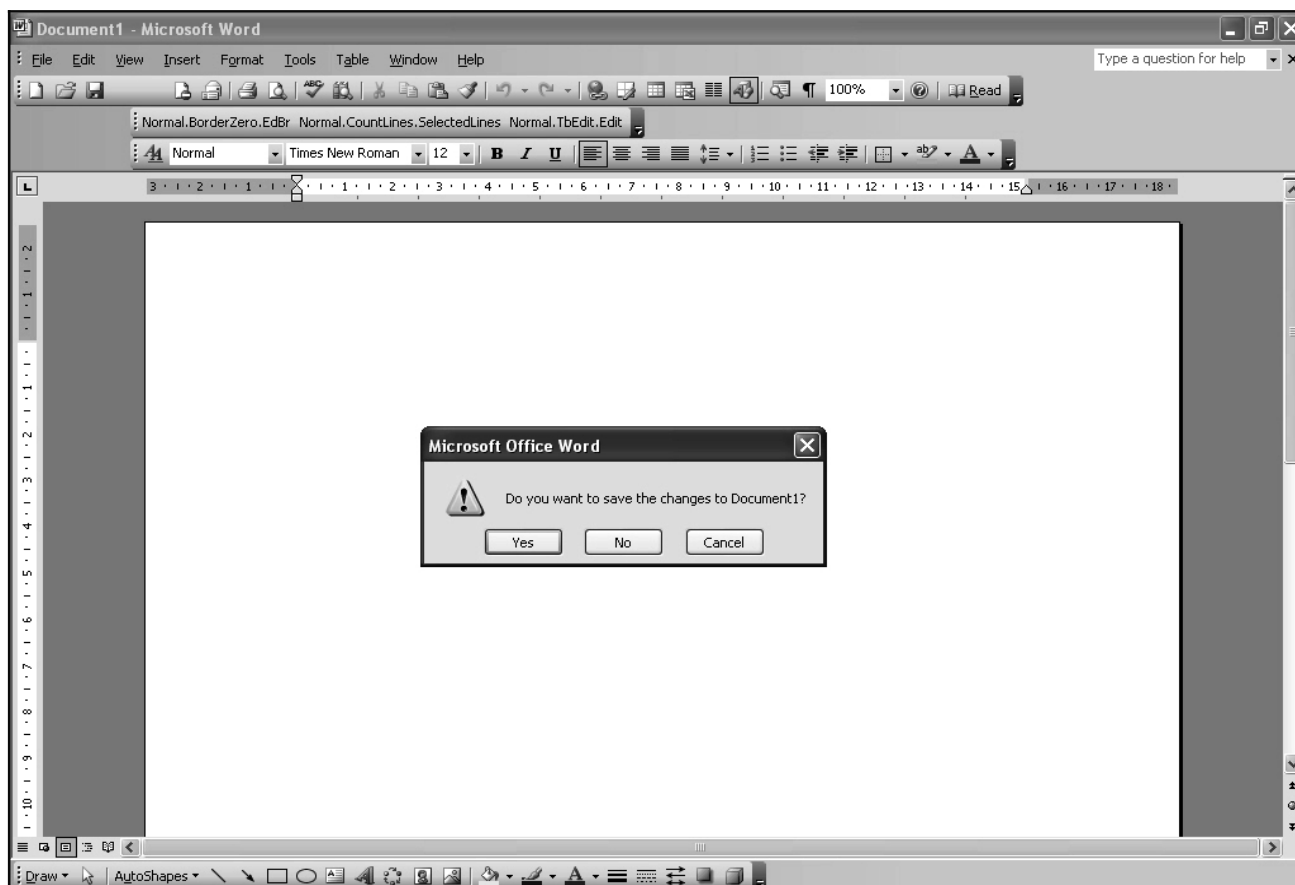
Option	Instructions given
No	To discard the changes made by the user
Yes	To save the changes made by the user
Cancel	To undo the step of exiting the application, and to keep it running.

2. Transferring a document from one place to another.

A file is transferred from the computer in the following manner:

(a) it is copied from one place to another.
(b) it is moved using the 'drag and drop' method
(c) it is renamed
(d) it is deleted

Function	Steps to be taken
Copy file from one location to another	(i) Select the file by clicking on it. (ii) Copy it using the **'Ctrl+C'** key or Right click on the file and choose the 'copy' option (iii) Go to the location where the file is to be copied and press **'Ctrl+V'** or Right click and select the Paste' option.
Copy file from one location to another using windows explorer	(i) Windows explorer has two panels. (ii) To see a collapsed folder click on the **'+'** sign or double click on the folder (iii) Select the file by clicking on the file (iv) Copy the file by clicking on the edit menu and select copy (v) Go to the location where you want to copy the file and click on the edit menu and select paste (vi) Alternatively, you can use the method mentioned in 'Copy File from one location to another to copy and paste files.
Moving a file using the drag and drop method	(i) Open windows explorer (ii) Use the smaller panel, locate the place where the file is to be saved (iii) Select the file to be moved by left clicking the mouse, don't release the left button (iv) With a light hand on the mouse, drag the file to the desired location
Renaming a file	(i) Select the file by clicking on it (ii) Right click on the file and select the 'Rename' option or Press 'F2' on the keyboard (iii) Write the new name of the file and press 'Enter'

Function	Steps to be taken
Deleting a file	(a) Select the file by clicking on it (b) Press the 'Delete' button on the keyboard or Right click on the file and select the 'Delete' option (c) Windows® will ask for a confirmation (d) Confirm the task (e) The file will be moved to the 'Recycle Bin' (f) The file can be retrieved by accessing the Recycle Bin (g) If you wish to permanently delete the file, then delete the file from the Recycle Bin (h) A file can be permanently deleted by pressing **Shift+Delete** or by pressing shift at the time of choosing the 'Delete' option from the keyboard and accepting it when Windows® asks for a confirmation.

3.   Printing the document

There are four ways to print a document

(a) Right click on the file to be printed and select the Print option. This will print the whole document.

(b) Open the document to be printed. Click on the Print icon on the toolbar. This will print the whole document.

(c) To print the whole document or a part of the document (Using Print Dialogue box):

(i)   click File and select the Print option or press **Ctrl+P**. This will open the Print dialog box.

(ii)   this dialog box will show information about the kind of printer installed e.g. HP Laser Jet 1020 and the status of the printer e.g. idle. The name drop down box will contain a list of printers installed to the computer.

(iii) choose the desired printer.

(iv) in the page range choose "All" (to print the whole document), "Current page" (to print the page being displayed on the screen) or "Pages" (enter a page range).

(v) on the right side there is an option to print the number of copies. Enter the number of copies to be printed for example, 1, 2 or 3.

(vi) there is collating option. Choosing this option prints the document pages in a sequence. If this option is not chosen then the printer prints the number of copies ordered of a single page and then proceeds to print copies of the next page.

(vii) the Zoom option allows the user to decide the number of pages of the document to be printed. Click print after selecting the desired options.
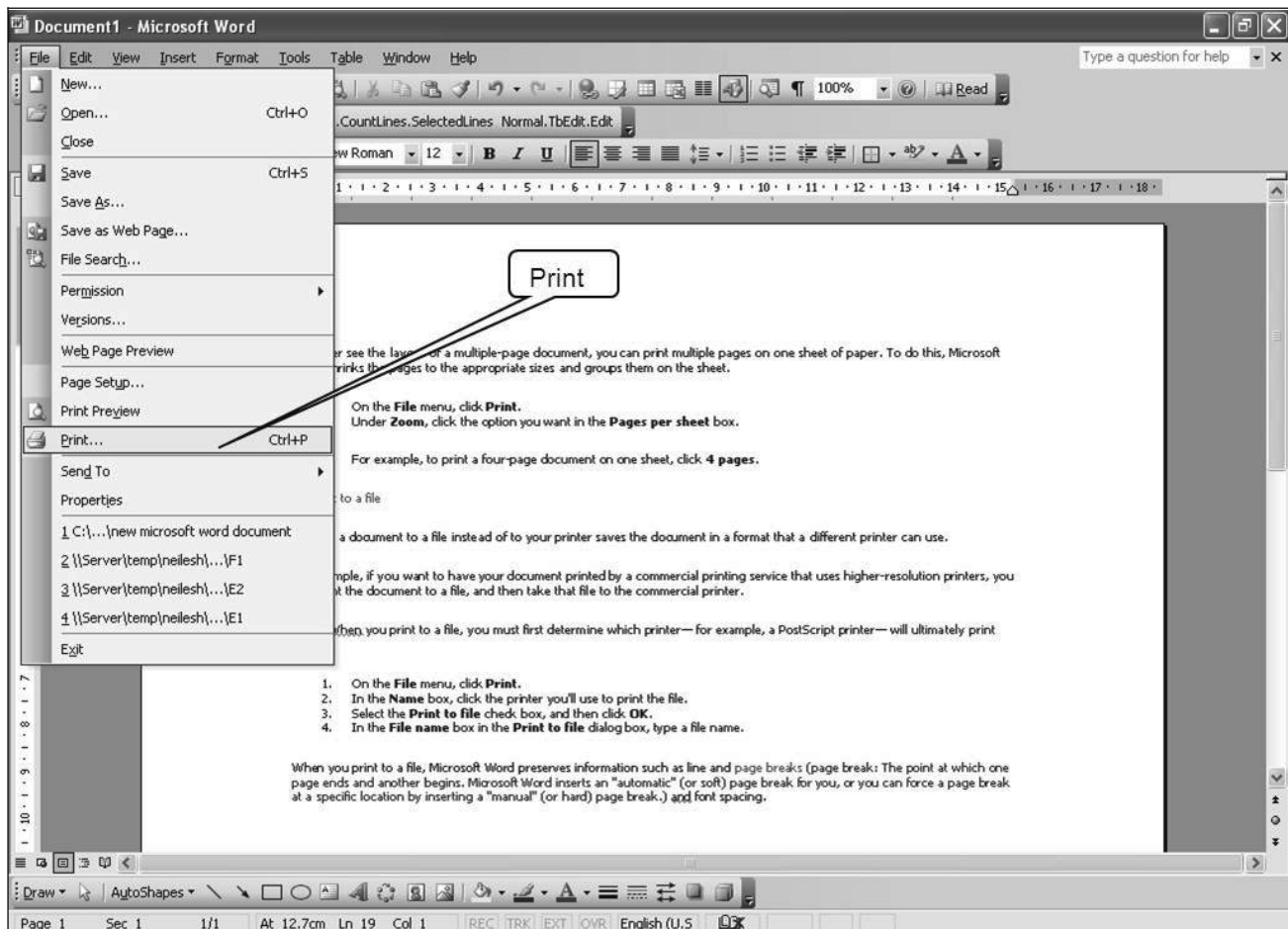
(d) To print a selection from document:

(i) open the document to be printed.

(ii) select the portion of the document to be printed by placing the mouse curser at the beginning or end of the area to be printed. Keep the left mouse button down and drag the curser to the other end of what is to be printed, this will highlight the area to be printed print.

(iii) open the Print dialogue box by giving the print command according to one of the two above mentioned steps or Right click on the mouse while keeping the curser over the highlighted area. This will open a menu. Choose print from the menu displayed. This will open the Print dialogue box.

(iv) choose "Selection" in the page range box. Click "Print" and the selection made using the mouse will be printed.
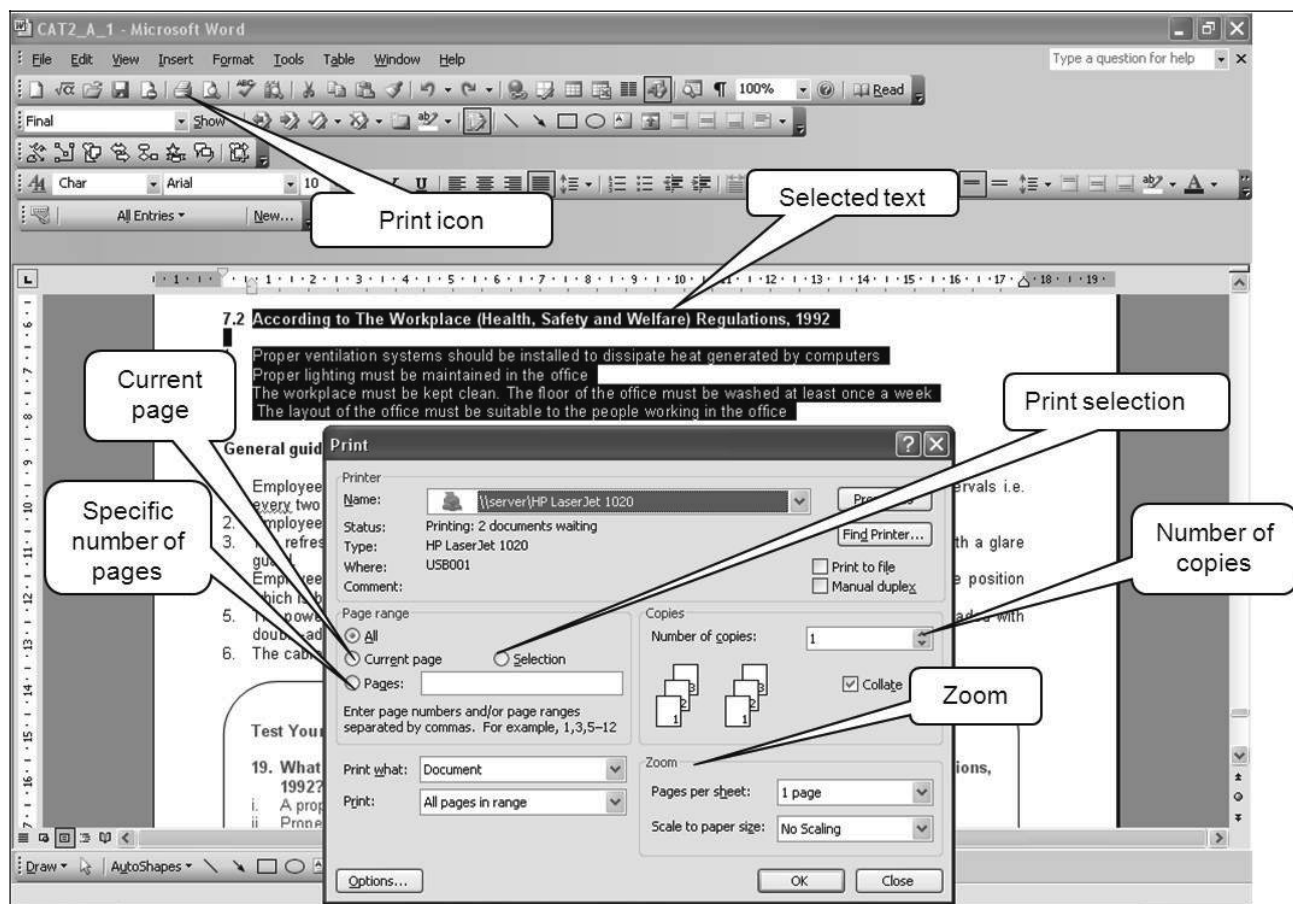
Test Yourself 2

Which one of the following option is not displayed to a user exiting Microsoft Office 2007 without saving the document?

A Yes
B No
C Cancel
D Delete

Answers to Test Yourself

Answer to TY 1

The correct option is **D.**

Software like internet explorer, mozilla fire fox are used to browse the internet.

Answer to TY 2

The correct option is **D.**

Self Examination Questions

Question 1

Fill in the blanks.

(a) Jack has opened a word document which was prepared earlier during the day. He edits the document and clicks the save option from the office button. He _____ the previous version of the document.

(b) A public accountant uses the _____ feature of Word 2007, to send a circular on the latest Finance
    Act to her client.

(c) Jack wants to delete the word 'three' which is typed on a word document. He places the cursor after the word three and presses the backspace key _____.

Question 2

The delete button deletes the character _____ the insertion
point.

A   Before
B   After
C   At

Question 3

When a paragraph in a word document is aligned by flushing towards the left and right margins, the paragraph is:

A   Right aligned
B   Left aligned
C   Justified
D   Centre aligned

Question 4

Richard wants to cut and move a paragraph on a word document to the office clipboard. For this, he presses which of the following keys together?

A   Shift and delete
B   Control and X
C   Control and Z
D   Control and Y

Question 5

Character height is generally measured in:

A   Millimetres
B   Centimetres
C   Inches
D   Feet

Question 6

You are required to guide Jack to delete a word file which was prepared by him yesterday.

Answers to Self Examination Questions

Answer to SEQ 1

(a)   Overwrites
(b)   Mail merge
(c) five times

Answer to SEQ 2

The correct option is **B.**

Answer to SEQ 3

The correct option is **C.**

Answer to SEQ 4

The correct options are **A and B.**

Answer to SEQ 5

The correct option is **B.**

Answer to SEQ 6

(i)   Select the file by clicking on it
(ii) Press the 'Delete' button on the keyboard or Right click on the file and select the 'Delete' option
(iii) Windows® will ask for a confirmation
(iv) Confirm the task
(v)   The file will be moved to the 'Recycle Bin'
(vi) The file can be retrieved by accessing the Recycle Bin
(vii) If you wish to permanently delete the file, then delete the file from the Recycle Bin

A file can be permanently deleted by pressing **Shift+Delete** or by pressing Shift at the time of choosing the 'Delete' option from the keyboard and accepting it when Windows® asks for a confirmation.

COMMONLY USED APPLICATION PACKAGES

F2

STUDY GUIDE F2: ELECTRONIC SPREADSHEETS

▉ Get Through Intro

In today's fast world, tasks need to be done speedily and accurately. Accounting is a critical function where both these are important. In many cases organisations need to process and analyse huge amounts of data within a short period of time.

It is important for any business to match this speed with accuracy. The spreadsheet package is the modern software tool that helps add **speed** to numerical and financial data processing. The spreadsheet helps by making tedious calculations **simpler** and **faster** to perform.

This Study Guide helps you understand the various applications and uses of spreadsheets. Spreadsheets help in recording, compiling and interpreting large amounts of data to create meaningful information for management of all accounting processes. It is extremely important to have a working knowledge of spreadsheets and the various analysis functions offered by them.

▉ Learning Outcomes

a) Define the term electronic spreadsheets.
b) List and explain various examples of electronic spreadsheets.
c) Use various tools in electronic spreadsheets (statistical, arithmetical, financial, text, database management, lookup and reference, information, etc.).
d) Use advanced tools in electronic spreadsheets (pivot tables and solver).

1. Define the term electronic spreadsheets.

[Learning Outcome a]

Meaning

A spreadsheet, also known as a worksheet, contains **rows** and **columns** and is used to record and compare numerical or financial data.

Originally, spreadsheets only existed in paper format, but now they are most likely created and maintained through a **software program (for example MS Excel)** that displays the numerical information in rows and columns.

Spreadsheets can be used in any area or field that works with numbers and are commonly found in the accounting, budgeting, sales forecasting, financial analysis and scientific fields.

