UNIT 1 – INTRODUCTION TO HUMAN-COMPUTER INTERACTION

HCI was adopted in the mid-1980s to denote a new field of study. Today it is a multi-disciplinary subject with computer science. Psychology and cognitive science.

A – Historical context

1 – Early

< 1450	Persian astrologer, *Al-Kashi*, used a device to calculate the conjunction of the planets.
1600	The German mathematician, Wilhelm Schickard, developed a tool to perform simple addition and subtraction. Blaise Pascal built a simplified replica of the Schickard device. The user population of early PC users consisted mainly of enthusiasts and experts who built their own systems, so there was little incentive to design for the casual end-user or improve HCI.
1700+	Agricultural & industrial revolutions in Europe increased trade, which increased the need to produce accurate maps and navigation charts.
1820 / 1870	Charles Babbage built his Difference Engine to calculate 6th degree polynomials. This machine was never completed. Charles Babbage's Analytical Engine was programmed using punch cards, which can therefore be viewed as the first solution to a user interface problem.
1900+	People from Ireland & Scandinavia fled from famines to the USA. The USA government wanted to monitor the immigrant population. Herman Hollerith developed a computational device, using punched cards, to calculate census statistics
1911	Computer-Tabulating-Recording Company, the first computer company, was founded.
1914	Tomas J Watson joined the Computer-Tabulating-Recording Company and built it up to form the International Business Machine's Corporation (IBM). The term 'computer' was originally used in the early 20th century to describe the people who manually performed calculations.
Mid-1900	The Second World War created another set of 'narrow' applications for computing devices.
1943	Alan Turing developed the Colossus to try and break German encryption techniques. The Colossus was the first truly interactive computer. The Colossus accepted input via a keyboard and produced output via a teleprinter.
1945	Vannevar Bush published his 'As we may think' article in Atlantic Monthly, introducing his Memex system. The Memex was a device in which you could store records, retrieved rapidly through indexing, keywords… You could also construct links through material. The system was never implemented, but it conceived the idea of hypertext.
1946	ENIAC, the first truly electronic digital computer (1946), was programmed by physically manipulating plugs and relays. As with Colossus, the impetus for this work came from the military
1957	IBM introduced the FORTRAN high-level programming language.
mid 50's	Computers had displays, so it was obvious they could be used for pictures too.
1963	Ivan Sutherland developed the SketchPad system at the MIT Lincoln Laboratory, the first sophisticated drawing package. Hardware developments of that period include: graphics terminals, input devices such as data tablets, and processors capable of real-time image manipulation. Doug Engelbart and Ted Nelson took the concept of Memex and elaborated on it. Nelson focussed on links and interconnections (which he named 'hypertext'). Engelbart focussed on the hierarchic structure of documents. Engelbart published 'A conceptual framework for augmenting human intellect'.
Mid 70's Turning points in the development of the computer allowed it to become available to the man in the street	
1976	Steven Wozniak produced Apple I, based on the MOStek 6502 chip.
1981	IBM produced their first PC with DOS. Casual workers appeared for the first time.
1982	Xerox produced the *star user interface (Star VI),* in which files were represented by icons and were deleted by dragging them over a wastebasket. This marked the advent of the modern desktop. Apple Lisa
1983	Apple Macintosh

Both Apple and Microsoft got the idea of the GUI from Xerox.

2 - THE INTERNET, WWW AND SOCIAL NETWORKS

1962 - Concern on how people will communicate after nuclear holocaust
APARNET – Grew into internet

1971- 23 host machines

1980 +/- 100 computers to the internet

1990 +/- 100 000 computer

1994 Over 1 million

1999 Over 200million

Internet explorer, Netscape and mosaic encouraged active participation of new groups of users.
Major development built on Internet:
1 – E-mail
2 – Word wide web
3 – Social networks

3 – Mobile computing
Mobile computation can take place over large distances using cellular and satellite telephone links. It has made internet access an integral part of everyday life through notebook computers, personal digital assistants (PDAs) like the iPhone®, and standard cell phones.

Two types of wireless access services:
• Wi-Fi - uses radio waves to broadcast an Internet signal from a wireless router to the immediate surrounding area..
• Cellular broadband technology typically - involves a cellular modem or card to connect to cell towers for Internet access.

