INFORMATION COMMUNICATION TECHNOLOGY

ATD LEVEL I

DCM LEVEL I

STUDY TEXT

GENERAL OBJECTIVE

This paper is intended to equip the candidate with knowledge, skills and attitudes that will enable him/her to apply fundamental information communication technology (ICT) skills in business

LEARNING OUTCOMES

A candidate who passes this paper should be able to:

- Demonstrate knowledge of computer systems
- Select appropriate computer hardware and software
- Use various computer application packages
- Select various types of information systems
- Use computer networks and the Internet

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TOPIC 1

INTRODUCTION TO ICT

OVERVIEW OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Information and communications technology (**ICT**) is often used as an extended synonym for information technology (IT). It is a more extensive term (i.e. more broad in scope) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.

The term *ICT* is also used to refer to the convergence of audio-visual and telephone networks with computer networks through a single cabling or link system. There are large economic incentives (huge cost savings due to elimination of the telephone network) to merge the telephone network with the computer network system using a single unified system of cabling, signal distribution and management.

However, ICT has no universal definition, as "the concepts, methods and applications involved in ICT are constantly evolving on an almost daily basis."The broadness of ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, e.g. personal computers, digital television, email, robots.

Information technology

Information technology (**IT**) is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise.

The term is commonly used as a synonym for computers and computer networks, but it also encompasses other information distribution technologies such as television and telephones. Several industries are associated with information technology, including computer hardware, software, electronics, semiconductors, internet, telecom equipment, engineering, healthcare, e-commerce and computer services

Components of ICT

Technological change is becoming a driving force in our society. Information technology is a generic term used for a group of technologies. James William (1982) has identified the following six major new technologies as most relevant in modern library and information system.

- Processor, memory and input/output channels,
- Micro. Mini and Large scale computers,
- Mass storage technologies,
- Data communication, networking and distributed processing,
- Data entry, display respond, and
- Software

These technologies can also be grouped into three major areas:

- Computer Technology,
- Communication Technology and
- Reprographic, Micrographic and Printing Technologies

A. Computer Technology

The wide spread use of computer technology has made dramatic developments in the information transmission process in very field of human life. Highly sophisticated information services ranging from elaborate abstracting and indexing services to computerized data bases in almost all scientific disciplines are in wide use all over the world. The current developments in computer technology include mini computers, microcomputers, personnel computers, portable computers, super computers, speaking computer with IQS, microchip technology, artificial intelligence, software developments, C-ROM technology, machine-readable database, etc.

B. Communication Technology

1. Audio Technology

Due to tremendous improvements and inventions, older gramophone records are now dwindling and much sophisticated cassettes and tape records are emerging. The outmoded AM (Amplitude Modulated) radio receivers are being received by the modern FM (Frequency Modulation) receivers. Thus, the new audio technology can be used in libraries and information centers for a wide variety of, recreation, etc.

2. Audio-Visual Technology

Motion pictures, Television, Videodisc are the main contributions of this technology.

Videodisc is a new medium containing prerecorded information, which allows the user to reproduce this information in the form of images on the screen of a television receiver at, will. Videodisc technology offers high quality storage, image stability and speed of recall.

3. Facsimile Transmissions (Fax)

Facsimile transmission has been boosted by the adoption of methods of data compression made possible by compact, reliable and inexpensive electronics. During the initial stages, the average speed of facsimile transmission was found to be 3.4 minutes per page. This technology was slow and it was replaced by micro facsimile. Satellite communication and fiber optics have increased the potential of facsimile transmission.

4. Electronic Mail

E-mail is the electronic transmission and receiving of messages, information, data files, letters or documents by means of point-to-point systems or computer-based messages system.

C. Reprographic, Micrographic and Printing Technologies

The technology of reprography made a big impact on the document delivery system. Most of the research libraries have reprographic machines and provide photocopy of any document on demand. Using reprographic and micrographic techniques, we can condense the bulky archives and newspapers and solve the storage problems. They also serve the purpose of preservation. They help in resource sharing and save the time of users.

1. Micro Forms

Microforms is a term for all type of micro-documents whether they are transparent or opaque or in roll or sheet form. The verities of microforms are microfilm, microfiche, ultra fiche, micro opaque, cards, computer about microfiche / micro film (COM).

2. Roll-film (microfilm)

It is a continuous strip of film with images arranged in sequence. It is available in 100 feet roll with 35mm width.

3. Microfiche

It is flat film having large number of images arranged in rows and columns. Standard sized microfiche of 4x6 inches accommodated 98 pages.

4. Printing Technology

Thousands of years ago, people recognized the necessity of keeping records of their daily activities. Paper was invented and the art of writing and record keeping came to be defined. At present, lasers and computers have entered the field of printing. Computer printers are three categories; line printers, dot matrix printer, and laser printers. Laser printers are popular today.

ICT SYSTEM

An ICT system is a set-up consisting of hardware, software, data and the people who use them. It commonly includes communications technology, such as the Internet.

ICT and computers are **not** the same thing.

Computers are the hardware that is often part of an ICT system.

ICT Systems are used in a number of environments, such as:

- offices
- shops
- factories
- aircraft
- ships

They're also used in fields such as:

- communications
- medicine
- farming

ICT Systems are everyday and ordinary, yet extraordinary in how they can add extra power to what we do and want to do.

The importance of ICT systems

By using ICT systems we are:

- more productive - we can complete a greater number of tasks in the same time at reduced cost by using computers than we could prior to their invention
- able to deal with vast amounts of information and process it quickly
- able to transmit and receive information rapidly

Types of ICT system

The three main types of ICT system to be considered for GCSE are:

Information systems

This type of ICT system is focused on managing data and information. Examples of these are a sports club membership system or a supermarket stock system.