The latest versions of spreadsheets include the fullest range of computational and graphical tools for both financial and scientific or engineering applications.

Before the development of spreadsheet packages, accounting staff used to do various calculations either manually or with the help of calculators. However, since spreadsheet packages came into the market, there is a vast change in their work style. The work of a few hours is possible in just a few minutes with 100 percent accuracy, using spreadsheets.

Spreadsheets are so widely used that any person who uses a computer is aware of computer spreadsheets. It is an important tool used in management accounting since it helps in the preparation of various reports and financial statements.

A spreadsheet is a blank sheet in a file and contains various **rectangular shaped cells**.

Figure 1: Blank spreadsheet screen
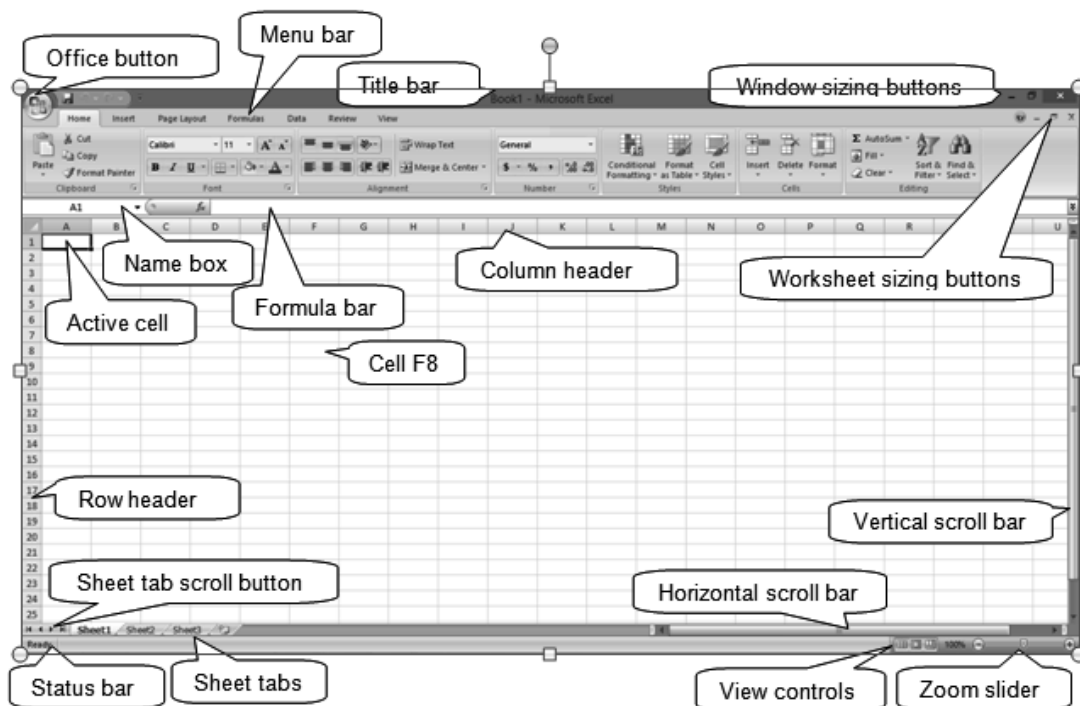
In a spreadsheet any number, text or values are identified by the **cell reference** in which they are written. The top most row specifies the column numbers and the left most column specifies the row numbers. These are highlighted in grey colour in the above Figure.

Text as well as numbers can be written in these cells. Arithmetical functions such as **addition, subtraction, multiplication and division** of these numbers can also be performed with the help of the formulae. Formulae can be given in the cells by actually typing in the formula for the function to be performed, giving the cell references in which the values lie. **The formula box** will always display the formula as it is. This helps in checking the formulae as one writes them.

Example

If we have to multiply the numbers in the cells A2 and B5, we can write the formula for it in the cell as "= A2 * B5"

The cell will display the product of the numbers in the cells A2 and B5. Suppose the values in the cells are - 25 in cell A2 and 5 in cell B5 then the cell will display the product of numbers 25 and 5 as 125 (25 x 5).

The **menu bar, formatting toolbar** and the **standard tool bar** help us perform various functions such as the summation of a number of values, copy and paste of values and text, editing the matter in various ways and so on.

The **worksheet tabs** and **scroll buttons** help to move from one worksheet to another or move around in a worksheet. A spreadsheet package contains three worksheets by default and further worksheets can be added as necessary.

The practical use of a package will give a better understanding of the functioning of spreadsheets. To have a better understanding it is recommended that students try the functions simultaneously as they go through this Study Guide.

Spreadsheets give quick end results. In decision making you have to work out various alternatives and choose one option for implementation. In this case, spreadsheets help make a clear presentation of the various options.

Role of spreadsheet systems

The basic role of a computer spreadsheet is to **simplify the procedures** for recording, manipulating, analysing and presenting data. Spreadsheets serve this purpose **as large amounts of data can be processed,** thereby removing the need for manual calculations which are prone to human errors.

In the sphere of accounting language a "spread sheet" or spreadsheet is a large sheet of paper with columns and rows that organises the data containing transactions relating to an entity for a person to examine. It spreads, or shows, all of the costs, income, taxes, and other related data on a single sheet of paper for a manager to examine when making a decision.

An electronic spreadsheet organises information into defined columns and rows. The data can then be 'added up' by a formula to give a total or sum. The spreadsheet program **summarises information** from many sources in one place and **presents the information** in the desired format to help a decision maker view the financial picture of the company.

A spreadsheet can pool together information and present it in a collective form. This is the biggest strength of a spreadsheet with regard to the managerial functions. Information that is arranged properly can prove to be useful to managers at various stages of strategic, tactical and operational planning, decision making and control.

Data can also be presented in a very detailed manner in spreadsheets, for example, a summary report contains data highlighting combined or aggregate figures. An underlying detailed version showing all the figures that make up the collective figures can also be stored in a spreadsheet.

SUMMARY

CD-Rom, DVD & Blu-ray disk

- simplifies procedures — for recording, manipulating analysing & presenting data
- organises information — into software defined columns & rows
- summarises information — from many sources in one place
- presents information — in a collective form
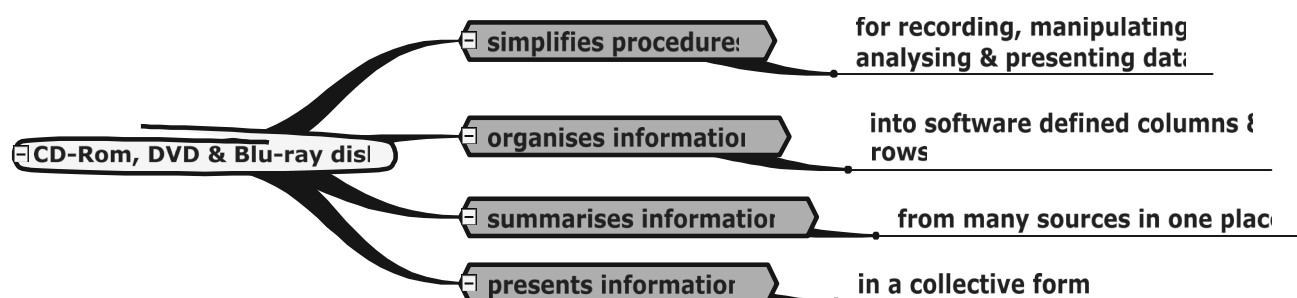
Test Yourself 1

A spreadsheet contains a number of:

A   Rows and columns used to record and compare numerical and financial data
B   Columns to record data
C   Rows to compare data
D   Blank sheets to write plain text

Test Yourself 2

With the help of a computer spreadsheet, _____ can be performed with great ease by just inserting the proper formula:

A   Spelling checks
B   Arithmetical calculations
C   Data sorting
D   Data protection

---

2.   List and explain various examples of electronic spreadsheets.

[Learning Outcome b]

2.1 Purposes of spreadsheets

The main purpose of a spreadsheet is to help a user manage data and view it in various required formats. These formats include charts, reports, various calculations, etc.

Other purposes include:

Sorting data
Presenting data
Formatting data
Performing a large number of calculations
Budget preparation
Graph preparation

2.2 Various examples of electronic spreadsheets are as follows:

1.   **Budgets**: income and expenditure budget with the actual figures can be compared and variance analysis done with the help of spreadsheets. Once the budgeted as well as the actual amounts for income and expenses are filled in on the worksheet you can analyse the variances between the two by making use of the various functions of spreadsheets.

2.   **Financial statements**: preparation of financial statements is speedy and accurate in a spreadsheet.

3.   **Interest calculation**: calculations for interest to be paid on loans borrowed by the organisation as well as for interest received on the investments made by the organisation can be done with precision using spreadsheets.

4.   **Consolidation:** combining several reports into one and preparing a consolidated report is easily possible with spreadsheets. This is an important tool used by managers in planning and decision making.

For example in word documents, spreadsheets can be inserted as an object. Its cells / worksheets can be linked with another spreadsheet data. This is mainly useful in importing charts.

Tip

There are TWO ways to insert an Excel object into Word, linking and inserting. When you insert (copy and paste selected cells in) an Excel worksheet, the worksheet will not be updated when you update the main Excel file. However, when you insert a linked worksheet, whenever you open the Word file, the linked Excel sheet will update its values to match the main external Excel file.

5. **Cash flow projections:** the complicated calculations in a cash flow projection may be made easy by using a spreadsheet for the preparation of the statement. Using formulae in the spreadsheets will enable calculations to be made quickly and hence aid in the preparation of complicated statements of cash flow. The functions of linking and sorting also make it easier to prepare these statements.

Example

Preparation of monthly MIS report showing various calculations for the salaries paid to the staff, components, deductions etc.

Starting from the titles of the report, the user may insert various formulae for different calculations. A sample spreadsheet showing these calculations is given on the next page.

	A	B	C	D	E	F	G	H	I
1	Monthly salary statement								
2									
3	Employee Code	00:00:00	5642	5643	5644	5645	5646	5647	5648
4	Designation	Supervisor	Clerk	Foreman	Attendant	Grade 3	Grade 3	Grade 3	Grade 3
5	Basic salary	20,000	10,000	7,000	3,000	2,500	2,500	2,500	2,500
6	DearnessAllowance	3000	1500	1050	450	375	375	375	375
7	HRA	4000	2000	1400	600	500	500	500	500
8	Travel Allowance	400	200	140	60	50	50	50	50
9	Medical Allowance	1500	1500	1500	1500	1500	1500	1500	1500
10	Gross salary	28,900	15,200	11,090	5,610	4,925	4,925	4,925	4,925
11	Less: Deductions								
12	Loan against salary		1000		500		400		400
13	PF	2400	1200	840	360	300	300	300	300
14	Income tax	5780	3040	2218	1122	985	985	985	985
15		20,720	9,960	8,032	3,628	3,640	3,240	3,640	3,240
16									

The formulae used in the above sheet are shown below. Using these formulae made the calculations easier and faster since by simply inserting a formula in one of the cells you may copy these formulae to the remaining cells.

The following Figure shows the formulae in the cells that have been used to calculate each figure in the chart.

	A	B	C	D
1	Monthly salary statement			
2				
3	Employee Code	5641	5642	5643
4	Designation	Supervisor	Clerk	Foreman
5	Basic salary	20000	10000	7000
6	DearnessAllowance	=B5*15%	=C5*15%	=D5*15%
7	HRA	=B5*20%	=C5*20%	=D5*20%
8	Travel Allowance	=B5*2%	=C5*2%	=D5*2%
9	Medical Allowance	1500	1500	1500
10	Gross salary	=SUM(B5:B9)	=SUM(C5:C9)	=SUM(D5:D9)
11	Less: Deductions			
12	Loan against salary		1000	
13	PF	=B5*12%	=C5*12%	=D5*12%
14	Income tax	=B10*20%	=C10*20%	=D10*20%
15		=B10-SUM(B12:B14)	=C10-SUM(C12:C14)	=D10-SUM(D12:D14)

6. **Graph preparation:** Presenting of data or information is one of the most essential features of spreadsheets. Whatever data that has been put in the spreadsheet can be presented in a graphical way. The graphical representation helps to understand more as it is in form of various charts that are available in the spreadsheet.
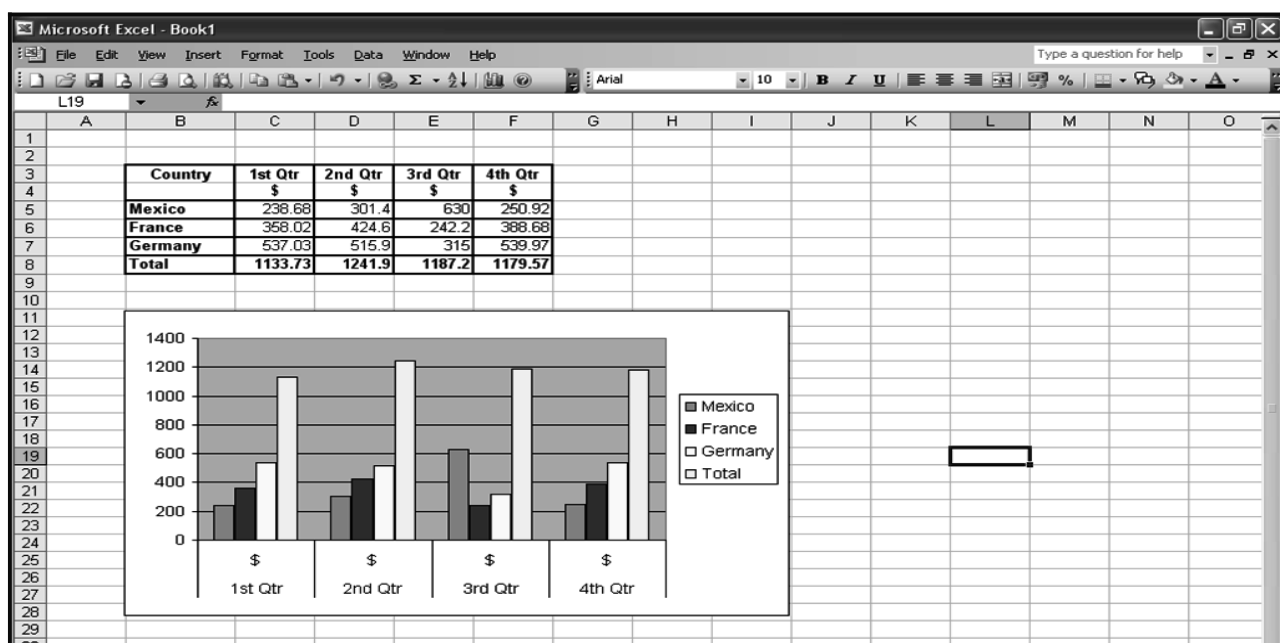
Charts are used for displaying series of numeric data in a graphical format which makes it easier to understand large quantities of data and its relationship between different series of data in a spreadsheet. Charts and graphs are visually appealing and make it easy for users to see comparisons, patterns, and trends in data.

In spreadsheets, data can be presented in a manner useful to the users by creating charts with the help of the charting engine. Visually appealing features like 3-D effects, soft shadowing, and transparency can be added to the charts and graphs to enhance their professional looks.

Example

The following excel sheet illustrates a bar chart which can be prepared using data in an excel sheet.

Country	1st Qtr $	2nd Qtr $	3rd Qtr $	4th Qtr $
Mexico	238.68	301.4	630	250.92
France	358.02	424.6	242.2	388.68
Germany	537.03	515.9	315	539.97
Total	1133.73	1241.9	1187.2	1179.57

SUMMARY

- Cost & management accountants use spreadsheets for
  - statistical forecasting & planning
  - analysing data & making decision pathway which connects spreadsheets
  - preparation of various statement such as
    - budgets
    - income statements
    - salary calculations
    - interest calculations
    - consolidated reports

2.3 Advantages of the spreadsheet software

1. It makes performing calculations and editing data very easy and fast and eliminates any errors in human calculation.
2. It makes analysis, reporting and sharing of financial information easy.
3. The Excel program can be mastered very easily.

2.4 Disadvantages of the spreadsheet software

1. Some critics of spreadsheets have found that some large models contained errors of a critical nature.
2. Formulae are not visible immediately under the figure for which the formula is given.
3. If a user makes an error in his/her formula, every single calculation done on that spreadsheet will be wrong.
4. Spreadsheet reports look very complicated.

Test Yourself 3

Electronic spreadsheets are used to prepare the following except:

A   Preparation of budgets
B   Preparation of financial statements
C   Drafting of letters
D   Preparation of graphs

3. Use various tools in electronic spreadsheets (statistical, arithmetical, financial, text, database management, lookup and reference, information, etc.).

[Learning Outcome c]

3.1 Database management

Part of the "Office" productivity suite, Microsoft Excel is a spreadsheet software which allows you to input, organise and manage your personal and business financial data.

To get started working in Excel you need to enter data. What data you enter depends on what you want to do with the spreadsheet. If you were working on an address book, you could be entering names and addresses or you may want to make a budget, which means you would be entering expense categories and numbers. The following text will help you to learn how to enter and change data in Excel.

1. Enter and Edit Data in Excel

(a) How to Use Excel - Entering Data

Simply click on the cell and start typing. You will see the data that you're typing in the active cell as well as Excel's Formula Bar. The data gets stored in the cell once you press ENTER or TAB. You can also click on the green check mark next to the Formula Bar to store the data and remain in the current cell.

Tip

If while typing your data you realise that you've made a mistake and want to start over, press the ESC key on the keyboard to clear the cell (you must do this before moving out of the cell)

(b) How to Use Excel - Editing Data

Double-click on the cell (or press F2) so that your insertion point is within the cell. Alternatively, you can select the cell and then make changes from within Excel's Formula Bar. If the data in a cell "spills out" over other cells, then just double-click on the starting cell, which is where the data is actually stored. To clear the "marching ants" around a cell, just press the ESC key.

(c) How to Use Excel - Copying and Pasting

To copy a cell, click on the cell(s) to be copied, press CTRL+C to copy it, click on the cell where you want to paste it, then press CTRL+V to paste. (Copied cells are designated by "marching ants" around cells.)

If you just want to copy a portion of the data from one cell to another, instead of copying the entire cell, just double-click on the cell that you want to copy from - you should see your insertion point inside the cell - then use your mouse to select the data to be copied and press CTRL+C to copy it. Then click on the empty cell where you want to paste it (or double-click within a cell that has existing contents and position your cursor where you want the new data to go), then press CTRL+V to paste. To delete the entire contents of a cell, select the cell and press the DELETE key on your keyboard.

When a cell is pasted to another cell, any existing content in that cell is replaced. But, say you had two existing cells, and you wanted to paste a cell between them - to do that just copy the cell, right-click on the location and select INSERT COPIED CELLS or INSERT CUT CELLS. The existing rows/columns will shift to make room for the new content.