B – CURRENT CONTEXT AND FUTURE DIRECTION

1 – CURRENT CONTEXT

The following aspects of computer use currently affect HCI:

- Distributed systems:
- Multimedia interfaces
- Advanced operating systems
- HCI development environments
- Ubiquitous computing (UbiComp): This refers to computer systems that are embedded in everyday objects and thus, unobtrusively, become part of the environment. An example is a computerised control system found in a modern car (for example, activating the windshield wipers at the appropriate wiping speed when it detects rain).
- Mobile technology

2 – FUTUR DIRECTIONS

- The changing notion of ‘the interface’.
- Increasing dependency on technology.
- Hyper-connectivity.
- Changes in the means of and reasons for recording information
- Increased creativity through technology.

C – HCI AND RELATED CONCEPTS

1 – DENITIONS OF HCI

HCI is a ‘set of processes, dialogues, and actions through which a human user employs and interacts with a computer’ (Baecker and Buxton, 1987).

HCI is a 'discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them
HCI is the study of people, computer technology and the ways these influence each other.
'Human' = whoever is trying to do something using the technology (individuals, groups…)
'Computer' = any technology (general / embedded computers, process control systems…
'Interaction' = any communication between a user and the computer.
(Direct interaction involves dialogue with feedback & control during performance of the task).
(Indirect interaction involves background / batch processing).

HCI is concerned with the design, evaluation, and implementation of interactive computing systems for human use, and the effectiveness and efficiency of computer use. It is also concerned with studying and improving the factors that influence the effectiveness and efficiency of computer use. It involves disciplines like: psychology, cognitive science, philosophy, sociology, physiology, engineering, computer science, anthropology, ergonomics, graphic design, management, communication science and linguistics.

HCI is a multi-disciplinary field of study, incorporating: Technology, ergonomics, physiology, perception, cognition.
.
Other terms used in conjunction with HCI:

- Ergonomics
- Human factors
- Usability
- User experience
- Interaction design
- Accessibility

2 – WHO IS INVOLVED IN HCI

The ideal designer of interactive systems should have expertise in a variety of topics including:

- Psychology and cognitive science, giving insight into the user's capabilities, and perceptual, cognitive, and problem-solving skills.
- Environmental factors and ergonomics to be able to address the user's working environment, physical capabilities and comfort factors.
- Organizational factors to be able to address training, job design, productivity, and work organization.
- Health and safety factors.
- Philosophy, sociology, and anthropology to help understand the wider context of interaction.
- Linguistics.
- Computer science and engineering to be able to build the necessary technology.
- Graphics design to produce effective interface presentation.

UNIT 2 – HUMAN ISSUES IN HCI

A – COGNITIVE PSYCHOLOGY IN HCI
Human information processing consists of 3 interacting systems : perceptual, cognitive and motor system

1 – PERCEPTION
Using senses to detect information
The way that users detect information in their environment.

Factors which affect perception
* Change in output (loudness / size)
* Maximum & minimum detectable levels
* Field of perception (can the user see the display?)
* Fatigue / Circadian rhythms
* Background noise

Partial sight, ageing and congenital colour (= existing since birth) deficits produce changes in perception that reduce the visual effectiveness of certain colour combinations.

Ageing, congenital colour deficits and colour conventions influence the way we perceive colour.

Three aspects of colour influence how they are perceived:

- Colour hue: Variety, tint, or quality of a colour.
  The attribute of a colour by which it is recognised as a red, green, etc. and which is independent of intensity / lightness.
  Hue enables us to identify basic colours.

- Colour lightness
  How much light appears to be reflected from a surface in relation to nearby surfaces.
  Lightness is the most important attribute in making contrast more effective.
  People with colour deficits have difficulty discriminating colours on the basis of lightness.

- Colour saturation
  The degree of intensity of a colour.
  It is associated with a colour's perceptual difference from a white, black or grey of equal lightness.

2 – COGNITION
The way you process information.