Control systems

These ICT systems mainly control machines. They use input, process and output, but the output may be moving a robot arm to weld a car chassis rather than information.

Communications systems

The output of these ICT systems is the successful **transport of data** from one place to another.

Input, output and system diagrams

What comes out of an ICT system is largely dependant on what you put into the system to begin with.

ICT systems work by taking inputs (instructions and data), processing them and producing outputs that are stored or communicated in some way. The higher the quality and better thought-out the inputs, the more useful the outputs.

Garbage In, Garbage Out (GIGO)

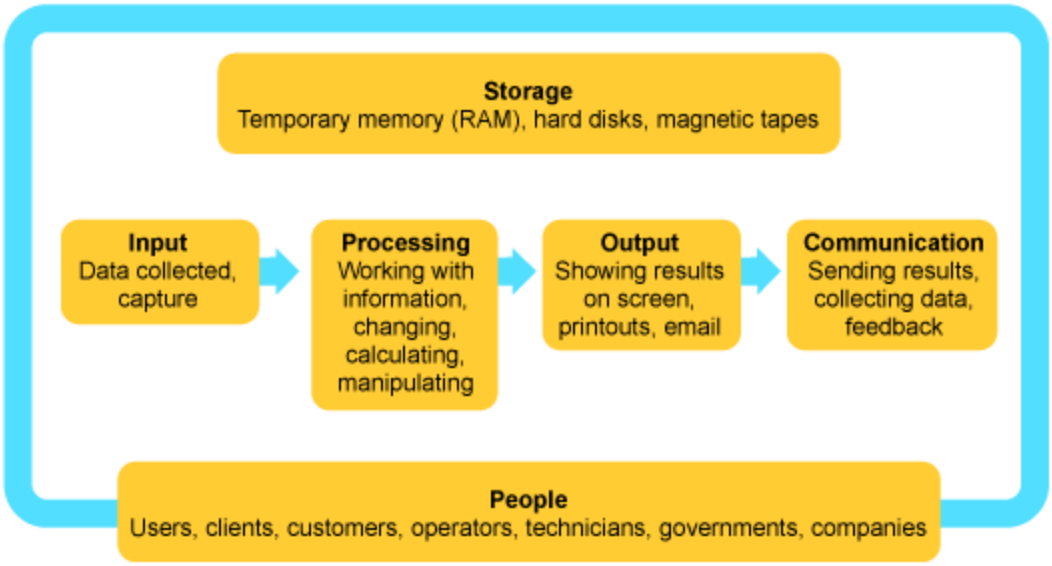
ICT systems cannot function properly if the inputs are inaccurate or faulty; they will either not be able to process the data at all, or will output data which is erroneous or useless.

GIGO is a useful term to remember in the exam - it can help explain many issues such as why validation is needed and why accurate data is valuable.

GIGO stands for Garbage In, Garbage Out

An ICT system diagram

A system is an assembly of parts that together make a whole. ICT systems are made up of some or all of the parts shown in the diagram. Various devices are used for input, processing, output, and communication.

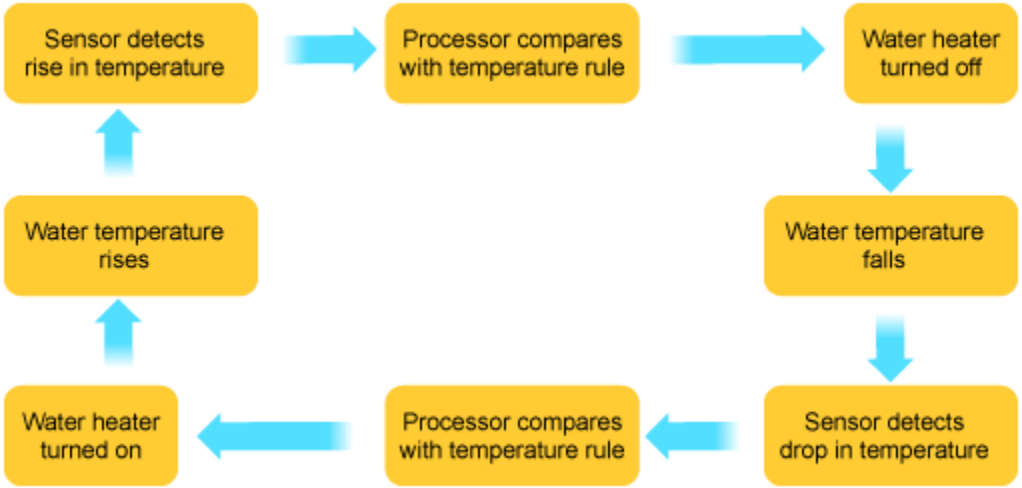


ICT systems can be made of some or all of the parts shown.

Feedback

It is sometimes good to have feedback in an ICT system. This is when the output from a system **feeds back** to influence the input and the process repeats itself.

A good example is a system set-up to control water temperature in a tropical fish tank. The temperature of the water is taken as an input from sensors. Processing takes place and the temperature of the water is compared against the pre-programmed parameters, eg maximum/minimum temperature. The outputs include the automatic decision to either turn on or off the heater to warm or let the water cool. The output, ie the change in the water's temperature, is then fed back by the sensors as an input and the process repeats itself.



A system that monitors the water temperature of a fishtank and reacts accordingly.