(d) How to Use Excel - Using AutoComplete

When typing in a cell, Excel automatically suggests a text entry based on the previous entries in the column. If the suggested entry is correct, press Enter or Tab to accept the suggestion and advance to the next cell. You can also click the green checkmark button next to the Formula Bar. However, if the suggested entry is not what you want, then just continue typing to overwrite the AutoComplete entry.

Tip

Instead of using CTRL+C to copy or CTRL+V to paste, you can also use the copy, cut and paste buttons on the Standard Toolbar.

(e) How to Use Excel - Using AutoFill

AutoFill can be used to copy and paste the contents of one cell to adjacent cells or to create a fill pattern. When a number, series of numbers, days, months, or other recognizable pattern is started, the AutoFill feature will complete the series for you. AutoFill is accessed by using the Fill Handle in the bottom right corner of the selected cell or range of cells.

(f) How to Use Excel - Excel's Formula Error Checker

When Excel recognizes a potential problem in a cell's formula or formatting; a GREEN FLAG appears in the upper left corner of the cell. This flag is a non-printing character and can be ignored. One example of when it appears is when a number has been entered as text.

(g) How to Use Excel - Comments

Comments can be added to cells in Excel to provide additional information to users. Comments are indicated by a RED FLAG in the upper right corner of the cell. TO INSERT A COMMENT, select the cell, right-click and choose Insert Comment. Type your comment in the box that appears. When you're done, click anywhere outside the box to close it. You should now see a red flag in the upper right corner of that cell. To DISPLAY THE COMMENT, just hover your mouse over the red flag. To DELETE THE COMMENT, right-click on the cell and choose Delete Comment. Comments inserted into spreadsheet can be shown or hidden depending upon requirements.

2. How Edit an Excel Spreadsheet

Editing an existing Microsoft Excel spreadsheet is an easy thing to do, but there are some important things you need to keep in mind before you edit and as you are completing the editing process. This way, you can ensure your edits are effective, permanent and don't unintentionally interfere with any previously-entered data

(a) Double-click an Excel document to open it. Enter a password if you're prompted to give one. If you don't have a password, you can still access the spreadsheet by clicking the "Read Only" button, although you will not be able to save any of the changes you make.

(b) Click on any box, or "cell," whose information you need to edit. You can input information into the cell itself or into the formula bar, which is a long field located just above the top of the main spreadsheet. Wherever you choose to add or edit information, it's important to take a look at what's in the formula bar. As its name suggests, the formula bar's primary purpose is to insert mathematical formulas into the spreadsheet, so you'll want to make sure the cell you're editing contains only data before you edit it.

(c) Locate your "source" cell in the event that the cell whose information you need to edit contains a formula.

Example

For example, imagine you need to edit cell F8 on an imaginary spreadsheet. When you inspect, the formula bar, however, you realise that the value in F8 is set to "=(F6+F7)." In other words, you'll need to click on either cell F6 or F7 in order to change the value of cell F8, which is a "dynamic" sum designed to change depending on the values contained in other cells.

(d) Make any formatting or alignment changes you deem necessary. For example, you might decide that one column of data is important and deserves to be bold or italic. Select an individual cell by double-clicking on it, or an entire row or column by clicking once on its number or letter in the grey border of the spreadsheet

3. Capturing data from another source

Inserting some value, text or any other data in the working worksheet from another worksheet can be easily done using consolidation of data.

If the data that is to be consolidated is in different cells on different worksheets:

Add, change, or delete the cell references to other worksheets.

Example

For example, to add a reference to cell G3 in a Facilities worksheet that you have inserted following from the Marketing worksheet, you would edit the formula as shown in the following example.

Before:

After:

If the data to consolidate is in the same cells on different worksheets:

To add another worksheet to the consolidation, move the sheet into the range that your formula refers to.

Example

For example, to add a reference to cell B3 in the Facilities worksheet, move the Facilities worksheet between the Sale and HR sheets as shown in the following example.

Because your formula contains a 3-D reference to a range of worksheet names, **Sales: Marketing!B3**, all worksheets in the range are included in the new calculation.

Test Yourself 4

When an Excel object is inserted as an object in word file, the main Excel sheet will not get automatically updated if Excel in word file gets edited.

A   True
B   False

---

4.   Formatting

Formatting is useful for helping the reader to read and understand the data in your workbook.

You have different options for formatting. You can manually change the individual style elements like font; colour etc. in the Font, Alignment and Number groups or you can apply pre-prepared styles that come with Excel. These are available in the Styles group when you click the Cell Styles button, and make for a quick way to apply stylish formatting. On clicking the Cell Styles button a gallery of thumbnails representing each style is displayed. If the thumbnails don't give you a detailed enough picture, live previews are also available here; hover over a style to see how your cells would appear if this formatting option was applied. When you move the cursor away, the live preview is removed. On the mini toolbar that appears when you right click a cell when you select cells and then right click on them a shortcut menu appears with the mini toolbar over it. After using a formatting tool, the shortcut menu disappears but the mini toolbar remains for you to select more formatting tools.

Example

The formatting styles can be applied as follows:

Dialogue box launcher
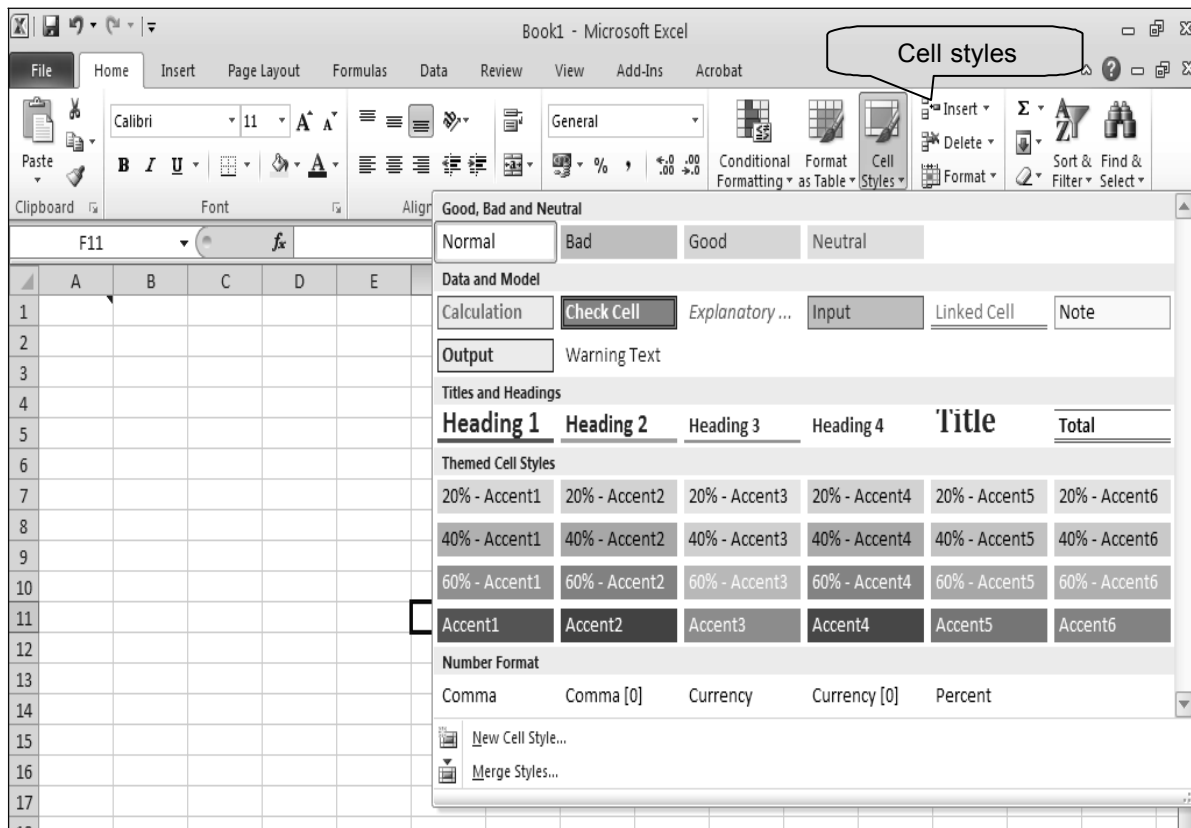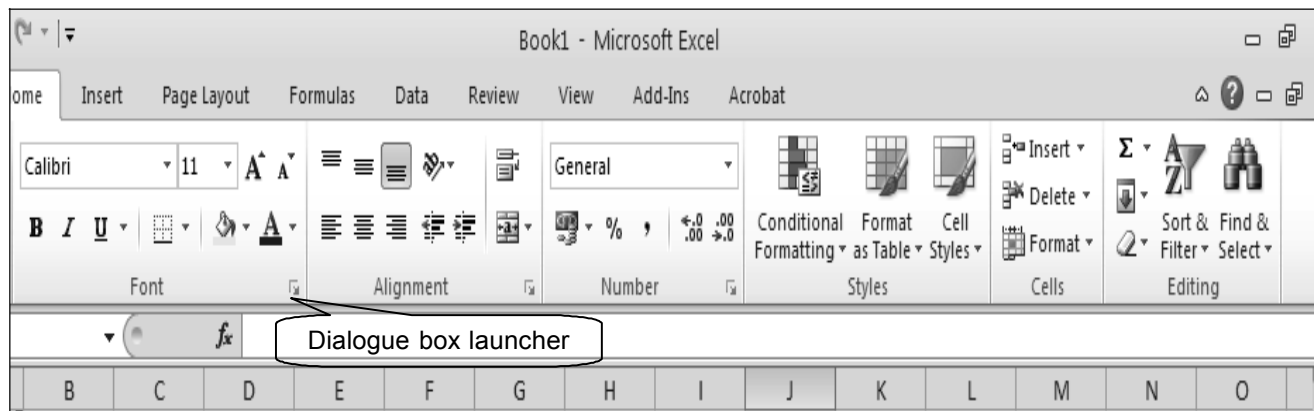
The dialog box launcher is the small button with the diagonal arrow that can be found in the bottom right of a group of commands. Under 'Home' menu, using different dialogue box launchers, font style, font size, alignment of text, alignment of figures, cell alignment, text orientation, indentation, etc. can be formatted.

(a) Format cells

The format cells dialog box contains tabs to control formatting for Number, Alignment, Font, Border, Patterns and Protection.
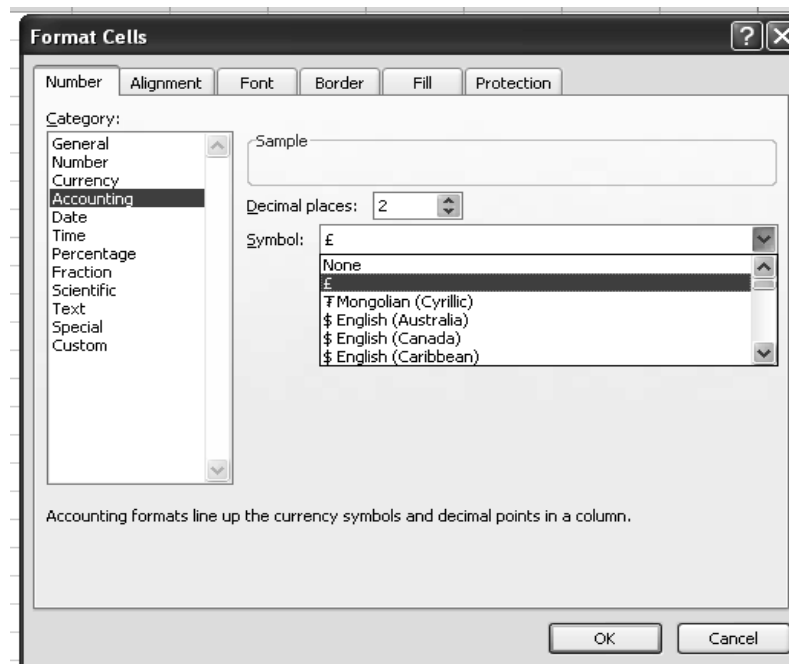
Tip

Under number formatting, by selecting the 'accounting' option, one can choose decimal places as well as currency units.

(b) Conditional Formatting

Conditional formatting makes your spreadsheets respond to the data they contain and is a useful tool for visualising numerical data. You can draw attention to particular cells when their contents satisfy certain conditions, by making those cells display differently. To apply a conditional formatting rule to a cell or range of cells, select the cells and then click Home > Styles > Conditional Formatting. There are a variety of different rules you can apply, and we'll just run through them here:

Example

A training school has prepared a report of the scores of its students. The report requires to include a comment 'good' if marks obtained are more than 30, else, the comment would be "bad".

We use the "IF" formula and conditional formatting for this.

Step-1

Use the 'If' formula in column "D" from the data of the scores obtained by the students in an exam mentioned in the column "C". The result would be as follows:

This is the formula!

Step-2

Click on "Conditional Formatting" tab

Select "New Rule"

Step-3 – At the end of step 2, you will get the following window

Select 2nd option for specific text i.e. "Good" or "Bad"

Continued on the next page

If you want the specific text to be highlighted in colour then select "Format" tab and click on the colour of your choice then click "OK"

End of the Step-3, click on "Ok" and you will get the final result in column "D".

(c) Formatting numbers in spread sheet

Number formatting in spreadsheets is used to change the appearance of a number or value in a cell in the spreadsheet. Formatting numbers does not change the actual number that you enter, but just the way it appears in the spreadsheet. Formatting is done to improve the appearance of the spreadsheet and to make the numbers easier to read and understand.

If you select a cell containing a number formatted for currency, the plain number, the one used in calculations, is displayed in the formula bar.

> Number formatting can be applied to a single cell, entire columns or rows, a select range of cells, or the whole worksheet.

> The default format for cells containing a value is the General style. This style has no specific format and displays values as plain numbers – no dollar signs, commas etc.

(d) Headers and Footers

In spreadsheets, headers and footers are lines of text that are printed at the top (header) and bottom (footer) of each page in the spreadsheet.

They contain descriptive text such as titles, dates, and/or page numbers. They are used to add information to a spreadsheet that is being printed

View Headers and Footers

> Headers and footers are not visible in the normal worksheet view.

> To view a header or footer before printing the spreadsheet, use the Print Preview option.

Headers and Footers Locations

A header or footer can contain up to three pieces of information.

For headers, the locations are the top left corner, the top centre, and the top right corner of the page.

For footers, the locations are the bottom left corner, the bottom centre, and the bottom right corner of the page.

How to add headers and footers to a worksheet:
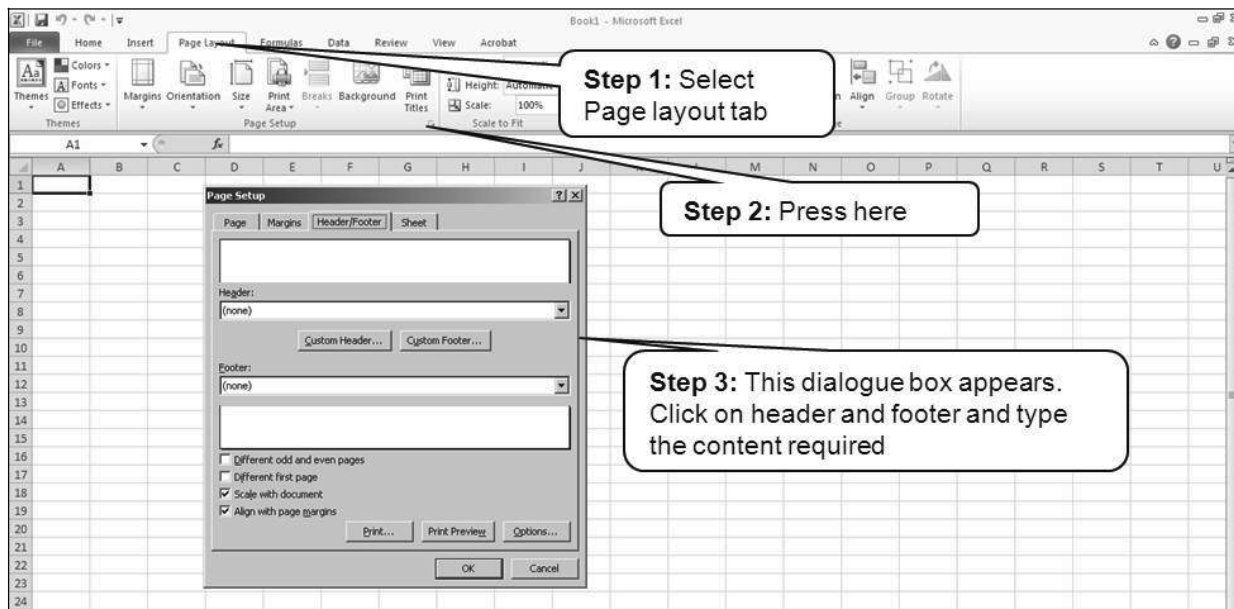
(e) Find and replace

The **Find function** can be activated using either the Ctrl+F key or clicking on the 'Find' in 'Home' tab.
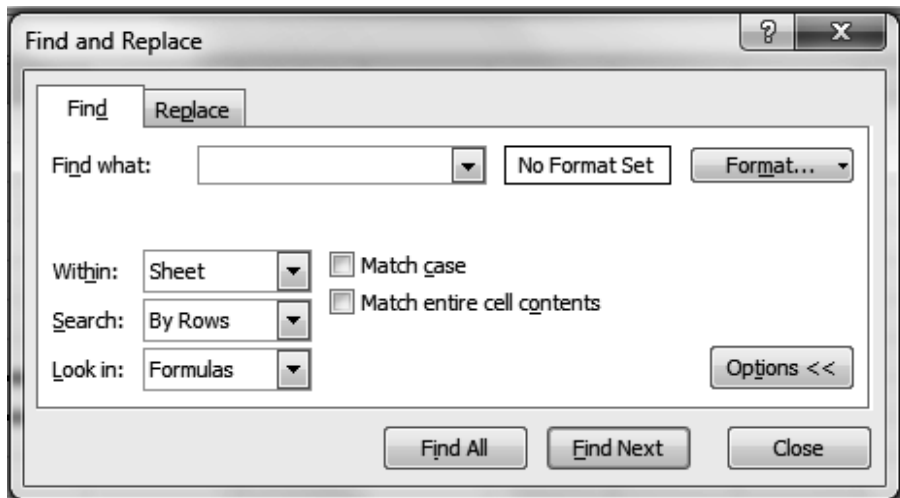
The functions within this are discussed below:

Find what: enter the information that you want to search for. You can use a question mark (?) to match any single character or an asterisk (*) to match any string of characters. For example, sm?th finds "smith" and "smyth" and *east finds "Northeast" and "Southeast."

Format: allows you to search for text or numbers that have a specific type of formatting. If you want to find cells that just match a specific format, you can delete any criteria in the Find what box and then select a specific cell format as an example. Click the arrow next to Format, click Choose Format From Cell, and then click the cell that has the formatting that you want to search for.