Cognition involves:
* Short term and information processing
* Long-term memory and learning
* Problem solving
* Decision-making
* Attention
* Search & scanning
* Time perception

a. Attention
   Process of concentrating on something at a specific point in time.
   Influenced by the way information's presented as well as by people's goals

b. Memory

- STM – short term memory
  Information is retained in it automatically and retrieved without effort.
  Chunking involves grouping information into meaningful sections.
  It can also involve mnemonics & acronyms to help the user recall additional detail.
  The memory is fragile - if you get distracted, the stuff in STM disappears.
  It has a relatively low capacity, fast access, and a short retention period.
  We should design interfaces that make efficient use of short-term memory.
  Users should only be required to remember a few items of information.
  Support short-term memory by representing additional information on the display.
  An important aim for user interface design is to reduce the load on short-term memory.
  We can do this by recording information 'in the world' not 'in the head'.

- LTM - Long-term memory
  It has a high capacity, slower access, and a long retention period.
  It takes time to put stuff away in LTM, and time & effort to get it out again.
  How well we can recover knowledge from LTM is highly dependent upon how the material was interpreted in the first place.
  What is stored in LTM under one interpretation probably can't be found later when sought under some other interpretation.
  There is no practical limit to LTM.
  he difficulty with LTM is not in capacity, but in organisation (Getting material in and figuring out how to retrieve it).
  Storage and retrieval are easier when the material makes sense.
  When the material makes no sense, it has to be worked on, structured, and interpreted, until finally it can be retained.

- Knowledge in the world vs knowledge in the head

Property	**Knowledge in the world**	**Knowledge in the head**
Retrievability	Easily retrievable whenever visible or audible. (Depends on availability in the environment.)	More difficult to retrieve. Requires memory search or reminding.
Learning	Learning is not required, only interpretation.	To get information there requires learning, which can be considerable.
Efficiency of use	Tends to be slowed up by the need to find and interpret the external sources.	Can be very efficient.
Ease of use at first encounter	High	Low
Aesthetics	Can be un-aesthetic and inelegant, especially if there is a need to maintain a lot of information. Can lead to clutter. Requires a skilled designer.	Nothing needs to be visible, which gives the designer more freedom.

- Examples to illustrate role of memory in HCI

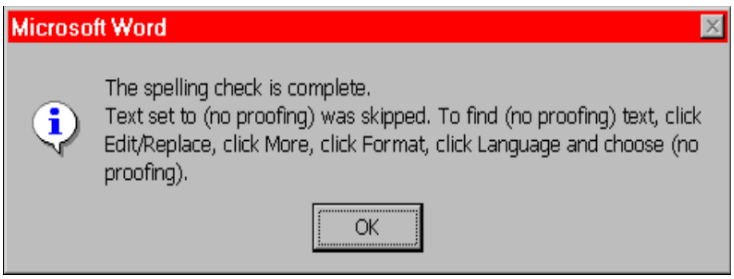

Figure 2.1 Proofing in Microsoft Word (Isys, 2000)
Figure 2.2 Mechanism to retrieve a forgotten password (Isys, 2000)

3 – PHYSIOLOGY
Study of the human anatomy

a. Physical interaction and the environment

- Visual display should always be positioned with the correct visual angle to the user.
- Keyboard and mouse use: Prolonged periods of data entry place heavy stress upon the wrist and upper arm.
- Chairs and office furniture: It's no good providing a really good user interface if your employees spend most of their time with a chiropractor

- Placement of work materials: Finally, it is important that users are able to operate their system in conjunction with other sources of information and documentation.
- Other people: You cannot rely upon system operators to prevent bad things from happening. Unexpected events in the environment can create the potential for disaster. For example, a patient-monitoring system should not rely on a touch screen if doctors or other staff that move around the patient can accidentally brush against it.

It also pays to consider the possible sources of distraction in the working environment:

- Noise: Distraction can be caused by the sounds of other workers (phone calls, sound from their computers) and office equipment (fans, printers).
- Light: Bright lighting can cause distraction in interaction with computers

There are also a number of urban myths (untruths) about the impact of computer systems on human physiology:

- Eyesight: Computer use does not damage your eyes or eyesight. It may, however, make you aware of existing defects.
- Epilepsy: Computer use does not appear to induce epileptic attacks. Television may trigger photosensitive epilepsy but the visual display units of computers do not seem to have the same effect. The effect of multimedia video systems upon this illness is still unclear.
- Radiation: The National Radiological Protection Board in the UK states that VDU's do not 'significantly' increase the risk of radiation-related illnesses.