Feedback can occur in information-based systems as well. Often an output will have a result on further inputs. For example, the output of accepting an online booking for an air ticket will be to reduce the number of tickets available.

The Measurement and control section has more information about the feedback cycle.

INFORMATION CENTRES

Information centre is a division within the IT department that supports end-user computing. It is responsible for training users in applications and solving related personal computer problems.

An information center is designed specifically for storing, processing, and retrieving information for dissemination at regular intervals, on demand or selectively, according to express needs of users.

ROLE OF ICT IN THE MODERN ORGANIZATION

Information technology (IT) has become a vital and integral part of every business plan. From multi-national corporations who maintain mainframe systems and databases to small businesses that own a single computer, IT plays a role. The reasons for the omnipresent use of computer technology in business can best be determined by looking at how it is being used across the business world.

Communication

For many companies, email is the principal means of communication between employees, suppliers and customers. Email was one of the early drivers of the Internet, providing a simple and inexpensive means to communicate. Over the years, a number of other communications tools have also evolved, allowing staff to communicate using live chat systems, online meeting tools and video-conferencing systems. Voice over internet protocol (VOIP) telephones and smart-phones offer even more high-tech ways for employees to communicate.

Inventory Management

When it comes to managing inventory, organizations need to maintain enough stock to meet demand without investing in more than they require. Inventory management systems track the quantity of each item a company maintains, triggering an order of additional stock when the quantities fall below a pre-determined amount. These systems are best used when the inventory management system is connected to the point-of-sale (POS) system. The POS system ensures

that each time an item is sold, one of that item is removed from the inventory count, creating a closed information loop between all departments.

Data Management

The days of large file rooms, rows of filing cabinets and the mailing of documents is fading fast. Today, most companies store digital versions of documents on servers and storage devices. These documents become instantly available to everyone in the company, regardless of their geographical location. Companies are able to store and maintain a tremendous amount of historical data economically, and employees benefit from immediate access to the documents they need.

Management Information Systems

Storing data is only a benefit if that data can be used effectively. Progressive companies use that data as part of their strategic planning process as well as the tactical execution of that strategy. Management Information Systems (MIS) enable companies to track sales data, expenses and productivity levels. The information can be used to track profitability over time, maximize return on investment and identify areas of improvement. Managers can track sales on a daily basis, allowing them to immediately react to lower-than-expected numbers by boosting employee productivity or reducing the cost of an item.

Customer Relationship Management

Companies are using IT to improve the way they design and manage customer relationships. Customer Relationship Management (CRM) systems capture every interaction a company has with a customer, so that a more enriching experience is possible. If a customer calls a call center with an issue, the customer support representative will be able to see what the customer has purchased, view shipping information, call up the training manual for that item and effectively respond to the issue. The entire interaction is stored in the CRM system, ready to be recalled if the customer calls again. The customer has a better, more focused experience and the company benefits from improved productivity.

USES OF ICT IN BUSINESS MANAGEMENT

Information technology is an essential partner in management of your business, regardless of the kind of enterprise you operate. Whether you need computers for storage, transfer, retrieval or transmission of information, you can manage your business with greater accuracy and efficiency with the assistance of information technology and computer applications. The U.S. Small Business Administration suggests it’s time to get connected.

Storage

You may already use a computer for data storage for your business. Inventory, sales, receivables and payables stored in Excel, Open Office or a similar program keeps these figures at your fingertips. Accounting software stores your payroll information, tax records and specialized data for your business. Once you're acquainted with a program, you won't know how you functioned without it. You can eliminate much of the physical storage at the office by using information technology to scan and store old personnel and payroll files, tax files or client files. You may need less square footage with information technology.

Marketing

Large and small businesses are on a level playing field on the Internet. You can have a Web presence, take orders, buy merchandise, sell excess or even operate some businesses entirely online. A marketing tool that uses information technology is the Quick Response or QR Code that looks like a bar code but is square. A scan advertises your website address and includes any text you choose. You can use your business management skills to direct employees or contractors to do your Internet marketing, or you can choose to learn a new set of skills in information technology.

Information

Whether you learned business management by the book or by practical experience, you'll need updates all of your life. The Internet is a wealth of information to keep you current with trends, techniques, software and human resources. You can draw on online databases and websites to locate potential employees, compare insurance proposals, tackle employee issues or check out the competition. Managing your business with information gleaned from the Internet keeps you knowledgeable and on the cutting edge.

Communication

Communication by email is faster and costs less than sending a paper letter in the mail. You can transform your business to the 21st century with the use of email for communication with clients or customers. Information technology allows you to organize email file folders by client or by type of communication, such as orders or billing. You can drag and drop your email files to closed folders as your company completes projects. Your communication files become closed files, placed in storage on CD or on a hard drive with a duplicate copy or backup automated by a program or service.

BENEFITS OF ICT IN BUSINESS

Information technology, also known as IT, is a comprehensive term that includes all types of technology used to exchange, store, use or create information. Commonly used information technology equipment includes computers, servers, peripheral devices, Internet connectivity equipment and phone systems. From basic computer terminals to IP-based telephony systems, information technology is an integral part of most modern business operations.

Communication

Rapid communications can help increase productivity, allow for better business decision-making and ease a company's expansion into new territories or countries. Email servers, routers, internal company billboards and chat services can serve as the backbone of a company's communications. These electronically based communication systems are used to disseminate routine and critical business information in a quick and efficient manner. IT equipment can be used to send business status reports to executives, to update employees on critical business projects and to connect with business partners and customers.