Options: displays advanced search options. This button changes to Options << while these advanced options are displayed. Click Options << to hide the advanced options.

Within: select 'Sheet' to restrict your search to the active worksheet. Select 'Workbook' to search all sheets in the active workbook.

Search: click the direction that you want to search: down through columns by using 'By columns' or to the right across rows by using 'By rows'. To search in columns or to the left across rows, hold down the SHIFT key and click Find Next. In most cases, it is faster to select 'By columns'.

Look in: specifies whether you want to search the value of the cells or their underlying formulas. For instance, a cell could appear on the worksheet as "11" but actually may contain a formula ="1"&"1". 'Look in: Values' would find this cell when searching for "11". 'Look in: Formulas' would not. You can also choose to search comments attached to cells. On the Replace tab, 'Look in: Formulas' is the only option.

Match case: distinguishes between uppercase and lowercase characters.

Match entire cell contents: searches for an exact and complete match of characters that are specified in the Find what box.

Find All: finds all occurrences of the search criteria in your document. If you want to find and review each occurrence separately, click Find Next instead of Find All.

Find Next: searches for the next occurrence of the characters specified in the Find what box. To find the previous occurrence, hold down SHIFT and click Find Next.

Close: closes the Find and Replace dialog box when you've completed your search.

The **Replace function** can be activated using either the Ctrl+H key or clicking on the 'Replace' tab in the 'Home' tab.
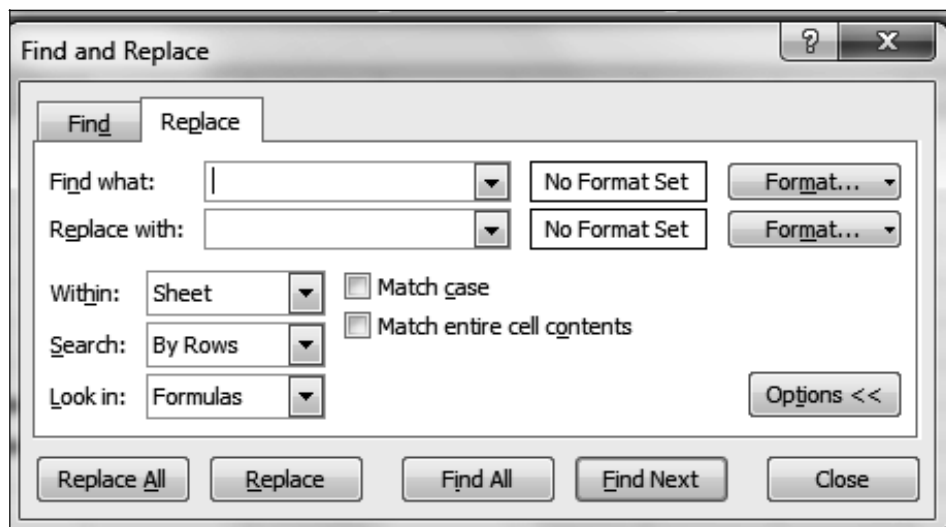
The Replace tab has the same options as the Find tab, with the following additional options that you can use to replace the data that you search for:

Replace with: type the text that you want to use to replace the characters in the Find what box. To delete the characters in the Find what box from your document, leave the 'Replace with' box blank.

Replace All: replaces all occurrences of the search criteria in your document. If you want to review and selectively replace each occurrence, click Replace instead of Replace All.

Replace: replaces the selected occurrence of the criteria in the Find what box, finds the next occurrence, and then stops. If you want to automatically replace all occurrences of the search criteria in your document, click Replace All.

Formatting in spreadsheets helps to:

(i)   get data / information into the correct order for analysis and decision making
(ii) make a worksheet look inviting to help readers find their way around
(iii) highlight the importance of various information on a worksheet

A   All of the above
B   Only (iii)
**C**   (ii) and (iii)
D   (i) and (ii)

---

5.   Sorting of data

Sorting enables a programmer to organise and re-order data (across multiple cells). This helps in proper visualisation and understanding of data, ultimately leading to quality decisions. Data can be sorted by text (A to Z or Z to A), numbers (smallest to largest or largest to smallest), and dates and times (oldest to newest and newest to oldest) in one or more columns.

The Sort and Filter option is present in the tool bar of the Excel worksheet.
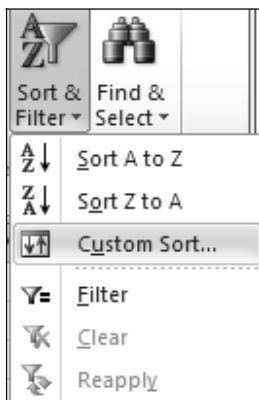
By selecting Custom Sort from the drop down list, the following dialogue box can be seen.
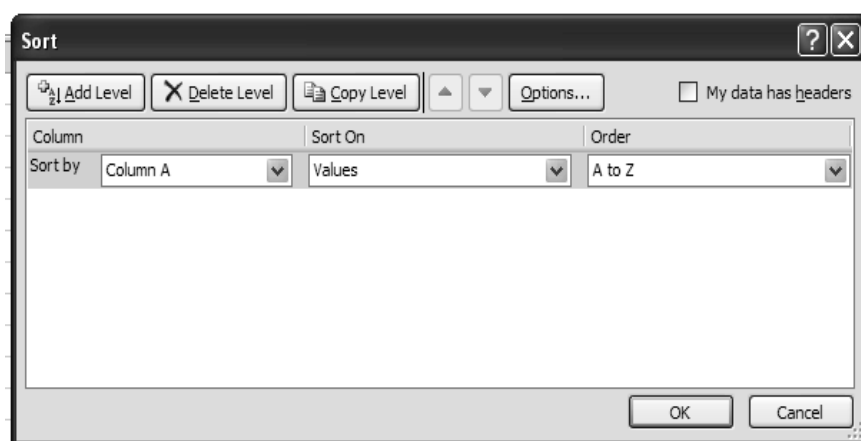
(a) Sorting text data

Text data can be sorted in Excel in either ascending or descending order.

Consider the following example showing names of students and marks obtained by them in a test:

	A	B
1		
2	Student Name	Marks
3	Tammy	56
4	Charlie	44
5	Freddie	69
6	Jimmy	86
7	Annabel	50

The names of students in the above example can be sorted alphabetically. The following are the steps for sorting the names in ascending order:

(i) Firstly, select the data to be sorted.

	A	B
1	Student Name	Marks
2	Tammy	56
3	Charlie	44
4	Feddie	69
5	Jimmy	86
6	Annabel	50
7		

(ii) Next, the 'Sort & Filter' option from the tool bar has to be clicked

To sort in ascending alphanumeric order, click [A→Z] Sort A to Z .

To sort in descending alphanumeric order, click [Z→A] Sort Z to A.

The following result can be observed (if chosen to sort in ascending alphanumeric order)

	A	B
1		
2	Student Name	Marks
3	Annabel	50
4	Charlie	44
5	Freddie	69
6	Jimmy	86
7	Tammy	56

(b) Sorting numerical data

Numerical data can also be sorted in Excel in either ascending or descending order. Similar steps like the sorting text data can be followed.

Let us see how the marks obtained by students can be arranged in ascending order.

Select the data to be sorted

	A	B
1	Student Name	Marks
2	Tammy	56
3	Charlie	44
4	Feddie	69
5	Jimmy	86
6	Annabel	50
7		

Next, the 'Sort and Filter' option from the tool bar has to be clicked

To sort in ascending numeric order, click [A↓Z] **Sort A to Z**.

To sort in descending numeric order, click [Z↓A] **Sort Z to A**.

The following result would be obtained:

	A	B
1		
2	Student Name	Marks
3	Charlie	44
4	Annabel	50
5	Tammy	56
6	Freddie	69
7	Jimmy	86

6. **Filter**

1. Click **Data>Filter>AutoFilter**
2. The first row of the spreadsheet becomes the filtering row.
3. To filter for specific data, click on the down arrow next to the head of the column you want to filter by.
4. Then select the criteria you want to filter for.
5. You may filter by multiple columns at once by repeating steps 3-4 for each column you want to filter by.
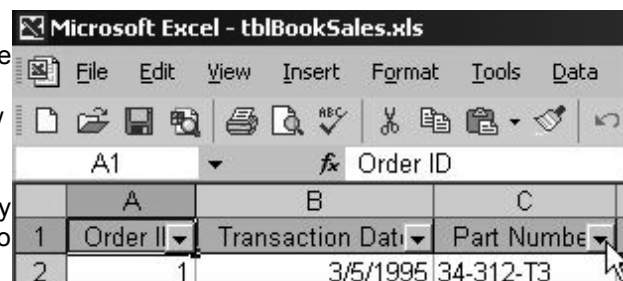
There are many powerful spreadsheet programs on the market, but Microsoft Excel 2003 is one of the most widely used. This popular spreadsheet program is used in both the home and business environment, and it is important for any employee who needs to work with numbers to understand how to use the advanced features of the program. One of the most powerful features of Microsoft Office 2003 is the ability to filter and sort data in a variety of different ways.

Auto Filter

Creating an auto filter is one of the best ways to make sense of the data in a large spreadsheet. Once that auto filter is in place, users can click on a drop-down list and choose only the data they need.

To create this auto filter, simply highlight the part of the spreadsheet you wish to filter. If you want to filter the entire spreadsheet, place your cursor at the top, left-hand corner of the screen and click to highlight the entire spreadsheet. Click on the "Data" menu and choose "Filter" from the menu. Choose "Auto Filter" from the list. After the auto filter is in place, you will see a drop-down arrow next to each column in the spreadsheet, and you can use that arrow to select the data you want to see. After the spreadsheet has been filtered, only the data that matches your criteria will be displayed.

Microsoft Office Excel spreadsheets are very useful for compiling information about customers, products, sales revenues and other types of data. But when the volume of data in a single worksheet grows to fill dozens of columns or rows, sorting through it can be a challenge. If you want to isolate, for example, your top 10 customers in a particular region over the last six months, you might spend a long time reviewing your data entries.

Fortunately, Excel includes an easy-to-use AutoFilter to show just what you want to see and hide the rest. Filtering doesn't change your data in any way. As soon as you remove the filter, all your data reappears,

7. Ranking

In spreadsheet, the **Rank** function returns the rank of a number within a set of numbers.

The syntax for the **Rank** function is:

Rank (number, array, and order)

(i)   Number is the number to find the rank for.
(ii) Array is a range or array of numbers to use for ranking purposes.
(iii) Order is optional. It specifies how to rank the numbers.

    If order is 0, it ranks numbers in descending order.
    If order is not 0, it ranks numbers in ascending order.

If the order parameter is omitted, the Rank function assumes order is 0 (descending order).

Applies To:

    Excel 2007, Excel 2003, Excel XP, Excel 2000

Example

Let's take a look at an example:

Based on the Excel spreadsheet above:

=Rank(B4, B2:B6, 1)   would return 5

=Rank(B4, B2:B6, 0)   would return 1

=Rank(B3, B2:B6, 0)   would return 4

Test Yourself 6

In order to see territory wise sales, which of the following function need to be applied in spreadsheets?

A Sorting
B Ranking
C Filtering
D None of the above

3.2 Arithmetical tools

Spreadsheets work just like a calculator, where everything is displayed like a screen. A spreadsheet is used for financial information because of its ability to re-calculate the entire sheet automatically even after a single change in the cell. As a result of this most complex of calculation can be done in short time.

(a) What is a formula?

A formula in a spreadsheet is defined as how a content of one cell is calculated with the contents of another cell or with multiple cells in a sheet. A cell containing a formula therefore has two display components; the **formula itself and the resulting value** Here we will be learning as how can we use **formulae** in a spreadsheet Formulae is one of the most commonly used features of spreadsheets. They are used to carry out the most simplest of addition and subtraction to far more complex mathematical calculations.

How to use a formula in spreadsheet?

Formulae can be given in the cells by actually typing in the formula bar for the function to be performed, giving the cell references in which the values lie.

Generally no matter how complex is the formula it starts with two steps:

Select the cell where you want the formula's result to be displayed.
Type an **equal sign** (**=**) in that cell to let Spreadsheet know you are creating a formula

After the steps mentioned above you get an output in the desired cell. All **arithmetical functions** such as addition, subtraction, multiplication and division of these numbers can also be performed with the help of the formulae.

Now let's study how to use the various arithmetical functions in spreadsheets with the help of an example.

Example

The following spread sheet illustrates the method of preparation of arithmetical calculation ranging from addition, subtraction, division and multiplication:

Average function of the spreadsheet is used to determine the average or the arithmetic mean from list of numbers that are there in the sheet
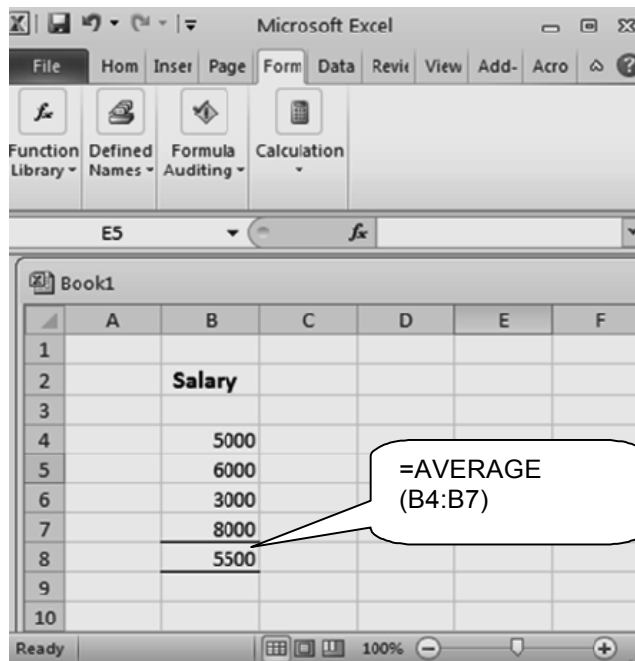
The above example clearly shows as how arithmetical functions are performed in the spreadsheet

---

(b) What is a cell reference?

In a spreadsheet, a cell reference shows or locates a cell or multiple cells in a spreadsheet that can either be a row or a column.

The two cell references used for a range are usually **separated by a colon (:)** which indicates the starting and closing cells that have to be selected.

Any change in the cell reference changes the formula that has been applied. By default, in a spreadsheet, cell reference is usually a relative cell reference.

Cell reference is used in a spreadsheet instead of typing directly into the cell. This is advantageous because if there is any change in the cell, it automatically updates itself without having to rewrite the formulae again. In spreadsheets, there are two types of cell reference: Relative and Absolute cell references.
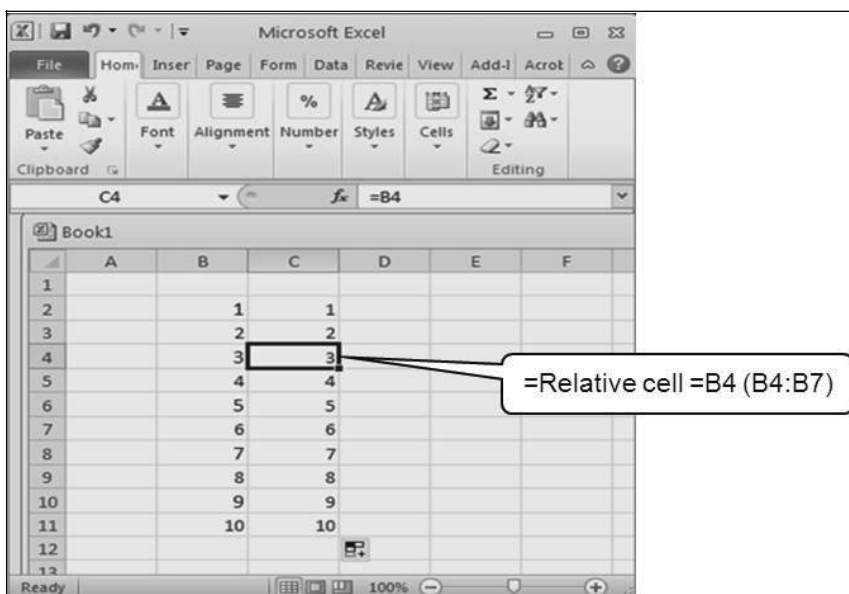
(i) Relative cell reference: here a particular cell is referred to a formula and then the same formula is copied in series of rows or columns. Hence, calculations are automatically adjusted.

This reference consists of the column letter and the row number that intersect at the cell's location.
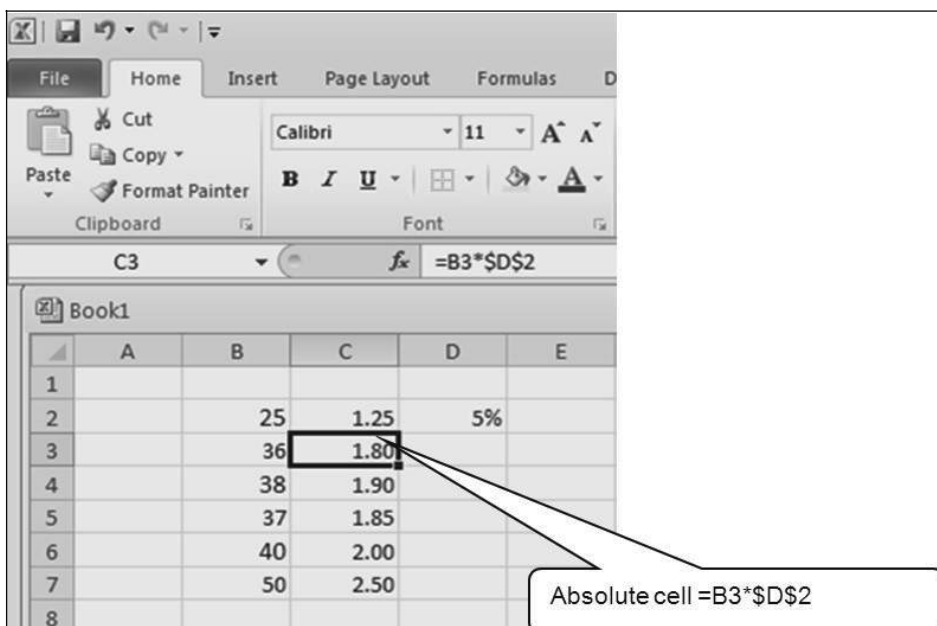
(ii) Absolute cell reference: is the exact opposite of relative cell reference. Here dollar signs are used to fix either row reference or column reference which remains constant. And hence, calculations do not adjust automatically.

Tip

($A1) it allows the reference row to change, but not the column reference.

(A$1) it allows the reference column to change, but not the row reference.

(A1) it allows neither the column reference nor the row reference to change.

(c) Round Function

The ROUND function is used for rounding up a decimal number to a specified number of digits.