b. Users with disabilities
Reasons for designing systems that is accessible to people with disabilities:
• Compliance with regulatory and legal requirements
• Exposure to more people
• Better design and implementation
• Cost savings:

Visual: You can enlarge portions of a display, convert displays to Braille / voice output.
Hearing: You can convert tones to visual signals.
Physical: You can use devices like speech recognition, eye-gaze control, head-mounted mice
Individual differences

4. CULTURE

Culture = behaviour typical of a group / class of people.
Culture includes race, ethnicity… and is manifested in customary behaviours, assumptions, values, patterns of thinking, and communicative style.
The growth of a worldwide market means designers must prepare for internationalisation:
* Translate your product into the target language.
* Hardware concerns: Different character sets, keyboards, and special input devices.
* Cultural concerns: Like the use of images and colour.

Two well-known approaches that designers follow when called on to create designs that span language or culture groups:
• Internationalisation - single design that is appropriate for use worldwide, among groups of nations.
• Localisation - the design of versions of a product for a specific group or community, with a unified language and culture.
Factors that need to be addressed before a software package can be internationalised or localised:

- Over factors: Tangible, straightforward, and publicly observable elements
  Includes: Dates, calendars, weekends, day turnovers, time, phone formats, character sets, collating order sequence, reading & writing direction, punctuation, translation, currency…
- Covert factors
  Intangible elements that depend on culture or special knowledge.
  Includes: Graphics, colours, functionality, sound, metaphors, mental models…
  (Be careful with metaphors and graphics - you might inadvertently offend the target culture).