Efficiency

Streamlined work flow systems, shared storage and collaborative work spaces can increase efficiency in a business and allow employees to process a greater level of work in a shorter period of time. Information technology systems can be used to automate routine tasks, to make data analysis easier and to store data in a manner that can easily be retrieved for future use. Technology can also be used to answer customer questions through email, in a real-time chat session or through a telephone routing system that connects a customer to an available customer service agent.

Competitive Advantage

Adoption of information technology resources allows companies to maintain a competitive advantage over their rivals. Companies using a first-movers strategy can use information technology to create new products, distance their products from the existing market or enhance their customer services. Companies that follow a low-cost product strategy can look to information technology solutions to reduce their costs through increased productivity and reduced need for employee overhead. Businesses can also build-in information technology to their products that makes it difficult for customers to switch platforms or products.

Economic Efficiencies

Companies can harness information technology resources to lower their costs. Using IT infrastructure, redundant tasks can be centralized at one location. For example, a large company could centralize their payroll function at one location to lower employee costs. Economic efficiencies can also be realized by migrating high-cost functions into an online environment. Companies can offer email support for customers that may have a lower cost than a live

customer support call. Cost savings could also be found through outsourcing opportunities, remote work options and lower-cost communication options.

THE POSITIVE AND NEGATIVE IMPACTS OF ICT

As it is known from time immemorial that everything in life is like the two side of a coin, there is always a positive and negative side of every phenomenon. But whether the effect is positive or negative the effects of Information Communication Technology (ICT) is far reaching and cannot be overemphasized. The Effects of ICT lens looks at how our lives have been changed, for better and for worse, by the impact of ICT. It includes both positive effects and negative effects and looks at how individuals organisations and society are affected.

POSITIVE IMPACTS OF ICT

ICT CAN HAVE POSITIVE IMPACTS ON PEOPLE

- **Access to information:** Possibly the greatest effect of ICT on individuals is the huge increase in access to information and services that has accompanied the growth of the Internet. Some of the positive aspects of this increased access are better, and often cheaper, communications, such as VoIP phone and Instant Messaging. In addition, the use of ICT to access information has brought new opportunities for leisure and entertainment, the facility to make contacts and form relationships with people around the world, and the ability to obtain goods and services from a wider range of suppliers.
- **Improved access to education**, e.g. distance learning and on-line tutorials. New ways of learning, e.g. interactive multi-media and virtual reality. New job opportunities, e.g. flexible and mobile working, virtual offices and jobs in the communications industry.
- **New tools, new opportunities:** The second big effect of ICT is that it gives access to new tools that did not previously exist. A lot of these are tied into the access to information mentioned above, but there are many examples of stand-alone ICT systems as well:

a) ICT can be used for processes that had previously been out of the reach of most individuals, e.g. photography, where digital cameras, photo-editing software and high quality printers have enabled people to produce results that would previously required a photographic studio.

b) ICT can be used to help people overcome disabilities. e.g. screen magnification or screen reading software enables partially sighted or blind people to work with ordinary text rather than Braille.

NEGATIVE IMPACTS OF ICT ON PEOPLE

- **Job loss:** One of the largest negative effects of ICT can be the loss of a person's job. This has both economic consequences, loss of income, and social consequences, loss of status and self esteem. Job losses may occur for several reasons, including: Manual operations being replaced by automation. e.g. robots replacing people on an assembly line.Job export. e.g. Data processing work being sent to other countries where operating costs are lower. Multiple workers being replaced by a smaller number who are able to do the same amount of work. e.g. A worker on a supermarket checkout can serve more customers per hour if a bar-code scanner linked to a computerized till is used to detect goods instead of the worker having to enter the item and price manually

- **Reduced personal interaction:** Being able to work from home is usually regarded as being a positive effect of using ICT, but there can be negative aspects as well. Most people need some form of social interaction in their daily lives and if they do not get the chance to meet and talk with other people they may feel isolated and unhappy.

- **Reduced physical activity:** A third negative effect of ICT is that users may adopt a more sedentary lifestyle. This can lead to health problems such as obesity, heart disease, and diabetes. Many countries have workplace regulations to prevent problems such as repetitive strain injury or eyestrain, but lack of physical exercise is rarely addressed as a specific health hazard.

ICT CAN HAVE A POSITIVE EFFECT ON ORGANIZATIONS

There are three main areas in which organisations are affected by the use of ICT, communications, information management, and security. The three areas have considerable overlap.

- **Communication**: By using ICT has brought a number of benefits to organisations, such as: Cost savings by using e.g. VoIP instead of normal telephone, email / messaging instead of post, video conferencing instead of traveling to meetings, e-commerce web sites instead of sales catalogues. Access to larger, even worldwide, markets. Web sites can be seen from all parts of the world and orders can be taken wherever there is a compatible banking system to process payments, e.g. credit / debit card, Pay-Pal, bank transfer facility. Web sites also have 24 hour opening and are available every day of the year. Flexible response. Organisations with good communications can respond to changes quickly. This may mean better customer relations, an improved supply chain for goods and services, faster development of new products to meet a new opportunity, etc.

- **Information management:** Organisations can benefit from using ICT for information management. e.g. Data mining of customer information to produce lists for targeted advertising. Improved stock control, resulting in less wastage, better cash flow,

etc.Mangers are better informed and will have more reliable and up-to-date information on which to base their decisions.

- **Security:** Although the use of ICT can bring its own security issues, see next section, it can also solve or reduce some security problems, e.g. Encryption methods can keep data safe from unauthorized people, both while it is being stored or while it is being sent electronically. This is important for reasons such as data protection legislation or commercial secrecy. ICT enables physical security systems such as fingerprint, iris or facial recognition.