The syntax for the round function is: ROUND(number, num_digits)

Example

If cell A1 contains 1.6666, it can be rounded up to two decimal places using the following formula:
=ROUND(A1, 2).

The result of this function would be 1.67.

(d) IF function

The 'IF' function in a spreadsheet is used to test and see whether a certain given condition is true or false.

The syntax for the IF function is: =IF(logical_test, value_if_true, value_if_false)

Example

If marks obtained in a test are more than 30, then the comment given would be "good"; else, the comment would be "bad". In case a student secures 50 marks, the result would be as follows:

B3	f_x	=IF(B2 > 30, "good", "bad")

	A	B	C	D
1				
2	Marks in Test	50		
3	Comment	good		

Test Yourself 7

Which of the following formulae is applied for the cell D7?

	A	B	C	D
1		No. of units sold	Selling Price per unit ($)	Sales revenue ($)
2	Week 1	20	2	40
3	Week 2	10	6	60
4	Week 3	30	4	120
5	Week 4	50	5	250
6		110		470
7				117.5
8				

A   =SUM (D1, D2, D3, D4, D5)
B   = PRODUCT (B6, 4.2727)
C   = AVERAGE (D2:D5)
D   None of the above

3.3 Statistical tools

Electronic spreadsheets are used to make many simple as well as complicated statistical calculations like average, maximum, minimum, mean, median, mode, average of the absolute deviations, beta cumulative distribution.

1. Maximum function

The 'MAX' function in a spreadsheet is used to identify the highest number from a set of numbers.

The syntax for the MAX function is: = **MAX**(**number1**,number2,...)

Example

If marks obtained in a test are listed and the user wants to find out the highest marks scored, the MAX function can be used as follows:

2. Minimum function

The 'MIN' function in a spreadsheet is used to identify the lowest number from a set of numbers.
The syntax for the MIN function is: = **MIN**(**number1**,number2,...)
Number1, number2, ... are the numbers for which you want to find the maximum value.

3. Mode

The Mode function identifies the value which is most repeated from an array or range of data.

The syntax is MODE(**number1**,number2,...)

Number1, number2, ... are the numbers for which you want to find the mode.

Example

The marks scored by students in the mathematics exam are listed and the user wants to identify the marks which are most repeated.

4. Median

This function identifies the number which is in the middle of a set of numbers.

Its syntax is MEDIAN(**number1**,number2,...)

Number1, number2, ... are 1 to 255 numbers for which you want the median.

5. Count

This function enables to determine a count of the number of cells within an array or range which contain numbers. **The syntax is COUNT**(**value1**,value2,...)

Value1, value2, etc. relate to the different types of data. **The count function will only give a count of the numbers in the range**. Therefore if the data contains text, it will not be counted.

The above table has data in 10 cells, but the count function indicates '8' as two cells contain alphabets.

3.4 Financial functions

As accountants, we are required to make many numerical calculations like interest calculation (simple, compound interest), depreciation calculation, number of days in coupon period, discount rate of security. These calculations are possible through the financial functions of the electronic spreadsheet.

1.   Depreciation function SLN

This function computes depreciation of an asset for one year using the straight-line method.

Its syntax is **SLN**(**cost**,**salvage**,**life**), where

> **Cost**   is the initial cost of the asset.

> **Salvage**   is salvage value at the end of the useful life of the asset.

> **Life**   is the number of useful years of the asset.

Example

JK Fisheries has purchased a non-current asset for $1 million. The asset has a useful life of 6 years and the salvage value expected is $100,000. Depreciation using the straight-line method can be calculated using a spreadsheet as follows:

2.   Simple interest

To calculate this, we need to use the function FV. Its syntax is

FV(rate,nper,pmt,pv,type) Rate = 0, this is assumed for a formula for simple interest

nper = number of periods

pmt = Interest x principal amount

pv = preset value

type = this is not to be recorded

3. Compound interest

This can be calculated by using the following formula:

$P_A = PV \times (1 + R)^N$
P_A = Amount at the end of period
PV = Present value
R = Rate of interest
N = Number of periods

Example

Let us calculate the compound interest using a formula on the following:

Principal amount = $1,000
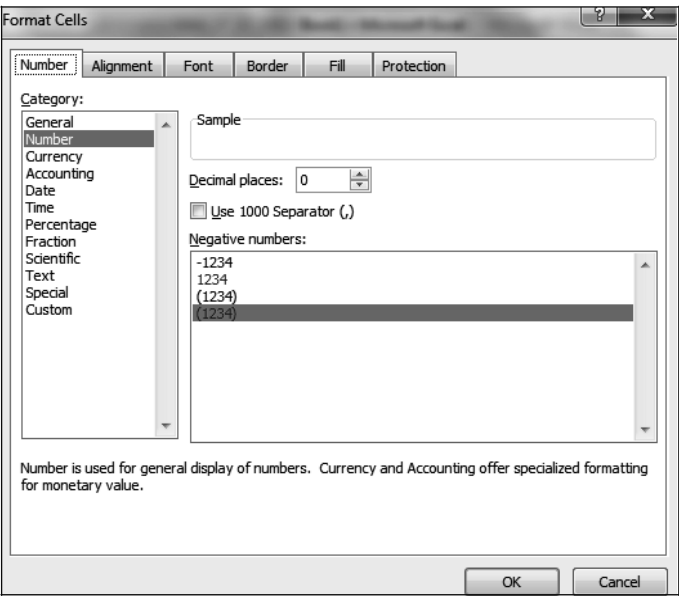Rate of interest = 8%
PV = Value at the start of the period = 1,000

3.5 Display of numbers and text

Numerical data can be formatted using the **Format numbers** tab under the **Home** tab.

This menu helps you to present numerical information.

1. Displaying only the last four digits of identification numbers

Let's say, for common security measures, you want to display only the last four digits of an identification or Social Security number, credit card number, or other number and replace the rest of the digits with asterisks.

Whether the digits in the cell are formatted as text, numbers, or the special Social Security number format, you can use the same function. To display only the last four digits of identification numbers, use the CONCATENATE, RIGHT, and REPT functions.

2. Display text before or after a number in a cell by using the number format

> These functions are not discussed in detail here as they do not form part of the syllabus.

If a column that you want to sort contains both numbers and text (such as Product #15, Product #100, Product #200), it may not get sorted as expected.

You can use a number format to add text without changing the sorting behaviour of the number.

(a) Select the cells that you want to format.

(b) On the **Home** tab, in the **Number** group, click the arrow, and then click **More**.

(c) In the **Category** list, choose a category, and then choose a built-in format that resembles the one that you want.

(d) In the **Category** list, click **Custom**.

(e) In the **Type** box, edit the number format codes to create the format that you want.

To display both text and numbers in a cell, enclose the text characters in double quotation marks (" ") or precede the numbers with a backslash (\). Editing a built-in format does not remove the original format.

To display	Use this code
12 as Product #12	"Product # " 0
12:00 as 12:00 AM EST	h:mm AM/PM "EST"
-12 as $-12.00 Shortage and 12 as $12.00 Surplus	$0.00 "Surplus";$-0.00 "Shortage"

Format text is a numerical format as a text string enclosed in quotation marks. You can see various numerical formats by clicking the **Number**, **Date**, **Time**, **Currency**, or **Custom** in the **Category** box of the **Number** tab in the **Format Cells** dialog box, and then viewing the formats displayed.

3. **Remarks**

   Format text cannot contain an asterisk (*).

   Formatting a cell by using a command (On the **Home** tab, in the **Number** group, click the arrow next to **Number**, and then click **Number**.) changes only the format, not the value. Using the TEXT function converts a value to formatted text, and the result is no longer calculated as a number.

4. **Text functions**

Function	Description
ASC	Changes full-width (double-byte) English letters or katakana within a character string to half-width (single-byte) characters
BAHTTEXT	Converts a number to text, using the ß (baht) currency format
CHAR	Returns the character specified by the code number
CLEAN	Removes all nonprintable characters from text
CODE	Returns a numeric code for the first character in a text string
CONCATENATE	Joins several text items into one text item
DOLLAR	Converts a number to text, using the $ (dollar) currency format
EXACT	Checks to see if two text values are identical
FIND, FINDB	Finds one text value within another (case-sensitive)
FIXED	Formats a number as text with a fixed number of decimals
JIS	Changes half-width (single-byte) English letters or katakana within a character string to full-width (double-byte) characters
LEFT, LEFTB	Returns the leftmost characters from a text value
LEN, LENB	Returns the number of characters in a text string
LOWER	Converts text to lowercase
MID, MIDB	Returns a specific number of characters from a text string starting at the position you specify
PHONETIC	Extracts the phonetic (furigana) characters from a text string
PROPER	Capitalizes the first letter in each word of a text value
REPLACE, REPLACEB	Replaces characters within text
REPT	Repeats text a given number of times
RIGHT, RIGHTB	Returns the rightmost characters from a text value
SEARCH, SEARCHB	Finds one text value within another (not case-sensitive)
SUBSTITUTE	Substitutes new text for old text in a text string
T	Converts its arguments to text
TEXT	Formats a number and converts it to text
TRIM	Removes spaces from text
UPPER	Converts text to uppercase
VALUE	Converts a text argument to a number

3.6 Look up and reference

This function identifies a 'look up value' either from one-row or one-column range or from an array. The look up function has two applications, the vector formula and the array formula. When a look up value is being identified from a one-row or one-column range, a vector formula of look up is used, whereas when a look up value is being identified from an array, the array formula of look up is used.

Look up value can be of the following formats:

> number,
> text,
> logical value, or s
> name or reference that refers to a value

1. Look up

The vector look up identifies a look up value from a range of only one row or one column and selects a value from the same position in a second one-row or one-column range. This formula is used for a LOOKUP function when you want to specify the range that contains the values that you want to match.

The formula is as follows: **LOOKUP(lookup_value,lookup_vector,result_vector)**

Lookup_vector: a range that contains only one row or one column.
Lookup_value: the value that LOOKUP searches for in the first vector.
Result_vector: a range that contains only one row or column. It must be the same size as lookup_vector.

> If LOOKUP can't find the lookup_value, it matches the largest value in lookup_vector that is less than or equal to lookup_value.

> If lookup_value is smaller than the smallest value in lookup_vector, LOOKUP gives the #N/A error value.

Example

Students of a class have been selected in various teams in a school. If we want to find out the team name of a student easily, we can use Excel as follows;

| | E16 | | f_x | =LOOKUP(90,A2:A13,B2:B13) | | | | | | | | | | | | |

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Roll no of students	Team														
2	24	Red														
3	27	Blue														
4	30	Yellow														
5	32	Yellow														
6	34	Green														
7	88	Blue														
8	97	Red														
9	100	Yellow														
10	107	Blue														
11	109	Red														
12	122	Blue														
13	145	Red														
14																
15	Identify the team for student having roll no 97:				Red											
16	Identify the team for student having roll no 90:				Blue											
17	Identify the team for student having roll no 12:				#N/A											
18																

The formulae used are as follows:

Student having roll no 97 =LOOKUP(97,A1:A13,B1:B13)
Student having roll no 90 =LOOKUP(90,A2:A13,B2:B13)
Student having roll no 12 =LOOKUP(12,A3:A16,B3:B16)

Tip

The values in lookup_vector must be placed in ascending order. For example, ...,-3, -2, -1, 0, 1, 2, ..., A-Z, FALSE, TRUE, etc. Furthermore, text in uppercase and lowercase text are equivalent.

2. V lookup

This function selects a value from the first column of a table, and identifies the value which lies in the same row of another column in the table.

Example

The following information of a company's inventories is as follows:

Product Code	Name of product	Inventory
B10	Blue bird soap	55
T7	Tender coconut soap	125
W9	Walnut soap	33
B71	Blue berry soap	45

If we want to identify the name of product having a code B71 we can use the Vlook up as follows:

=VLOOKUP(lookup_value,table_array,col_index_num,range_lookup)

Lookup_value = B71, as it is text, we should write it as 'B71' in the formula

Table array: the range of the table i.e. A2:C5

Col_index_number: columns from where the product name is to be identified i.e. range lookup: should be either true or false. While identifying exact values, we use false; otherwise true

If we want to identify the inventory of product B71 we only need to change the Col_index_number as 3 on the above formula.

3. HLOOKUP

This function selects a value from the first row of a table and identifies the value which lies in the same column of another row in the table. It is similar to the VLOOK UP.

Test Yourself 8

Following information is provided:

Product Code	B10	T7	W9	B71
Name of product	Blue bird soap	Tender coconut soap	Walnut soap	Blue berry soap
Inventory	55	125	33	45

Required:

Using Excel, identify the inventory of the Products having codes "T7" and "B7"

3.7 Information

When the data is entered in the spreadsheet, one may require the same for use in future or may just need it as a reference in future. It is, therefore, necessary that the spreadsheet is saved as a soft file and retrieved as and when required in future.
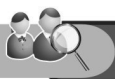
Example

The company plots salesman-wise sales figures in the spreadsheet as follows:

The sales figures are updated every month. There is a need therefore to store this spreadsheet for future updating and reference. This is done by storing it as a file. For example, the file format for a spreadsheet could be the Excel file format of Microsoft office or Lotus 1-2-3 of IBM.

The storing of a spreadsheet file is called as "file saving" process. The steps are as follows:

1. Click 'file' from the menu bar
2. Click 'save' or 'save as' button
3. Choose the place/folder where you want to save the file. it is necessary maintain a proper filing system so that spreadsheets related to a particular subject, person, year or department etc. are grouped into one folder
4. Choose the version of the file format you want to save the file in.
5. Click save

This process will enable you to permanently store the spreadsheet file. Whenever this file is required in future either for updating with new data or just as a reference, it can be retrieved through one of the following ways:

1. Open the application tool i.e. MS Excel or Lotus 123
2. Click file open tab
3. Type in the file name in the dialogue box
4. Click 'open'

Another way is to use the search function, wherein one needs to type in the full file name or may a part of it if one doesn't remember the name fully. The computer will search and list the files containing the name (or a part thereof) that one has typed in. Select the correct file and double click on the same, the file will be opened (i.e. retrieved) using relevant application.

3.8 Password protection

1. Overview of security and protection in spreadsheets (MS-Excel)

Microsoft Office Excel provides several layers of security and protection that allow users to control who can access and change the Excel data.

To help protect the data in a workbook, the following needs to be done:

For optimal security, a user should protect the entire workbook with a password, which allows only authorised users to view or modify data.

For additional protection of specific data, a user can also protect certain worksheets or workbook elements, with or without a password. Protecting worksheet or workbook elements may help prevent users from accidentally or deliberately changing, moving, or deleting important data.

2. Using passwords to help secure an entire workbook

A user can secure an entire workbook by restricting who can open and use the workbook data and by requiring a password to view or to save changes to the workbook. Password security at the workbook level uses advanced encryption to help protect the workbook from unauthorised access.

A password can be set when the workbook is saved. Two separate passwords can be specified that users must type to:

Open and view the workbook: this password is encrypted to help protect your data from unauthorised access.

Modify the workbook: this password is not encrypted and is only meant to give specific users permission to edit workbook data and to save changes to the file.

These passwords apply to the entire workbook. For optimal password security, one should always assign a password to open and view the file. To give only specific users permission to modify data, one may want to assign both passwords.

3. One should always use strong passwords that combine uppercase and lowercase letters, numbers, and symbols.

Passwords can also be set for:

protecting specific worksheet or workbook elements
protecting entire worksheet elements
unlocking specific areas of a protected worksheet
controlling access to protected elements
protecting the structure and windows of a workbook
protecting confidential data in a workbook

4. Use advanced tools in electronic spread sheets (pivot tables and solver).
[Learning Outcome d]

4.1 Pivot tables

Microsoft Excel has a tool called pivot table report which is used by organisations to take decisions on critical data. A pivot table report analyses, summarises and reports on summarised data.

The main features of pivot tables are as follows:

Large amounts of data can be summarised quickly.
It facilitates an in depth analysis of numerical data by subtotalling, aggregating and, summarising data based on categories and sub-categories
Large amounts of data can be queried in a user friendly manner and important data can be filtered, sorted, grouped, and conditionally formatted
Data in rows and columns can be transposed and different summaries of the source data can be presented.
Brief and attractive reports can be generated.
The most important feature of pivot tables is that it designs standard reports which can be updated with latest database.

Example

Pivot table reports are useful for analysing totals in tables and comparing different figures.