5. PERSONALITY AND GENDER
6. AGE – YOUNG CHILDREN, ELDERLY

7. EXPERTISE

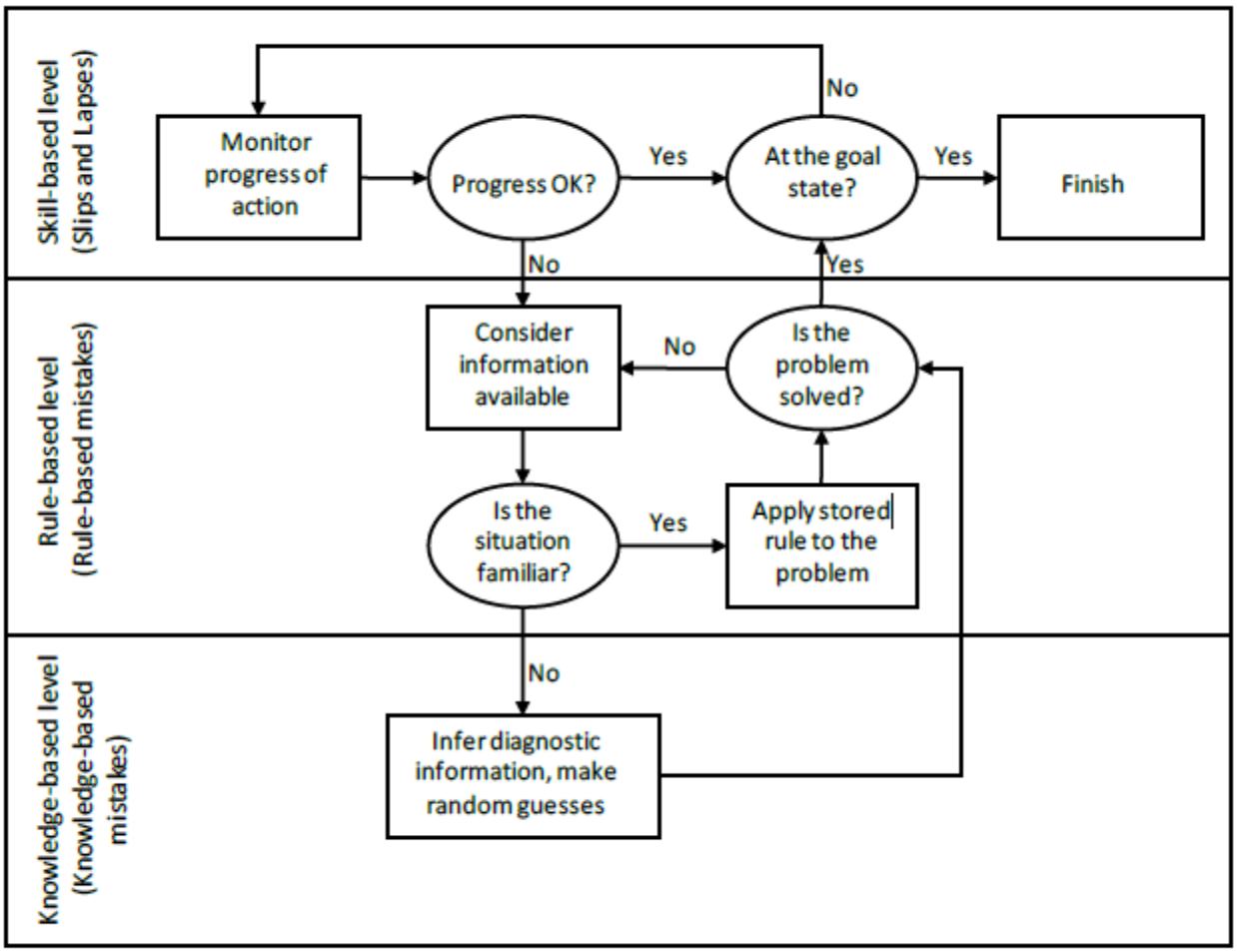

Figure 2.5 Three levels of expertise

Two forms of consistency:
• Internal consistency - similar operations being performed in a similar manner within an application.
• External consistency - similar operations being performed in a similar manner between several applications.

8. ERRORS

a. Types of errors

- Mistakes (incorrect plans) – forming wrong goal, performing wrong action with relation to a specific goal. Arise through lack of training, poor management or deliberate negligence.
  Result of conscious but erroneous considerations of options.
- Slips - observable errors and result from automatic behaviour.
  If you form an appropriate goal but mess up in the performance, you've made a slip.
  Slips are usually small things, and are relatively easy to discover by observation.
  Example of slips:
  - Capture errors: This occurs when an activity that you perform frequently is done instead of the intended activity. For example, when I take a day's leave and still drop my child at the pre-school, I drive from the school to work instead of home.
  - Description errors: This occurs when instead of the intended activity, you do something that has a lot in common with what you wanted to do. For example, instead of putting the ice-cream in the freezer you put it in the fridge.
  - Data-driven errors: These errors are triggered by some kind of sensory input. I asked the babysitter to write her telephone number in my telephone directory. Instead of her own number she copied the number of the entry just above where she wrote hers. She was looking at that entry to see whether that person's name or surname was written first.
  - Mode errors: These occur when a device has different modes of operation and the same action has a different purpose in the different modes. For example, a watch can have a time-reading mode and a stopwatch mode. If the button that switches on a light in time-reading mode is also the button that resets the stopwatch, one may try to read the stopwatch in the dark by pressing the light button and thereby accidentally clear the stopwatch.
  - Associative activation errors: These are similar to description errors but are triggered by internal thoughts or associations instead of external data. For example, our secretary's name is Lynette, but she looks a lot like someone I know called Irene. I often call her by the name Irene.

- Loss-of-activation errors: These are errors due to forgetting. For example, you find yourself sitting with the phone in your hand but you have forgotten who you wanted to call.

c. The cause of human error

Poorly defined requirements / little testing - Bugs in the product can result in failure.
Management failures - system may be well designed, but accidents can be caused by poorly trained operators.
Poor working environments - system may work well in a development environment, but not with noise, heat, vibration

d. How to prevent human error

There is no simple way to improve the operational safety of computer systems.
Improving operator training won't address fundamental problems created by lapses & slips.
Errors are latent within us, so we can never engineer out human error.
Steps that can reduce the frequency & cost of human error:
* Engineer decision support systems that give users guidance during critical operations.
* Improve working practices. (Introduce job monitoring and formal examinations).