NEGATIVE IMPACTS OF ICT ON ORGANIZATIONS

a) **Cost**: the cost of using ICT may cause a number of problems for organisations. A lot of ICT hardware and software is expensive, both to purchase and to maintain. An ICT system usually requires specialist staff to run it and there is also the challenge of keeping up with ever-changing technology. These extra costs should be offset by the poitive effects of using ICT, but if an organisation gets its cost-benefit analysis wrong it may lose money.

b) **Competition**: this is usually thought of as being a good thing, but for some organisations being exposed to greater competition can be a problem. If the organisation is competing for customers, donations, or other means of funding nationally or even internationally, they may lose out to other organisations that can offer the same service for less money.

c) **Security**: this is always a problem for any organisation that uses ICT. Data must be kept secure, Internet connections must be protected from attack, new viruses and other forms of malware are released nearly every day.

Organisations will usually have legal obligations to protect data such as customer information. Even if the organisation does not have to comply with a specific data protection law it will usually be in the organisation's interest to protect data from rivals.

ICT CAN HAVE POSITIVE EFFECT ON THE SOCIETY

Probably the largest effect that ICT use has on society is allowing members of society to have greatly increased access to information. This can have numerous positive effects, such as:

a) Increasing opportunities for education
b) Improving communication
c) Allowing people to participate in a wider, even worldwide, society.

The positive impact of ICT on education: On the positive side, the use of ICT in education can provide opportunities that might not otherwise exist, such as:

i. Distance learning, where students can access teaching materials from all over the world,
ii. The ability to perform 'impossible' experiments' by using simulations,
iii. The possibility for students to have individual learning programs within a topic, rather than everybody having to do the same thing at the same time at the same pace. More able students can be given more challenging work, less able students can access remedial lessons.

The negative impact of ICT on education:

I. There are large costs involved and poorer students / educational establishments establishments can end up being disadvantaged. This is often referred to as being a factor in the **digital divide**
II. Students, and sometimes teachers, can get hooked on the technology aspect, rather than the subject content. Just because a topic can be taught via ICT, does not mean that it is taught most effectively via ICT.
Even if a subject can be taught effectively via ICT, and there is the money available, it does not always follow that there is any advantage to it. There have been a lot of studies / assessments carried out, looking to see if ICT usage improves learning. The results are mixed. Much simplified, it would appear that:

1. There is some initial impact of using ICT in that students get a wider range of resources and experience some extra motivation.
2. The motivation effect soon fades as using ICT becomes the new normal
3. The wider resource range remains a positive factor
4. There are some well documented positive effects in specific. e.g. simulation and modelling is effective in improving science standards, use of word processing and communication software is effective in developing language skills, but there is concern that large areas of the curriculum are not benefiting.

The manner in which the subject is taught probably has a larger effect than the mere use of ICT. i.e. if the teacher does not adapt their methods in order to make best use of ICT, the students do not gain from that use.

The attitude of the educational establishment also seems to have a greater effect. i.e. the people running them may not have the knowledge and experience, or often the money, to enable widespread and effective use of ICT in their schools.

The attitude of society / government can have a large impact of how ICT is perceived and thus how effectively it is used. Countries where the government encourages ICT usage and where the majority of the people use ICT on a daily basis are likely to make better use of ICT in education as well as in the larger society.

On the other hand, in countries where some uses of ICT are restricted because of e.g political or religious reasons, the use of ICT in education becomes less effective and may even be seen as a threat to those in power and thus actively discouraged

NEGATIVE IMPACT OF ICT ON SOCIETY

Probably the largest effect that ICT use has on on society is allowing members of society to have greatly increased access to information. This can have numerous negative effects, such as: causing a digital divide between those who can access information and those who cannot, reducing levels of education and understanding due to the vast amount of incorrect and misleading information that is available causing moral and ethical problems due to the nature of some of the material available.

TOPIC 2

COMPUTER SYSTEMS

OVERVIEW OF COMPUTER SYSTEMS

Introduction

A computer is a device that can receive, process and store data. They are used as tools in every part of society together with the Internet. Computers nowadays are complex; there are a lot of different components inside them, and they all serve different purposes. They all need to work together for the computer to work; knowing how a computer works makes it easier to use a computer by being able to understand how a computer will respond.

A computer system is a *system* of interconnected *computers* that share a central storage *system* and various peripheral devices such as a printers, scanners, or routers. Each *computer* connected to the *system* can operate independently, but has the ability to communicate with other external devices and *computers*.

COMPUTERISATION

It's the process of taking activities or tasks not previously done on the computer and shifting them to being done on the computer.