Xylo Plc has recorded the production information of its products in an Excel sheet as follows:

	A	B	C
1	Product	Period	Quantum of production
2	Water coolers	Jan-12	125
3	Air conditioners	Jan-12	200
4	Water coolers	Feb-12	180
5	Air conditioners	Feb-12	180
6	Water coolers	Mar-12	170
7	Air conditioners	Mar-12	190
8	Air conditioners	Apr-12	175
9	Air conditioners	May-12	195
10	Air conditioners	Jun-12	205
11	Water coolers	Apr-12	220
12	Water coolers	May-12	140
13	Water coolers	Jun-12	220

The above information can be summarised and various kinds of reports can be generated using pivot table as follows:

|	E	F		H	I
1	Row Labels	Sum of Quantum of production		Row Labels	Sum of Quantum of production
2	Air conditioners	1145		Air conditioners	1145
3	Water coolers	1055		Jan-12	200
4	Grand Total	2200		Feb-12	180
5				Mar-12	190
6				Apr-12	175
7				May-12	195
8				Jun-12	205
9				Water coolers	1055
10				Jan-12	125
11				Feb-12	180
12				Mar-12	170
13				Apr-12	220
14				May-12	140
15				Jun-12	220
16				Grand Total	2200

There are two reports generated above:

Report 1: Column E and F contains information of the total production from Jan 2012 to June 2012 for the two products (along with a grand total).
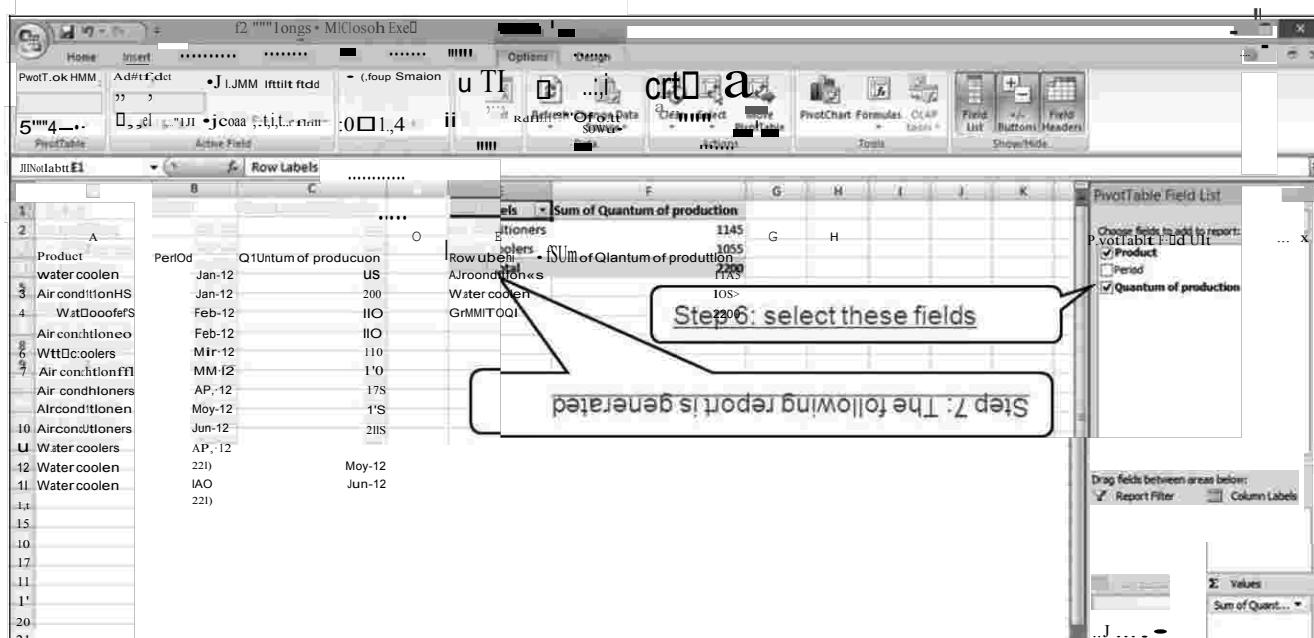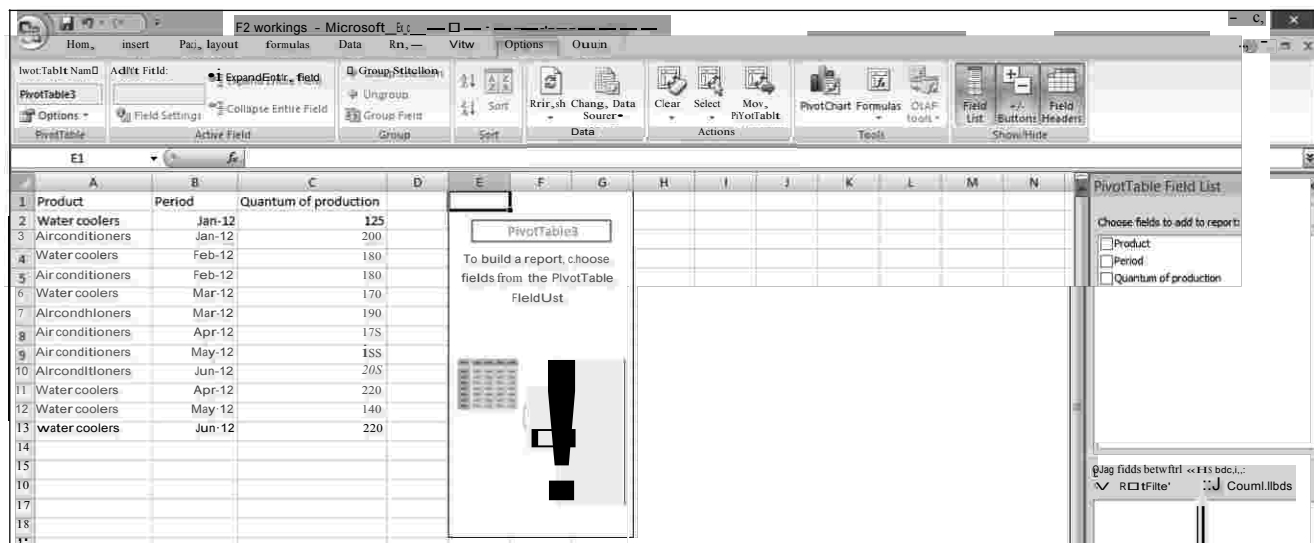
Step 1: Select insert tool

Step 2: Click pivot tables
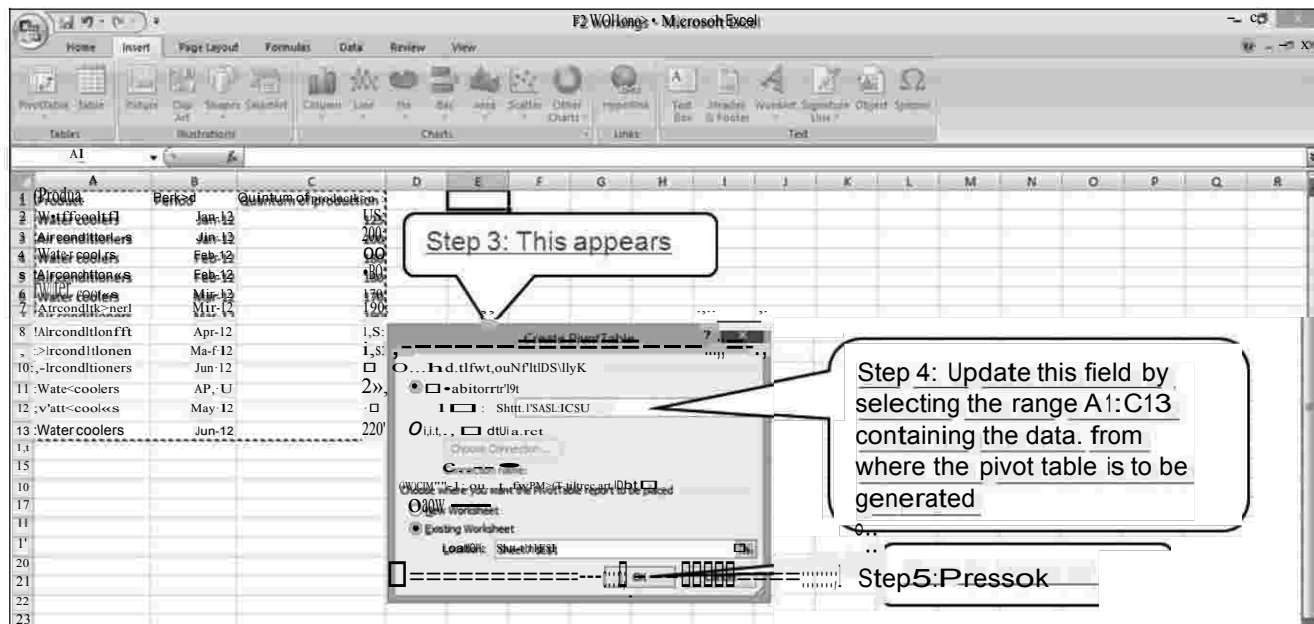
Now the following information is displayed:

Report 2: Column H and I contain information about the monthly production from Jan 2012 to June 2012 for the two products of the organisation, along with totals.

This report is created by choosing the fields 'product', 'period' and 'quantum of production' from the pivot table field list.

The above reports can be easily created using simple Excel functions and formulae. **However, the advantage of using pivot tables to generate reports is that the same database can create various kinds of reports using the simple function of pivot tables. However, if reports were created using formulae, it would be more time consuming and prone to errors if formulae are not applied correctly. That is why the application of pivot tables is advantageous.**

4.2 Solver

Every organisation needs to make decisions relating to various aspects of business like how to invest its surplus funds, how to raise finance (through equity or debt), scheduling production on available machinery, location of new manufacturing premises, etc. All decisions are taken after ensuring that the decision will ensure that costs are minimised, profits are maximised, and the most efficient products / services are produced.

Electronic spreadsheets have introduced the solver tool which facilitates organisations to take decisions on the above matters after taking into account the complexities and constraints (like availability of limited resources) faced by the organisation.

The software can be used in making decisions. The following table gives a few areas where it can be used.

Area	Decisions involve consideration of:
Budgeting	The extent of investments to be made on projects which have a high gestation period i.e. projects which involve heavy investment but give low returns in the initial years, and give high returns in the long run.
Portfolio management	The extent of investment in equity and bonds such that the entity earns maximum returns and simultaneously is exposed to minimum risks and uncertainties.
Working capital management	The extent of funds which need to be allocated to various current assets like inventory, loans and advances, etc. and ensure that the net interest earned by the organisation is maximised.
Blend of raw materials	The right blend of raw materials which will generate maximum satisfaction to end users and involve minimum costs.
Efficient production	**The best way of carrying out manufacturing activities such that minimum wastages are caused and simultaneously efficient and effective production is undertaken.**

Example

Greenwoods is a lumber factory which produces four varieties of particle boards which are used to make furniture. The production of each panelling involves making a mix of ply chips and teak chips and gluing and pressing them together. The following table identifies the quantum of raw materials along with the labour hours which go into making each pallet of panelling. Each pallet contains 50 units of each type of panelling:

	Resources required per pallet of panelling type			
	Deluxe	**Grade 1**	**Grade 2**	**Grade 3**
Glue (quarts)	100	100	200	100
Pressing (hours)	10	30	20	10
Teak chips (pounds)	1,000	800	600	400
Ply chips (pounds)	1,000	1,500	500	1,000

Following information relating to production for Jan 2012 is available:

Product	Budgeted profit per pallet
Deluxe	Tshs900
Grade 1	Tshs2,300
Grade 2	Tshs1,600
Grade 3	Tshs800

The entity has 11,600 quarts of glue; 1,460 hours of pressing capacity; 58,400 pounds of teak chips; and 121,000 pounds of ply chips available.

The entity has to decide on the quantum of products which need to be produced taking into account the above information.

Step 1: Derive the formulae.

Assume the following:

X_1 = Quantum of deluxe pallets produced
X_2 = Quantum of Grade 1 produced
X_3 = Quantum of Grade 2 produced
X_4 = Quantum of Grade 3 produced

Therefore, the entity will want to maximise profits

i.e. Maximize: $900 X_1 + 2{,}300X_2 + 1{,}600X_3 + 800 X_4$

However, the entity faces a constraint on the availability of resources i.e. the amount of glue, pressing, teak chips, and ply chips. The constraints for this problem are expressed as follows:

$100X_1 + 100X_2 + 200X_3 + 100X_4 <= 10{,}600$ (Glue)
$10X_1 + 30X_2 + 20X_3 + 10X_4 <= 1{,}460$ (Pressing)
$1{,}000X_1 + 800X_2 + 600X_3 + 400X_4 <= 58{,}400$ (Teak chips)
$1{,}000X_1 + 1{,}500X_2 + 500X_3 + 1{,}000X_4 <= 121{,}000$ (Ply chips)

Since the number of products built cannot be negative, the following should also be assumed:

$X_1, X_2, X_3, X_4 >= 0$.

Step 2: Let us solve this using 'solver'.

This requires recording the available data in an Excel sheet. Refer to the Excel sheet below. As we need to derive at the quantum of each type of panel which must be produced, we should assume the quantum to be zero. Derive the total profits using the formula:

Test Yourself 9

Identify the most important feature of pivot tables:

A   To summarise large amounts of data quickly
B   Preparation of different summaries of the source data
C   Generation of brief and attractive reports
D   Design standard reports which can be updated with latest database.

Answers to Test Yourself

Answer to TY 1

The correct option is **A.**

The spreadsheet contains a number of rows and columns used to record and compare numerical and financial data. Only columns to record data or only rows to compare data will be insufficient to support any management activity for which spreadsheets are mainly used. Blank sheets will again not solve the purpose of reporting.

Answer to TY 2

The correct option is **B.**

By putting proper formula in the formula box or in the cell, different arithmetical calculations such as addition, subtraction, division and multiplication can be done very quickly. There are separate commands for spelling check, data sorting and data protection in the menu bar. Formula is not necessary for these functions.

Answer to TY 3

The correct option is **C.**

Word processing is used to draft letters.

Answer to TY 4

The correct option is **B.**

When you insert (copy and paste selected cells in) an Excel worksheet, the worksheet will not be updated when you update the main Excel file. However, when you insert a linked worksheet, whenever you open the Word file, the linked Excel sheet will update its values to match the main external Excel file.

Answer to TY 5

The correct option is **C.**

Answer to TY 6

The correct option is **C.**

After the spreadsheet has been filtered, only the data that matches your criteria will be displayed.

Answer to TY 7

The correct option is **C.**

Answer to TY 8

The formulae used are as follows:

Inventory of T7 = HLOOKUP("T7",A1:E3,3,FALSE) = 125
Inventory of B7 = HLOOKUP("B7",A2:E4,3,FALSE) = # N/A

Answer to TY 9

The correct option is **D.**

The most important feature of pivot tables is that it designs standard reports which can be updated with latest database.

Self Examination Questions

Question 1

On a computerised spreadsheet, the intersection of a row and a column is called a:

A   Joint
B   Connection
C   Unit
D   Cell

Question 2

The data once entered in a spreadsheet cannot be formatted later:

A   True
B   False

Question 3

The spreadsheet package has changed the work style of the cost and management accountants:

A   True
B   False

Question 4

In a spreadsheet the grid containing rows and columns, where data is entered and processed is called a:

A   Worksheet
B   Table
C   Chart
D   Database

Question 5

Spreadsheets are:

(i)   convenient only where a large amount of data has to be presented and calculated
(ii) suitable in producing a flexible budget
(iii) designed in such a way that they can even display data in the form of graphs

Which of these statements is / are correct?

A   (ii) and (iii) only
B   (ii) and (i) only
C   (i) and (iii) only
D   (i), (ii) and (iii) only

Question 6

Absolute cell reference can be created in spreadsheets by using "$" before each letter and number.

A   True
B   False

Question 7

Which of the following formulae has been applied to cell D4?

	A	B	C	D
1				
2		Total hours worked	No. of units produced	Hours per unit
3	Monday	80	10	8
4	Tuesady	90	15	6
5	Wednesday	48	8	6
6	Thursday	126	18	7
7	Friday	91	13	7

A   =B4*C4
B   =B4 ÷ C4
C   =B4/C4
D   =B4 x C4

Question 8

Like any other application, Spreadsheet program has special data types that have to be entered up-to cells for either good arrangement or for accurate computational results.

Required:

Briefly, with examples discuss at least five data types that can be entered into a spread sheet program.

(Adapted from T08 Mau 2012)

Answers to Self Examination Questions

Answer to SEQ 1

The correct option is **D.**

In computer spreadsheets, the intersection of a row and a column is called a cell. One can write text as well as numbers in these cells.

Answer to SEQ 2

The correct option is **B.**

The information once written in a spreadsheet can be formatted as desired. The formatting function helps make changes such as the fonts, size of characters used, and indentation of the text, numbering and styles and so on.

Answer to SEQ 3

The correct option is **A.**

Before the development of spreadsheet packages, cost and management accounting staff used to do various calculations either manually or with the help of calculators. Spreadsheet is an important tool used in cost and management accounting since it helps in preparation of the various reports and financial statements.

Answer to SEQ 4

The correct option is **A.**

A spreadsheet is also known as a worksheet which contains rows and columns**.** The MS Excel spreadsheet contains three worksheets by default and further worksheets can be added as required.

Answer to SEQ 5

The correct option is **A.**

Although spreadsheets are designed to display data in the form of graphs and charts for large volumes of data, they are convenient even for a small amount of data.

Answer to SEQ 6

The correct option is **A.**

Answer to SEQ 7

The correct option is **C.**

Answer to SEQ 8

The Types of data that can be entered into a spread sheet Cells are:

(i) **Labels/Text/alphanumeric: they a**re descriptive text that identifies the components of the worksheet. For example, time, age, pass marks etc.

(ii) **Values/Numbers: they a**re numeric data either entered in directly or as a result of calculation. For example 0, 3, 4,34,89, 100 … etc.

(iii) Formulas: it is a mathematical expression that calculates a value / equation that you build using arithmetic operations. For example, = (A4+B5+B6+B7)/4 to calculate the average.

(iv) Functions: are formulas that help you with calculations ranging from simple to the complex ones. For example, average function that would look like = AVERAGE(B4:B7)

(v) **A constant: relates to** values that never changes. For example, Pi, a rate fixed to be referenced for other computation.

(vi) Dates (Calendar): for example, DD/MM/YYYY

COMMONLY USED APPLICATION PACKAGES

F3

STUDY GUIDE F3: DATABASE MANAGEMENT SYSTEMS

■ Get Through Intro

In today's rapidly developing business world, data entry includes all kinds of text and non-text data (for example images) captured from paper documents, manuscripts, scanned image files, old databases, microfilms, web research, etc.

A **data warehouse** is the main repository of an organisation's historical data; it is corporate memory. It contains the raw material for the support system that assists management in taking decisions. It contains data regarding the internal transactions of a business (sales / purchase ledger details) as well as external data.

Data can be useful only if the data analyst can effectively perform complex queries and analysis, such as data mining, on the information without slowing down the operational system.

This Study Guide discusses the concept of database management tools, the various database management systems along with the tools in database management systems. Knowledge of this will enable you to understand the importance of database management and also give an insight into various technical aspects of database management systems.

■ Learning Outcomes

a) Define the term database management systems.
b) List and explain various examples of database management systems.
c) Use various tools in database management systems.

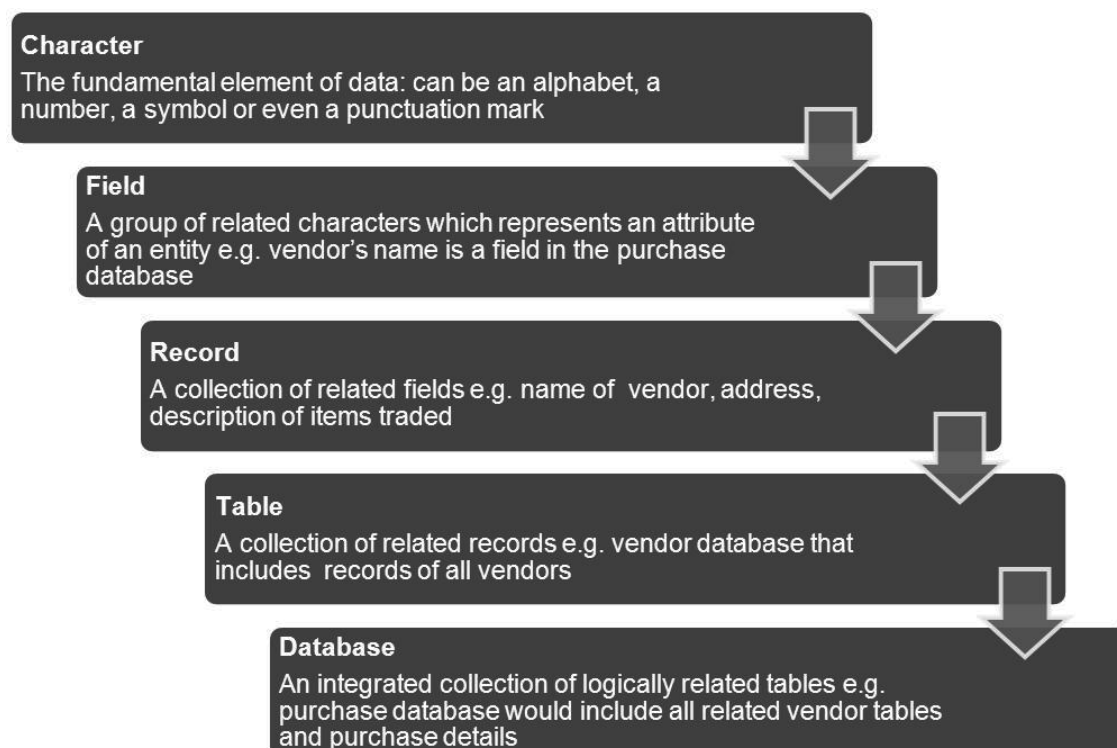| 1. Define the term database management systems. |
|---|
| **[Learning Outcome a]** |

1.1 Database systems

In today's rapidly developing business world, data entry includes all kinds of text and non-text (e.g. images) data captured from paper documents, manuscripts, scanned image files, old databases, microfilms, web research, etc.