UNIT 3 – DESIGN PROBLEMS AND SOLUTONS

1. DESIGN PROBLEMS
   a. Hampering the Natural evolution of design
      Evolutionary design - process whereby a product is gradually improved over time
      Obstacles to such natural evolution:
      i. The demands of time
      ii. Pressure to be distinctive
      iii. The curse of individuality and market differentiation

   b. Common design mistakes
      iv. **Putting Aesthetics above Usability -** An interface need not be an artwork to be aesthetically pleasing.
      v. **Thinking for the User -** Designers sometimes believe that they know what the user would want, thinking that they can put themselves in the shoes of the user.
      vi. **Cluttering the Interface -** Interfaces should provide users with enough information to allow them to perform their required task successfully.

   c. Design solutions
      1) Affordance - property of an object or interface that refers to its perceived and actual properties that tells an observer or user how the object or interface can be used
         The stronger the clues provided by the affordances the better the user will know what to do.

      2) Constraints - mechanism that restricts the allowed behaviour of a user when interacting with a computer system
         i. Physical constraints - ATM will only accept your card if you insert it into the slot the right way round.
         ii. Semantic constraints - red traffic light constrains a driver from crossing the road
         iii. Cultural constraints - use a green button to go ahead with an operation or action and a red button to indicate the opposite. This follows the cultural convention that red means 'stop' or 'danger' while green means 'go' or 'ok'
         iv. Logical constraints - rely on the logical relationships between functional and spatial aspects of the situation.
         v.

      3) Mapping
         - relationship between two things, for example, the relationship between a device's controls and their movements, and the results of the actual use of these controls.
         - good mapping is a mapping that enables users to determine the relationships between possible actions and their respective results
         - Natural mappings use physical analogy and cultural standards to support interpretation.

      4) Visibility
         - parts of a system that is essential for its use must be visible
         - visible structure of well-designed objects gives the user clues about how to operate them
         - clues take the form of affordances, constraints and mappings

      5) Feedback - information that is sent back to the user about what action has actually been performed, and what the result of that action is

      6) Guidelines, Principles and Standards - The aim with design guidelines, standards and design principles is to help designers to improve the usability of their products by giving them rules according to which they can make design decisions

         Guidelines tend to be lower in authority and more general in application
         - high-level guiding principles
         - low-level detailed rules

         Standards – high in authority and limited in application
         Principles are abstract; they establish goals for the dev. team. They therefore impose fewer constraints than design rules.

Most prominent sets of guidelines:

i. Dix, Finlay, Abowd and Beale - provide interface designers with a comprehensive set of high-level directing principles with the aim of improving the usability of interactive systems

- **Learnability** refers to the ease with which new users can begin effective interaction and then attain maximum level of performance.
- **Flexibility** the multiplicity of ways in which the user and the system exchange information
- **Robustness** to the level of support the user is given in determining successful achievement and assessment of goals Observability states that the users must be able to observe an effect on the display forany input that they enter.

ii. Preece, Rogers and Sharp
Prescriptive suggestions to help designers to explain or improve their designs

Principle	**Explanation**
Visibility	The more visible the available functions are, the better users will be able to perform their next task.
Feedback	This involves providing information (audio, tactile, verbal or visual) about what action the user has performed and what the effect of that action was.
Constraints	These restrict the actions a user can take at a specific point during the interaction. This is an effective error prevention mechanism.
Mapping	This has to do with the relationships between interface elements and their effect on the system. For example, clicking on a left-pointing arrow at the top left hand corner of the screen takes the user to the previous page and a right-pointing arrow in the right hand corner take the user to the next page.
Consistency	This is similar to consistency as defined by Dix et al. (2004).
Affordance	This refers to an attribute of an object that tells people how it should be used. In an interface it is the perceived affordance of an interface element that helps the user see what it can be used for. Whereas a real button affords pushing, an interface button affords clicking. A real door affords opening and closing, but an image of a door on an interface affords clicking in order to 'open' it.

iii. Shneiderman

Principles for user-centered design
1. Recognize diversity
2. Use the 8 Golden rules
3. Prevent errors

Recognize diversity
· Usage profiles (All design should begin with an understanding of the intended user, including profiles that reflect age, gender etc)
· Tasks profiles (The developer must identify the tasks to be done)
· Interaction styles (When all is done the designer should choose from the primary interaction styles, such as menu, selection etc)

8 Golden rules/guidelines/principles for interface design
1. Strive for consistency
2. Enable frequent uses to use shortcuts
3. Offer informative feedback
4. Design dialogues to yield closure.
5. Offer error prevention and simple error handling
6. Permit easy reversal of actions
7. Support internal locus of control
8. Reduce short-term memory load

Prevent errors
· Understand the nature of errors
· Organize screens and menus functionally to be distinctive and making it difficult for users to perform irreversible actions.
- Correct matching pairs
- Complete sequences
- Correct commands

d. Design standards

Standards concern prescribed ways of discussing, presenting or doing something. The aim is to achieve consistency across products of the same type.