Advantages of computerisation in an organisation

1. Response time is greatly reduced
2. Very large data are stored for information and decision-making
3. Accuracy of information is considerably improved, thereby improving the quality of the decision
4. Problems are handled more easily by using various operation research models
5. The cost involved in the decision-making process is reduced
6. More secrecy is observed as compared to manual file system

Disadvantages of computerisation

1. **Unemployment**
   Different tasks are performed automatically by using computers. It reduces the need of people and increases unemployment in society.
2. **Wastage of time and energy**
   Many people use computers without positive purpose. They play games and chat for a long period of time. It causes wastage of time and energy. Young generation is now spending a lot of time on the social media websites like Facebook, Twitter etc or texting their friends all night through smartphones which is bad for both studies and their health. And it also has adverse effects on the social life.
3. **Data Security**
   The data stored on a computer can be accessed by unauthorized persons through networks. It has created serious problems for the data security.
4. **Computer Crimes**
   People use the computer for negative activities. They hack the credit card numbers of the people and misuse them or they can steal important data from big organizations.
5. **Privacy violation**
   The computers are used to store personal data of the people. The privacy of a person can be violated if the personal and confidential records are not protected properly.
6. **Health risks**
   The improper and prolonged use of computer can results in injuries or disorders of hands, wrists, elbows, eyes, necks and back. The users can avoid health risks by using the computer in proper position. They must also take regular breaks while using the computer for longer period of time. It is recommended to take a couple of minutes break after 30 minutes of computer usage.
7. **Impact on Environment**
   The computer manufacturing processes and computer waste are polluting the environment. The wasted parts of computer can release dangerous toxic materials. Green computer is a method to reduce tire electricity consumed and environmental waste generated when using a computer. It includes recycling and regulating manufacturing processes. The used computers must be donated or disposed off properly.

EVOLUTION OF COMPUTERS

History of Computers

The first electronic computers were produced in the 1940s. Since then, many breakthroughs in electronics have occurred leading to great improvements in the capacity, processing speed and quality of computer resources.

The evolution of computerisation in business may be summarised as:

- **1870s:** Development of the typewriter allows speedier communication and less copying.

- **1920s:** Invention of the telephone enables both Wide Area Networks (WAN) and Local Area Networks (LAN) communication in real time. This marks the beginning of telecommunication.
- **1930s:** Use of scientific management is made available to analyse and rationalize data.
- **1940s**: Mathematical techniques developed in World War II (operations research) are applied to the decision making process.
- **1950s:** Introduction of copying facilitates cheap and faster document production, and the (limited) introduction of Electronic Data Processing (EDP) speeds up large scale transaction processing.
- **1960s:** Emergence of Management Information Systems (MIS) provides background within which office automation can develop.
- **1970s**: Setting up of telecommunication networks to allow for distant communication between computer systems. There is widespread use of word processors in text editing and formatting, advancement in personal computing - emergence of PCs. Use of spreadsheets.
- **1980s**: Development of office automation technologies that combine data, text, graphics and voice. Development of DSS, EIS and widespread use of personal productivity software.
- **1990s**: Advanced groupware; integrated packages, combining most of the office workclerical, operational as well as management.
- **2000s**: Wide spread use of Internet and related technology in many spheres of
- organisations including electronic commerce (e-commerce), e-learning, and e-health

Computer Generations

The classification of computers into generations is based on the fundamental technology employed. Each new generation is characterised by greater speed, larger memory capacity and smaller overall size than the previous one.

i. First Generation Computers (1946 – 1957)

- Used vacuum tubes to construct computers.
- These computers were large in size and writing programmes on them was difficult.
- The following are major drawbacks of First Generation computers.
    - The operating speed was quite slow.
    - Power consumption was very high.
    - It required large space for installation.
    - The programming capability was quite low.
    - Cumbersome to operate – switching between programmes, input and output

ii. Second Generation Computers (1958 - 1964)

- Replaced vacuum tubes with transistors
- The transistor was smaller, cheaper and dissipated less heat than a vacuum tube.

- The second generation also saw the introduction of more complex arithmetic and logic units, the use of high–level programming languages and the provision of system software with the computer.
- Transistors were smaller than electric tubes and had higher operating speed. They had no filament and required no heating. Manufacturing cost was also lower. Thus the size of the computer got reduced considerably
- It is in the second generation that the concept of Central Processing Unit (CPU), memory, programming language and input and output units were developed. The programming languages such as COBOL, FORTRAN were developed during this period.

iii. Third Generation Computers (1965 - 1971)

- Had an integrated circuit.
- Although the transistor technology was a major improvement over vacuum tubes, problems remained. The transistors were individually mounted in separate packages and interconnected on printed circuit boards by separate wires. This was a complex, time consuming and error-prone process.
- The early integrated circuits are referred to as small-scale integration (SSI).
- Computers of this generation were smaller in size, cost less, had larger memory while processing speed was much higher.

iv. Fourth Generation Computers (1972 - Present)

- Employ Large Scale Integrated (LSI) and Very Large Scale Integrated (VLSI) circuit technology to construct computers. Over 1,000 components can be placed on a single integrated-circuit chip.

v. Fifth Generation Computers

- These are computers of 1990s
- Use Very Large Scale Integrated (VLSI) circuit technology to build computers. Over 10,000 components can be incorporated on a single integrated chip.
- The speed is extremely high in fifth generation computer. Apart from this, it can perform *parallel processing*. The concept of *Artificial intelligence* has been introduced to allow the computer to make its own decision.

CLASSIFICATION OF COMPUTERS

Computers can be classified in different ways as shown below:

Classification by processing

This is based on how the computer represents and processes the data:

a) **Digital computers** are computers which process data that is represented in the form of discrete values by operating on it in steps. *Digital computers* process data represented in the form of discrete values like 0, 1, 2. They are used for both business data processing and scientific purposes since digital computation results in greater accuracy.

b) **Analog computers** are used for scientific, engineering, and process-controlled purposes. Outputs are represented in the form of graphs. *Analogue computers* process data represented by physical variables and output physical magnitudes in the form of smooth graphs.

c) **Hybrid computers** are computers that have the combined features of digital and analog computers. They offer an efficient and economical method of working out special problems in science and various areas of engineering.