Most entities today create a variety of database. Some of them include:

Type of data base	Details
Operational database	Contains information which is specific to the various operations of an entity. For example HR department will have data relating to personnel, like names of employees, job title, salary amongst other details; Purchase department will have procurement related details, like names of vendors, items purchased, rate of purchase, vendor performance and more; Customer database and inventory database are some more examples. Data offers support in smooth operations of the entity.
Management database	Contains information needed by the managerial staff to take decisions. The data is generally organised and includes data which is internally generated as also from external sources.
Information warehousing database	Contains specific operational data and management data (from current as well as previous years) which enables in generation of standard reports. For example while generating the chairman's report of an entity, information from operational database is merged with the MIS information.
End user database	Many employees generate their own reports in MS word, excel and other formats using the data files which the employees maintain. For example daily production report. These are the end user database.
External database	Entities often purchase data from external sources for a fee. For example a tax consultant can generate a transfer pricing report only after procuring information about the industry from the regulators against payment. This information is required for making an analysis in the report.

Figure 1: Categories under which data is organized

Character
The fundamental element of data: can be an alphabet, a number, a symbol or even a punctuation mark

Field
A group of related characters which represents an attribute of an entity e.g. vendor's name is a field in the purchase database

Record
A collection of related fields e.g. name of vendor, address, description of items traded

Table
A collection of related records e.g. vendor database that includes records of all vendors

Database
An integrated collection of logically related tables e.g. purchase database would include all related vendor tables and purchase details

Definition

A database can be described as a collection of records stored in a computer in a systematic way. This enables a computer program to retrieve stored data to provide relevant information.

A database system refers to the way a certain set of related information is stored and accessed by a computer. Information is segregated into a set of fields. Since this information is stored in a structured manner the process of **retrieving** specific sets of data or even **cross referencing** data is greatly **simplified and expedited**.

Figure 2: Database system

The underlying concept behind a database system is that it is an **inter-related collection of records**. Given the interconnectivity of information, users can run "queries" i.e. ask questions to which the computer will provide an answer after scanning through all records.

Example

A very common application and use of database system is found in libraries. The library database will contain a list of the entire collection of books in the library. Stored information can be:

    the title of the book;
    the name of the author;
    the type of the book (e.g. fiction, history, science etc.);
    its year of publication.

The database system can be used to run a variety of searches. These include finding:

    all books by a particular author;
    all books by a particular title (e.g. biographies on David Beckham);
    all books on a particular topic (e.g. World War 2), and
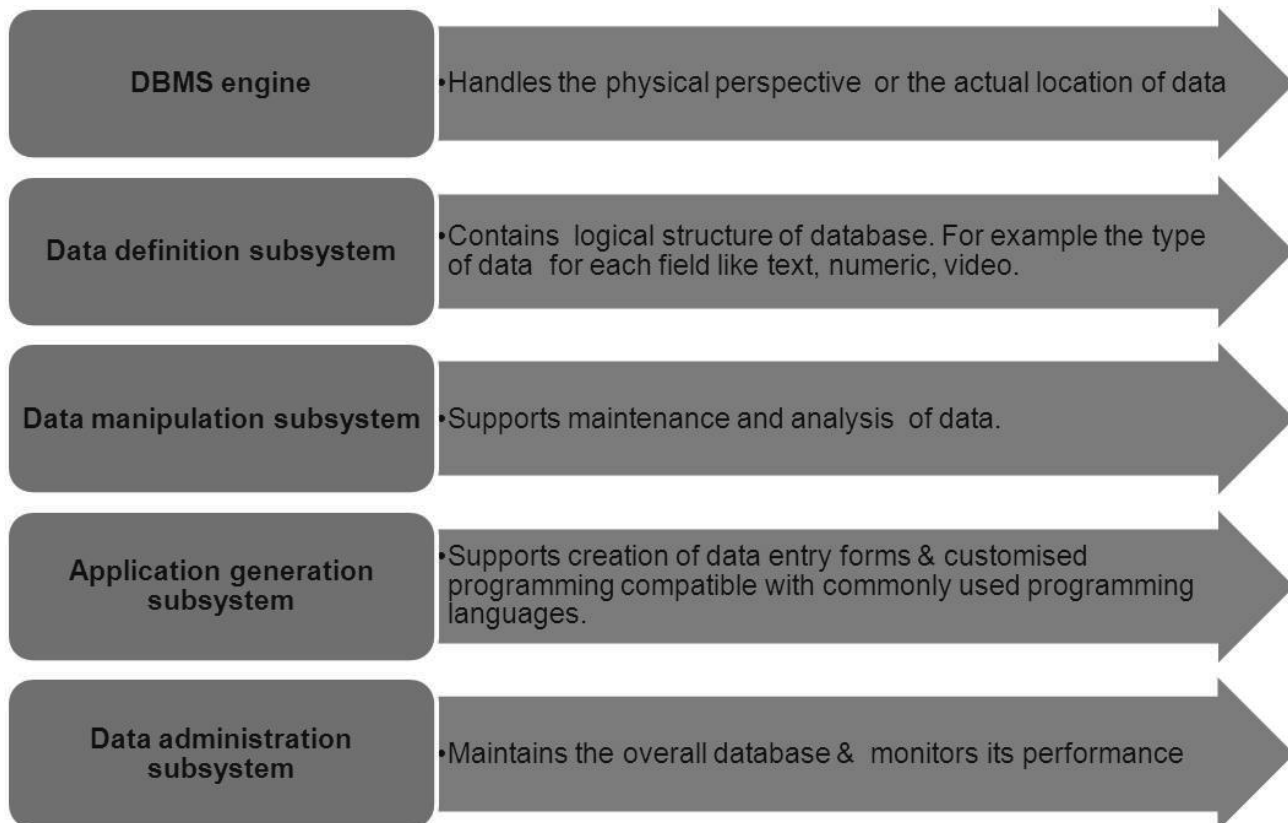   all books of a particular type (e.g. murder mysteries).

1.2 Database management systems

A **database management system** (**DBMS**) is computer software designed for the purpose of organising and managing databases. The DBMS accepts requests for data from the application program and instructs the operating system to transfer the appropriate data. It provides the user with the means of accessing the database.

When a DBMS is used, information systems can be changed much more easily with a change in the information requirements of the organisation. New categories of data can be added on to the database without disrupting the existing system. Thus, database management tools facilitate retrieval and / or editing existing data as well as recording new data to the existing data base.

Figure 3: Parts of a DBMS

DBMS engine	•Handles the physical perspective or the actual location of data
Data definition subsystem	•Contains logical structure of database. For example the type of data for each field like text, numeric, video.
Data manipulation subsystem	•Supports maintenance and analysis of data.
Application generation subsystem	•Supports creation of data entry forms & customised programming compatible with commonly used programming languages.
Data administration subsystem	•Maintains the overall database & monitors its performance

Test Yourself 1

What can be described as a collection of records stored in a computer in a systematic way?

A Management database
B Operational database
C Database management system
D Database

2. List and explain various examples of database management systems.
    Use various tools in database management systems.

                                                    [Learning Outcomes b and c]

 There are three main database architectures: network, hierarchical and relational.

Organisations may use one kind of DBMS for daily transaction processing and then transfer the processed information onto another DBMS which is better equipped for random enquiries and analysis.

The DBMSs that follow the relational architectural concept are known as Relational Data Base Management System (RDBMS). .A RDBMS is a database management system that is based on the relational model as introduced by E.F. Codd. RDBMS is supposed to be superior in design and performance to the other two database architectures.

In a relational database, data is stored in a tabular format, where the columns are the fields and the rows are the records.

Example

The following table contains personal information of the staff of SK Enterprises:

Employee ID	Name	Designation	Age	Blood group	Basic salary (Tshs)	Years in service
108	Peter	Production manager	35	0+	100,000	12
110	Jane	HR manager	32	AB+	90,000	10
205	Jack	IT manager	30	A-	125,000	8
307	Tim	Accounts supervisor	25	AB-	65,000	3

Each row contains data from various fields of each employee

The database management system generally has various tools which enable to organise the data such that it can be analysed and interpreted easily.

2.1 Examples of database management systems (DBMS)

As already explained, DBMS is a software which facilitates recording and organising of data.

Some examples of DBMS are Microsoft access, Sybase, Structured Query Language (SQL) and Oracle a few of which are described below:

1. Microsoft access

Microsoft access is a relational database management system that allows users to create data, organise data and manage data from the database. It is a Microsoft application. The software matches the data in the field which is common in two tables and then links the information to generate reports (refer to example of JK Enterprises discussed in earlier paragraph.

Example

The screen of an access file is as follows:
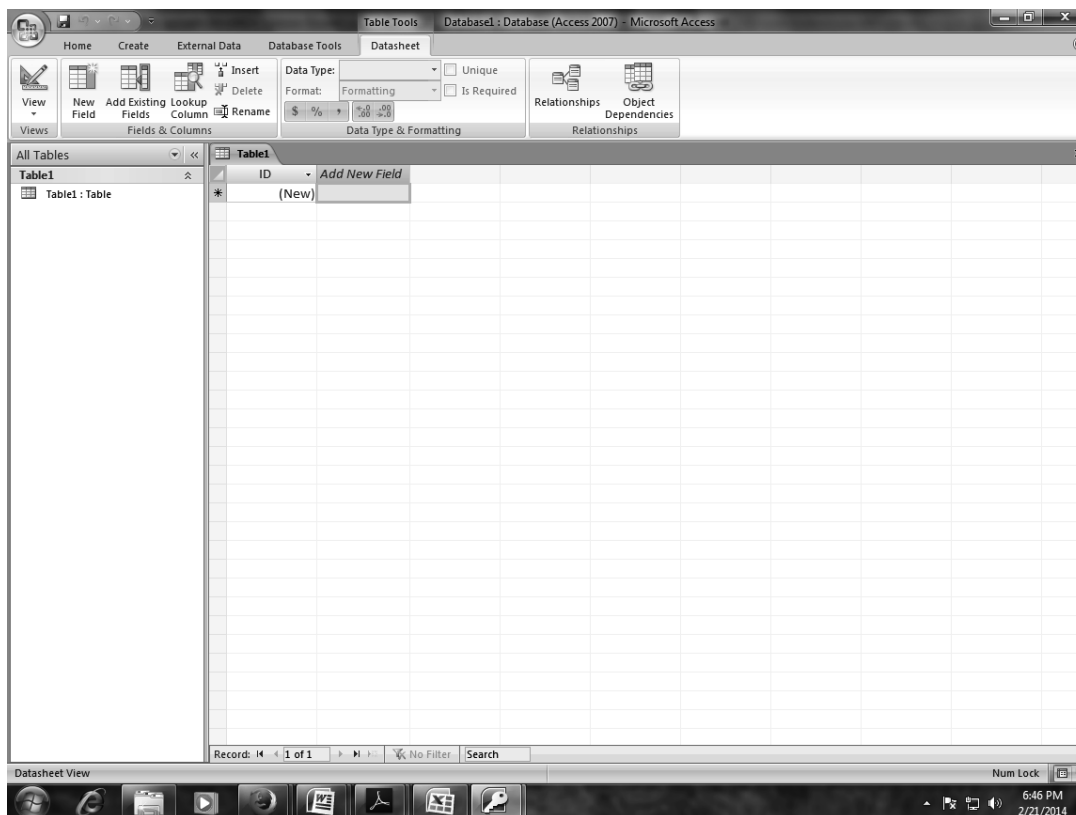
Features

The data can be in the following formats: text, memo, number, date / time, currency, auto number, Boolean and hyperlink.

It has many common features of MS word, Excel and PowerPoint.

It uses data from different tables and organises data. For example if a user decreases the rate of cash discount offered to its customers, this information is required to be recorded only in one table containing the customer data. There is no need to record this information on the pricing table, sales table, etc.

The files have '.mbd' extension. Each file contains all the tables relating to one database. The file also includes queries, forms, reports etc. relating to one database.

Data can be edited by adding new rows, updating or deleting existing data and in many other ways.

Copying and backup of database is easy in Microsoft access.

Reporting is easy as Microsoft access permits export of database tables into word document and electronic spreadsheets. This in turn also facilitates analysis and reporting of data.

It is generally used for management of smaller databases since it is designed to handle desktop size databases used by not more than four users at the same time. Therefore, small business houses and individual departments of big organisations use this software.

Each column must contain data of the same type.

Converting bidirectional text to and from ANSI (enabled through Microsoft office language setting), SQL Server 2000 Desktop Engine (i.e. local data can be stored in a format compatible with Microsoft SQL Server 2000) and handwriting recognition (simplified Chinese, English, Japanese and Korean) are some utilities of this DBMS.

It is user friendly so users, having reasonable working knowledge can develop useful databases.

2. Structured Query Language (SQL)

SQL is a relational database management system which is a computer programming language used to create, organise and manage data from the database without the help of an IT professional. American National Standards Institute (ANSI) and International Organisation for Standardisation (ISO) recognise this for accessing data in a RDBMS.

Features

It is a server based database, used by database software systems like Oracle database, MySQL, SQL Server, etc. Hence, it has a wide usage.

It is easy to apply as compared to other traditional programming languages.

It has three components:

Data manipulation language (DML) includes SELECT, UPDATE, INSERT, DELETE and MERGE statements.

Data definition language (DDL) includes CREATE, APPEND and ALTER statements.

Data Control Language (DCL) includes GRANT and REVOKE statements.

It has several elements like:

Clauses which are components of queries.

Expressions which generate either scalar vales or information in tabular formats.

Predicates which are used to evaluate queries.

Queries which generate data based on selected criteria.

Statements which may affect the data.

SQL statements which are standard part of SQL grammar.

Insignificant white space which is generally not taken into account in SQL queries and statements.

2.2 Commonly used tools

The commonly used tools of a DBMS are:

1. Sort

This function will change the way the data is arranged. Sorting enables to organise and re-order data (across multiple fields). This helps in proper visualisation and understanding of data, ultimately leading to quality decisions. Data can be sorted by text (A to Z or Z to A), numbers (smallest to largest or largest to smallest), and dates and times (oldest to newest and newest to oldest) in one or more ways.

2. Filter

Generally the volume of data is high, therefore sorting through it and isolating data that meets certain criteria can be a challenge. For example, if you want to know the names of employees of a particular blood group, instead of spending time reviewing your data you can use the filter tool which will show just what you want to see and hide the rest. Filtering does not change the base data in any way. As soon as the filter is removed all data reappears,

3. Query

This is the basic tool used to access, add and edit a database management system. It involves raising questions or queries on fields contained in various tables of the database management systems.

The query tool performs many tasks, some of which include

Selection of data from the DBMS

Addition of new data in the DBMS

Updating an existing field of the DBMS with a new value

Deletion of specific subsets of records

Creation of a new table using the existing database

Example

Continuing the example of JK Enterprises

The personal department has one more table in the database containing the following information.

One of the employees has met with an accident and requires the AB group blood urgently. The personnel department has the related information in the following table:

Employee ID	Blood group
108	0+
110	AB+
205	A-
307	AB-

The above table does not contain the names of employees. However, this information is available in the first table described in the example. This is called the primary key as it enables to identify the record of the second table. Therefore, the personal department applies a query to the two tables and generates a list of names of employees along with their blood groups. This is then sorted according to blood group and the required report is created.

Tip

A primary key generally represents a column in a table. It cannot have null value. It is used to establish a relationship with foreign keys of other tables.

4. Performance monitoring

The usage of database can be monitored because the software generates statistics relating to its usage.

5. Backup

Back-up is a secondary copy of the data base. It is physically stored outside the internal drives of the computer i.e. on alternative storage mediums such as a floppy disk, CD-ROM or magnetic tape etc. Back-up ensures that the organisation does not lose data because of an accident or a breach in security. In these circumstances, the organisation uses back-up data to restore its systems.

Data dictionary or data repository

It stores information relating to:

design decisions;
descriptions relating to application programmes;
user information.

Access to this data is available to users as well as database administrators.

Test Yourself 2

Fill in the blanks:

(a) _____ is a collection of fields.
(b) Access is a _____ database management
system. (c) RDBMS stands for _____.
(d) _____ uniquely identifies a column of a table.

Answers to Test Yourself

Answer to TY 1

The correct option is **D**.

A database can be described as a collection of records stored in a computer in a systematic way

Answer to TY 2

(a) Record
(b) Relational
(c) Relational database management system
(d) Primary key

Self Examination Questions

Question 1

State whether the following statements are true or false:

(a) Access is an application programme of PowerPoint.
(b) Access files have extension '.dbs'
(c) Structured Query Language (SQL) is created for multi user computer systems.
(d) A relational database has no fixed format.

Question 2

Processed data is called:

A Record
B Field
C Data
D Information

Question 3

Structured Query Language (SQL) is:

A Network database management system
B Hierarchical database management system
C Relational database management system
D Structured programming language

Question 4

A database row is called:

A Record
B Field
C Data
D Information

Question 5

Explain two differences between Microsoft access and SQL.

Answers to Self Examination Questions

Answer to SEQ 1

(a) False.

Access is an application programme of database management systems.

(b) False.

Access files have extension '.mbd'

(c) True.

(d) False.

A relational database has a tabular format.

Answer to SEQ 2

The correct option is **D.**

Information contains specific operational data and management data (from current as well as previous years) which enables in generation of standard reports

Answer to SEQ 3

The correct option is **C**.

SQL is a relational database management system which is a computer programming language used to create, organise and manage data from the database without the help of an IT professional.

Answer to SEQ 4

The correct option is **A**.

In a relational database, data is stored in a tabular format, where the columns are the fields and the rows are the records.

Answer to SEQ 5

Microsoft access is a relational database management system that allows users to create data, organise data and manage data from the database. SQL is a relational database management system which is a computer programming language used to create data, organise data and manage data from the database without the help of IT.

Microsoft access is generally used for management of smaller database as it is designed to handle desktop size databases used by not more than four users at the same time. Therefore, small business houses and individual departments of big organisations use this software. SQL is a server-based database, used by database software systems like Oracle database, MySQL, SQL Server etc. and has a wide usage.