Classification by purpose

This is a classification based on the use to which the computer is put.

a) ***Special purpose*** computers are used for a certain specific function e.g. medicine, engineering and manufacturing.
b) ***General-purpose*** computers can be used for a wide variety of tasks e.g. accounting and word processing

Classification by generation

This is a time-based classification coinciding with technological advances.
The computers are categorised as ***First generation*** through to ***Fifth generation.***

a) First generation. These were computers of the early 1940s. They used a circuitry of wires and were vacuum tubes. Produced a lot of heat, took a lot of space, were very slow and expensive. Examples are LEO 1 and UNIVAC 1.

b) Second generation. These were computers of the early 1950s. Made use of transistorsand thus were smaller and faster. (200KHz). Examples include the IBM system 1000.

c) Third generation. These were computers of the 1960s. They made use of IntegratedCircuits. They had speeds of up to 1MHz. Examples include the IBM system 360.

d) Fourth generation. These were computers of the 1970s and 1980s. They used LargeScale Integration (LSI) technology. They had speeds of up to 10MHz. Examples include the IBM 4000 series.

e) Fifth generation. These were computers of the 1990s. They used very Large Scale Integration (VLSI) technology and had speeds of up to 400MHz and above.

Classification by power and size/ configuration

a) Supercomputers. These are the largest and most powerful. Used to process large amounts of data very quickly. Useful for meteorological or astronomical applications. Examples include Cray and Fujitsu.

b) Mainframe computers. Large computers in terms of price, power and size. Require a carefully controlled environment and specialist staff to operate them. Used for centralised processing for large commercial organisations. Manufacturers include International Business Machine (IBM).

Minicomputer

Minicomputers are used by small businesses & firms. Minicomputers are also called as "Midrange Computers". These are small machines and can be accommodated on a disk with not as processing and data storage capabilities as super-computers & Mainframes. These computers are not designed for a single user. Individual departments of a large company or organizations use Mini-computers for specific purposes. For example, a production department can use Mini-computers for monitoring certain production process.

Microcomputer

Desktop computers, laptops, personal digital assistant (PDA), tablets & smartphones are all types of microcomputers. The micro-computers are widely used & the fastest growing computers. These computers are the cheapest among the other three types of computers. The Micro-computers are specially designed for general usage like entertainment, education and work purposes. Well known manufacturers of Micro-computer are Dell, Apple, Samsung, Sony & Toshiba.

Desktop computers, Gaming consoles, Sound & Navigation system of a car, Netbooks, Notebooks, PDA's, Tablet PC's, Smartphones, Calculators are all type of Microcomputers.

DATA/INFORMATION REPRESENTATION IN COMPUTERS

What is data?

Data can be defined as a representation of facts, concepts or instructions in a formalized manner which should be suitable for communication, interpretation, or processing by human or electronic machine.

Data is represented with the help of characters like alphabets (A-Z,a-z), digits (0-9) or special characters(+,-,/,*,<,>,= etc.).

What is Information?

Information is organised or classified data which has some meaningful values for the receiver.

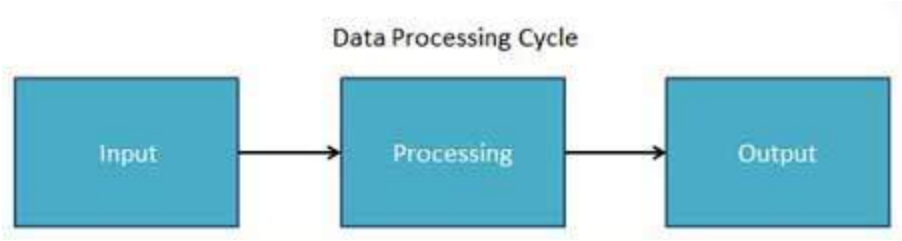
Information is the processed data on which decisions and actions are based.

For the decision to be meaningful, the processed data must qualify for the following characteristics:

- **Timely -** Information should be available when required.
- **Accuracy -** Information should be accurate.
- **Completeness -** Information should be complete.

Daa Processing Cycle

Data processing is the re-structuring or re-ordering of data by people or machine to increase their usefulness and add values for particular purpose. Data processing consists of basic steps input, processing and output. These three steps constitute the data processing cycle.



- **Input -** In this step the input data is prepared in some convenient form for processing. The form will depend on the processing machine. For example, when electronic computers are used, the input data could be recorded on any one of several types of input medium, such as magnetic disks, tapes and so on.
- **Processing -** In this step input data is changed to produce data in a more useful form. For example, pay-checks may be calculated from the time cards, or a summary of sales for the month may be calculated from the sales orders.
- **Output -** Here the result of the proceeding processing step are collected. The particular form of the output data depends on the use of the data. For example, output data may be pay-checks for employees.

Data Representation refers to the methods used internally to represent information stored in a computer. Computers store lots of different types of information:

- text
- graphics of many varieties (stills, video, animation)
- sound
- numbers

At least, these all seem different to us. However, ALL types of information stored in a computer are stored internally in the same simple format: a sequence of 0's and 1's. *How can a sequence of 0's and 1's represent things as diverse as your photograph, your favorite song, a recent movie, and your term paper?*

It all depends on how we *interpret* the information. Computers use numeric codes to represent all the information they store. These codes are similar to those you may have used as a child to encrypt secret notes: let 1 stand for A, 2 stand for B, etc. With this code, any written message can be represented numerically. The codes used by computers are a bit more sophisticated, and they are based on the binary number system (base two) instead of the more familiar (for the moment, at least!) decimal system. Computers use a variety of different codes. Some are used for numbers, others for text, and still others for sound and graphics.

Memory Structure in Computer

- Memory consists of bits (0 or 1)
  - a single bit can represent two pieces of information
- bytes (=8 bits)
  - a single byte can represent 256 = 2x2x2x2x2x2x2x2 = 2^8 pieces of information
- words (=2,4, or 8 bytes)

    - a 2 byte word can represent 256^2 pieces of information (approximately 65 thousand).
- Byte addressable - each byte has its own address.

Text

Text can be represented easily by assigning a unique numeric value for each symbol used in the text. For example, the widely used ASCII code (American Standard Code for Information Interchange) defines 128 different symbols (all the characters found on a standard keyboard, plus a few extra), and assigns to each a unique numeric code between 0 and 127. In ASCII, an "A" is 65," B" is 66, "a" is 97, "b" is 98, and so forth. When you save a file as "plain text", it is stored using ASCII. ASCII format uses 1 byte per character 1 byte gives only 256 (128 standard and 128 non-standard) possible characters The code value for any character can be converted to base 2, so any written message made up of ASCII characters can be converted to a string of 0's and 1's.

Graphics

Graphics that are displayed on a computer screen consist of pixels: the tiny "dots" of color that collectively "paint" a graphic image on a computer screen. The pixels are organized into many rows on the screen. In one common configuration, each row is 640 pixels long, and there are 480 such rows. Another configuration (and the one used on the screens in the lab) is 800 pixels per row with 600 rows, which is referred to as a "resolution of 800x600." Each pixel has two properties: its location on the screen and its color.

A graphic image can be represented by a list of pixels. Imagine all the rows of pixels on the screen laid out end to end in one long row. This gives the pixel list, and a pixel's location in the list corresponds to its position on the screen. A pixel's color is represented by a binary code, and consists of a certain number of bits. In a monochrome (black and white) image, only 1 bit is needed per pixel: 0 for black, 1 for white, for example. A 16 color image requires 4 bits per pixel. Modern display hardware allows for 24 bits per pixel, which provides an astounding array of 16.7 million possible colors for each pixel!

Compression

Files today are so information-rich that they have become very large. This is particularly true of graphics files. With so many pixels in the list, and so many bits per pixel, a graphic file can easily take up over a megabyte of storage. Files containing large software applications can require 50 megabytes or more! This causes two problems: it becomes costly to store the files (requires many floppy disks or excessive room on a hard drive), and it becomes costly to transmit these files over networks and phone lines because the transmission takes a long time. In addition to studying how various types of data are represented, you will have the opportunity today to look at a technique known as data compression. The basic idea of compression is to make a file shorter by removing redundancies (repeated patterns of bits) from it. This shortened file must of course be de-compressed - have its redundancies put back in - in order to be used.

However, it can be stored or transmitted in its shorter compressed form, saving both time and money.

Number System

When we type some letters or words, the computer translates them in numbers as computers can understand only numbers. A computer can understand positional number system where there are only a few symbols called digits and these symbols represent different values depending on the position they occupy in the number.

A value of each digit in a number can be determined using

- The digit
- The position of the digit in the number
- The base of the number system (where base is defined as the total number of digits available in the number system).

Decimal Number System

The number system that we use in our day-to-day life is the decimal number system. Decimal number system has base 10 as it uses 10 digits from 0 to 9. In decimal number system, the successive positions to the left of the decimal point represent units, tens, hundreds, thousands and so on.

Each position represents a specific power of the base (10). For example, the decimal number 1234 consists of the digit 4 in the units position, 3 in the tens position, 2 in the hundreds position, and 1 in the thousands position, and its value can be written as

(1x1000)+ (2x100)+ (3x10)+ (4xl)
($1x10^3$)+ ($2x10^2$)+ ($3x10^1$)+ ($4xl0^0$)
1000 + 200 + 30 + 41234

As a computer programmer or an IT professional, you should understand the following number systems which are frequently used in computers.

S.N.	Number System and Description
1	**Binary Number System** Base 2. Digits used : 0, 1
2	**Octal Number System** Base 8. Digits used : 0 to 7
3	**Hexa Decimal Number System** Base 16. Digits used : 0 to 9, Letters used : A- F

Binary Number System

Characteristics of binary number system are as follows:

- Uses two digits, 0 and 1.
- Also called base 2 number system
- Each position in a binary number represents a 0 power of the base (2). Example 2^0
- Last position in a binary number represents a x power of the base (2). Example 2^x where x represents the last position - 1.

Example

Binary Number : 10101_2

Calculating Decimal Equivalent:

Step	Binary Number	Decimal Number
Step 1	10101_2	$((1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	10101_2	$(16 + 0 + 4 + 0 + 1)_{10}$
Step 3	10101_2	21_{10}

Note : 10101_2 is normally written as 10101.

Octal Number System

Characteristics of octal number system are as follows:

- Uses eight digits, 0,1,2,3,4,5,6,7.
- Also called base 8 number system
- Each position in an octal number represents a 0 power of the base (8). Example 8^0
- Last position in an octal number represents a x power of the base (8). Example 8^x where x represents the last position - 1.

Example

Octal Number: 12570_8

Calculating Decimal Equivalent:

Step	Octal Number	Decimal Number
Step 1	12570_8	$((1 \times 8^4) + (2 \times 8^3) + (5 \times 8^2) + (7 \times 8^1) + (0 \times 8^0))_{10}$
Step 2	12570_8	$(4096 + 1024 + 320 + 56 + 0)_{10}$
Step 3	12570_8	5496_{10}

Note : 12570_8 is normally written as 12570.

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