F4

COMMONLY USED APPLICATION PACKAGES

STUDY GUIDE F4: INTEGRATED ACCOUNTING SYSTEMS

■ Get Through Intro

Online availability of information is not a luxury anymore for modern day organisations. The information systems have evolved very fast over the last decade to facilitate such requirements. The application of information systems such as Enterprise Resource Planning (ERP), data mining, data warehousing etc. enable companies to make data / information / reports available to decision-makers on a real time online basis. These systems play the role of a decision support tool so that the managers can compare, evaluate and manage the performance using various forms of analytics such as business intelligence (BI).

This Study Guide discusses the meaning of integrated accounting systems along with some examples and tools.

■ Learning Outcomes

a) Define the term integrated accounting systems.
b) List and explain various examples of integrated accounting systems.
c) Use various tools in integrated accounting systems.

> 1. **Define the term integrated accounting systems.**
>
> **[Learning Outcome a]**

1.1 Interlocking system

Two sets of accounts are maintained under the interlocking system of accounting. One set of accounts according to the financial accounting system and another according to the cost accounting system.

The cost accounting system differs from the financial system because it does not record company transactions with the outside world such as creditors account, debtors account and capital account. Instead, a common account known as the cost ledger control account is maintained to record these aspects of the transactions. Furthermore, the organisation would independently generate two statements of profit and loss under the financial accounting system and the cost accounting. Both statements would have to tally and in case of any differences between the two, the difference would have to be reconciled.

This method of accounting faces the following drawbacks:

Complexity: maintaining the cost accounting system records is complex due to the maintenance of a cost ledger control account. Furthermore, a reconciliation of any differences in the statements of profit and loss is also required. Due to its complexity, it is sometimes difficult for a layman to understand.

Cost: this method of accounting is costly due to the cost involved in maintaining duplicate sets of accounts.

Time consuming: this method of accounting is time consuming, which delays the reporting process.

1.2 Integrated accounting systems

With a view to overcome the drawbacks of the interlocking system, the concept of integrated accounting system was introduced. Under an integrated system, a common input is used by the financial and cost accounting systems.

Definition

Integrated accounting system refers to a system of accounting where a **single set of accounts** provides data for financial and cost accounting systems.

An integrated system includes a control account for every major cost heading. These control accounts cover various items relating to cost and management accounting. This system of accounting generates only one statement of profit or loss under both financial accounting and cost accounting.

1. **Benefits of integrated accounting systems**

The benefits of this system are as follows:

(a) **Simple to understand:** this system of accounting is simple to understand because it is less complex than the interlocking system of accounting

(b) **Cost effective:** it is cost effective as it avoids duplication arising from maintaining two sets of accounts.

(c) **Saving of time and efforts:** it saves the accountant's time and efforts in accounting and reporting as there is no need for:

maintaining two separate records and
carrying out a reconciliation of the statement of profit or loss.

(d) **Prompt recording of information**: records are available without any delay.

(e) **Holistic picture**: all information is saved on one database so it provides a holistic picture of the accounting system.

2. **Benefits of mechanised system of accounting**: the benefits of mechanised system of accounting can be obtained by the entity.

(a) Accounting packages enable accountants to enter data efficiently and in line with requirements of financial reporting standards.

(b) Certain recurring calculations can be automated. For example, depreciation and amortisation calculations at the end of a period can be automated.

(c) These packages can aid in automatic updating of related accounts. For example, if any updating is made in a supplier's account, the concerned entry in the purchases ledger too would get updated.

(d) Well structured budgets can be prepared with ease.

(e) An organisation engaged in international trade can easily convert figures related to its transactions from one currency to another.

(f) Management reports like inventory reports, aged debtors' reports, and reports on sales, puchases, payrolls and variances can be generated instantly and accurately.

(g) Goods and Services Tax and Value Added Tax returns can be calculated easily.

(h) The tax liability of an entire organisation can be calculated accurately.

Example

The Integrated Accounting System is made up of several modules like:

Financial management module: it facilitates the computation of budgets, actuals, accruals and allocation. Furthermore, the financial reporting can generate customized financial reports.

Accounts receivable module which helps to:

> Keep a track of cash received against each invoice raised
> Generate aging analysis of accounts receivables
> Transfer transactions to general ledger
> Automatically compute interest charges on overdue receivables.

The **Accounts Payable** module which helps to:

> Enter invoices
> Automatically create the general ledger
> Easily review vendor's activities

The **non-current assets modul**e which helps to:

> Compute depreciation
> Prepare depreciation schedules
> Print amortization schedules

Inventory control module which helps to:

> Track ageing of inventory in hand
> Transfer inventory amounts to the general ledger using one screen

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3. **Drawbacks of integrated accounting systems**

Just as a coin has two sides, an integrated accounting system also has the following drawbacks:

> Small organisations may find it expensive to implement an integrated accounting system as the software is costly.
> The accounting software will require staff who have knowledge of using the software.
> Volume of transactions is high

1.3 The differences between an interlocking system and an integrated system

	Interlocking system	Integrated system
Number of sets of accounts	Two sets of accounts are maintained.	Single set of accounts is maintained.
Duplication of work	Each transaction is processed twice leading to duplication of work.	Single processing of a transaction avoids duplication of work.
Time required to prepare cost accounts	Cost accounts are prepared after posting is made into the financial accounting system.	Cost accounts are prepared directly from the book of original entry. Hence, the time required to obtain cost records is reduced.
Reconciliation system	Reconciliation statement is prepared to discover the causes of discrepancy between the two accounting systems.	There is no need to prepare a reconciliation statement.
Cost of maintaining accounting system	Since two sets of accounts are maintained, it is comparatively expensive to maintain.	Comparatively less expensive to maintain.

Test Yourself 1

Two sets of accounts are maintained under _____ accounting systems.

(a) Intermediate
(b) Interlocking
(c) Integrated
(d) Intersection

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2. List and explain various examples of integrated accounting systems.
Use various tools in integrated accounting systems.
**[Learning Outcomes b and c]**

In the past, managers always complained of lack of information as their failure to take decisions effectively. The basic cause was related to different forms and formats of data, absence of a central repository to manage it, lack of information and the time when it was required.

Modern IT systems bring the information to the user in many ways, as and when needed (or may be ahead of the requirement at times!). The most common IT systems in vogue today are the ERP and data warehouses. Let's see how such systems help in making information available instantly. The users of information just get it without even knowing what goes on at the backend. The users get information in an integrated way, either in the form of a report or as an onscreen query.

Examples and tools in integrated accounting systems

1. Enterprise Resource Planning (**ERP) systems**

ERP systems represent software application packages such as Systems, Applications and Products (SAP) and PeopleSoft which are designed to help an organisation to integrate its various departments / functions by allowing information to freely flow across the business.
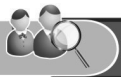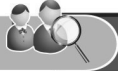
Example

An organisation's MIS might consist of three separate software applications for its accounting, inventory control and human resources functions. An ERP system would integrate the systems used by these departments to enable the organisation to operate them all from the same software platform.

Overall the focus behind using ERP systems is to automate existing processes as far as possible and replace existing department specific software with one all encompassing and integrated program.

ERP is an enterprise-wide software system which is a transaction processing and reporting mechanism through an integrated approach. ERP enables the organisation to use a unified database so that the transactions are recorded and processed in an integrated manner. **The different business intelligence tools like EIS enable managers to access dash board reports almost on an online basis.**

The facility is usually access-controlled so managers can access only relevant data. In the previous versions of IT systems, managers did not have a direct access to the required data and had to depend on IT or the accounts department for information.

Performance measures such as budgets, standards or any other benchmarking parameters can be fed into the system. According to the defined time frequency (which can be real time online!), the system processes the comparison of actual vs. benchmarks and updates variance reports for managers. These reports are useful in measuring the performance and controlling the activity by initiating actions in time.

Example

Mycar Auto Comp Plc, a medium-sized organisation, has not been meeting the delivery schedules for components which it has committed to its customers. The inventory of finished components has also been increasing over the last two years. The sales are very erratic. Profitability is declining and cash flows are irregular.

The management of Mycar conducted an initial assessment and has found that:

adequate information on pending customer orders (order backlog) is not available
there is a lack of coordination between the sales and production functions
the production plan is unable to follow proper delivery commitments
material procurement is based on the judgement of the purchase head
components not due for delivery are manufactured, resulting in the build-up of inventory

Management considered the following approaches to this situation:

replacing the current processes with completely new processes (i.e. business process re-engineering)
revamping vital processes
changing the existing processes to some extent
using off-the-shelf ERP solutions

After considering the various impacts of each of the options, the decision was taken to redesign operational processes and to implement an off-the-shelf ERP solution. The ERP product comprised all standard processes for:

processing customer orders
preparing a delivery plan
generating information on the pending deliveries
preparing a production plan
calculating the material requirement for a given production plan
raising purchase orders
updating inventory information (raw materials and finished components)
raising invoices of components delivered
reporting on payments receivable from customer with due dates
reporting on payments due to suppliers etc.

The process redesign carried out through implementing the ERP solution in core operational processes solved Mycar's problems to a great extent.

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2. SAP

Companies looking for a packaged supply chain application may opt for SAP, for example, which provides maps that show how the company organises its modules to support supply chain systems in different industries. **SAP is an integrated ERP software that deals with the business software requirements of organisations across various industries and sectors.**

All of the leading packaged software vendors offer modules to support multi-industry operations. Similarly, some are designed to actually automate processes and others are designed to monitor processes and report to managers.

These packages have gone through substantial improvements over recent years. As a result, this option can save substantial work volume, time and can give reasonably good results at reasonably low cost.

Recently developed organisational process tools such as ERP systems, supply chain management and customer relationship management systems have embedded ideologies of cross-functional process integration and elimination of duplication to enhance the effectiveness of processes. There is an increasing trend among small and medium organisations to adopt these tools to meet their selective process redesign needs.

Example

Speed Bikes Ltd, the largest motorcycle company in the world, is trusted by 2 million customers in the UK. The company commands a substantial market share in the industry. This fact combined with the company's technological excellence, expansive dealer network and reliable after sales service makes Speed Bikes one of the most customer-friendly companies in the world.

Speed Bikes' existing information system operates on different platforms (technologies), which were developed in-house and tailor-made to the company's method of working. The system is responsible for data processing; only some operational reports are generated by the system. The processes are loosely integrated across functional areas. Duplication and inconsistency of information are present in most applications.

The MIS reports are generated in the form of spreadsheets along with different kinds of analysis. Information, therefore, is fragmented and its authenticity is questionable. Speed Bikes lacks access to real time information on product cost, profitability analysis, despatch and production status. The company is facing operational, management information and management control problems.

The management of Speed Bikes now wants to migrate from fragmented technology to a single, more stable and more modern information system. It has chosen to implement SAP, a well known software solution, to solve the abovementioned problems. The overwhelming presence of SAP in the automotive sector was one of the most important reasons for its selection.

Required:

(a) Establish the limitations of Speed Bikes' information system, their causes and effects.
(b) Establish the relationship between the problems and the proposed solution of SAP implementation.

Answer

(a) The company is facing a number of multidimensional problems:

It uses multiple software technologies.
The processes are loosely integrated across functional areas.
There is duplication and inconsistency of information in most applications.
Software has been developed in-house for data processing and producing some management information reports.

The above mentioned are clear indicators of a casual and negligent management approach towards the information system, business process redesign and improvement aspects. The company has redesigned processes or has attempted coverage of functions from time to time; most probably by opting for cheap and quick development with a very short-term view and lack of foresight. The company has saved little money and has paid a heavy price by creating a deficient information system and business processes.

The majority of the management data is compiled in Excel spreadsheets.
The information is spread over various Excel worksheets and is therefore fragmented.
Speed Bikes lacks real time information on product cost, profitability analysis, despatch and production status.

(b) The relationship between the problems and the proposed solution of SAP implementation.

These conditions have been created by Speed Bikes' management without realising the limitations of Excel worksheets. In the absence of data compiling modules from the data source, the company is forced to use Excel worksheets. Independent information compilations of this kind will inevitably lack reliability, consistency of report formats, will remain fragmented and, moreover, will make tracing the original worksheets very difficult.

The company is facing serious problems relating to the effectiveness of its business processes, its information system and the availability of timely and reliable management information. Its decision to redesign its processes, improve its information system and make use of the latest information technology is a welcome step, although late.

The solution to these problems lies in the process design of the SAP package. This package has gone through continual improvements. It also said to be the most flexible and versatile package and suitable for a variety of industries. It is claimed to have incorporated best practices in order to meet business needs. It has inbuilt cross-checks and validations for processes involving cross-functional interactions.

The business intelligence module of SAP is claimed to provide real time information of every kind required by business organisations for management control. It is said to be able to be configured to meet the specific needs of a particular industry.

SAP incorporates common processes such as PP with MRP (production planning with material requirement planning), QM (quality management), FI / CO (finance and controller office), SD (sales and distribution) and MM (material management). These are integrated cross-functionally.

The company can make continuous improvements and change the configuration to add more functionality to the systems. SAP has various additional modules such as Plant Maintenance, Human Resources (including Payroll) module, Supply Chain Management project and CRM. The company can choose to implement these modules in phases in accordance with its ability to absorb the technology. These modules can add value in future, as and when implemented. However, this could involve certain implementation problems.

The overwhelming presence of SAP in the automotive sector was one of the most important reasons for its selection. Customers have confirmed that SAP was able to address their needs. Therefore, SAP is a much-admired solution in the automotive industry.

Therefore, we may be confident that SAP will be useful in solving the problems of Speed Bikes Ltd.

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3. **Data warehouses and information access**

Date warehouse can be defined as **an integrated, subject-oriented time-variant and non-volatile database that provides information for decision making.** It is a user-friendly Decision Support System (DSS) and is extensively used in modern day organisations for performance improvement and control. The data is derived from multiple sources within the organisation and then put into a centralised repository. The data is generally organised and optimised so that it can be readily used and processed through reporting tools to answer the queries of functional managers from sales, marketing, production, finance and other departments.

The data is generally permanently stored so that historical information can be easily available. Operational systems like ERP enable data input, whereas the data warehouses mostly provide read only information to be used for control purposes. Benchmarking and performance control is facilitated through multidimensional data analysis and easy to use end-user interfaces. Data warehousing plays a pivotal role is converting data into information so that it can be used for decision making.

An ideal data warehouse should have the following features:

the data in the database is organised so that all the data elements relating to the same real-world event or object are linked together;
the changes to the data in the database are tracked and recorded so that reports can be produced showing changes over time;
data in the database cannot be over-written or deleted, once committed.
the data is static, read-only, retained for future reporting; and
the database contains data from most or all of an organisation's operational applications, and this data is made consistent.

4. **The above tools would help today's knowledge worker to answer questions like:**

(a) Which are the most profitable products?
(b) Which customers buy the most and what is customer-wise profitability?
(c) What is the average cost of various resources per unit of product or service?
(d) How do our prices compare to that of competitors? (benchmarking)
(e) What are the major favourable and adverse variances? (control)

5. Additional tools:

Integrated accounting systems have tools which generate the following reports:

    Bank reconciliation
    Debtors ageing analysis
    Slow moving inventory
    Budgets
    Variance reports

Design of integrated accounting systems

Large organisations develop the software in-house and also provide customer service and support in-house. The software is customised to suit the client. This is expensive but the benefits will outweigh the cost of the software.

Smaller sized entities, having separate modules for general ledger and cost accounting, develop programmes which integrate the two modules.

In order to ensure that the integrated accounting system used by the entity increases its efficiency, the organisation should ensure that the software takes into account the entity's long term objectives and ensures that the software which is used by the entity also takes care of the operations involved in meeting the objectives. For example, if the entity plans to penetrate the market by selling its products on-line, the accounting system must take care of the operations involved for this. Furthermore, the entity must also ensure that the existing software is regularly updated with latest versions as it may otherwise affect the efficiency of the entity's operations.

Test Yourself 2

Identify the business intelligence tool that enables managers to access dash board reports almost on an online basis.

A EIS
B SAP
C People soft
D Data mining

Test Yourself 3

The tools of an ideal data warehouse would provide answers to which of the following questions?

A Which are the most profitable products?
B Which customers buy the most and what is the customer-wise profitability?
C What is the average cost of various resources per unit of product or service?
D All of the above

Answers to Test Yourself

Answer to TY 1

The correct option is **B.**

Two sets of accounts are maintained under an interlocking system of accounting. One set of accounts is maintained for the financial accounting system and another for the cost accounting system.

Answer to TY 2

The correct option is **A.**

SAP and PeopleSoft are examples of ERP systems.

Answer to TY 3

The correct option is **D.**

The tools of an ideal database would provide answers to questions like:

Which are the most profitable products?
Which customers buy the most and what is customer-wise profitability?
What is the average cost of various resources per unit of product or service?
How do our prices compare to that of competitors? (benchmarking)
What are the major favourable and adverse variances? (control)

Self Examination Questions

Question 1

(a) An organisation's MIS might consist of four separate software applications for its accounting, inventory control, accounts receivables and production functions. An ERP system would _____ the systems used by these departments to enable the organisation to operate them all from the same software platform.

(b) Overall the focus behind using ERP systems is to _____ existing processes as far as possible and _____ existing department-specific software with one all-encompassing and integrated program.

Question 2

Write short notes on ERP systems

Question 3

SAP is _____ that deals with the business software requirements of organisations across various industries and sectors.

A An interlocked ERP software
B An integrated ERP software
C An independent ERP software

Question 4

Distinguish between ERP and SAP.

Answers to Self Examination Questions

Answer to SEQ 1

(a) integrate
(b) automate, replace

Answer to SEQ 2

ERP systems relate to software application packages which are designed to integrate the database of various functions of an organisation and make information instantly available either in the form of a report or as an onscreen query.

SAP and PeopleSoft are examples of ERP systems.

The most common IT systems in vogue today are the ERP and data warehouses.

Features of ERP are as follows:

The organisation uses unified database
Transactions are recorded and processed in an integrated manner.
It helps in making information available instantly.
The users of information need not have knowledge of what goes on at the backend.
Information is made available in the form of a report or as an onscreen query.

The benefits of ERP systems are that it increases the efficiency of its operations as the entity develops only one unified database and reports can be generated very easily. Reports like variance reports generated are useful in measuring the performance and controlling the activity by initiating actions in time.

Answer to SEQ 3

The correct option is **C.**

SAP is an independent ERP software that deals with the business software requirements of organisations across various industries and sectors.

Answer to SEQ 4

ERP	Data warehouse
ERP systems represent software application packages which are designed to help an organisation to integrate its various departments / functions by allowing information to flow freely across the business.	Date warehouse can be defined as an integrated, subject-oriented time-variant and non-volatile database that provides information for decision making.
Operational systems like ERP enable data input	Data warehouses mostly provide read only information to be used for control purposes i.e. data in the database cannot be over-written or deleted, once committed.