Standardization in interface design offers the following benefits:

- Provides a common terminology, so that designers know that they are discussing the same concept.
- Facilitates program maintenance and allows for additional facilities to be added.
- Gives similar systems the same 'look and feel' so that elements are easily recognisable.
- Reduces training needs because knowledge can be transferred between standardized systems.
- Promotes health and safety of users who will be less likely to experience stress or surprise due to unexpected system behaviour.

UNIT 4 - INTERACTION DESIGN

1) Interface Types
   a) Advanced Graphical Interfaces
   Graphical User Interface – any interactive system that uses pictures or images to communicate information

   Direct Manipulation – Both the objects and actions are visible to the user. The actions are rapid, reversible and incremental; the actions are applied directly to the objects of concern rather than using the complex syntax of a command language interface.

   Advantages of GUI
   - Visibility
   - Cross-cultural communication
   - Impact and animation

   Weaknesses of GUI
   - Clutter
   - Ambiguity
   - Imprecision
   - Slow speed

Interface Type	Description	Advantages	Problems	Application examples
Web-based	Located on servers connected to the Internet and are accessed by users through web browsers	*It provides users with access to large volumes of information at the click of a button *It allows people to connect very easily with anybody, anywhere in the world.		google
Speech	Allows the user to talk to a system that has the capacity to interpret spoken language		*Relatively difficult to develop. *May not be adaptable to different accents, voice pitch and speech defects (e.g. lisping). *May misinterpret what the user is saying. *Voice response may appear unnatural	Commonly used in systems that provide specific information (e.g. flight times) or perform a specific transaction (e.g. buy a movie ticket)
Pen, gesture, touch screen		*users use natural gestures to interact. *Provide options for users who may have difficulty using the mouse and keyboard	*flow of interaction may be interrupted *incorrect options may accidentally be chosen and movement *handwriting may be misinterpreted	
Mobile	Designed for handheld devices such as cell phones that are intended for use on the move	Can be used on the move		cell phone
Multimodal	Different ways of interacting – including touch, sight, sound and speech – are combined so that users can experience or control information in multiple different ways	Allow more flexible interaction and can support users with disabilities or very young users	*input needs to be calibrated for accurate interpretation * complex and difficult to implement * very expensive	
Shareable	Allow more than one user to interact with the system, providing multiple (sometimes simultaneous) inputs	Provide large interactional space and supports flexible group work and sharing of information	*Separating personal and shared workspaces requires specialised hardware and software and correct positioning at the interface. *expensive to develop	

Tangible	sensor-based interaction	generally good for learning, design and collaboration	*development cost, *accurate mapping between actions and their effects, *incorrect placement of digital feedback.	used for urban planning and storytelling technologies
Augmented and mixed reality	•augmented reality interface virtual representations are superimposed on physical devices and objects •Mixed reality environment views of the real world are combined with views of a virtual environment.	enhance perception of the real-world, and can thereby support training and education	Added information could become distracting, and users may have difficulty to distinguish between real and virtual worlds. Very expensive	flight simulators).
Wearable	Involve input and output devices that are integrated with normal apparel, such as headgear or spectacles	Create a sense of realism, and provide a means of immediate feedback	*uncomfortable because of size and weight factors, *restricted by battery life.	sensor built into running shoes so that trainers or family can monitor the progress of a long distance runner during a race.
Robotic	enable users to move and steer a remote robot	can be built to go into places too small or dangerous for humans, or for manual repetitive tasks		Sony's Aibo

2) Interaction Design Techniques
   Involves
   - identify the users' needs and requirements;
   - develop alternative designs according to those requirements
   - build interactive versions (prototypes) of those designs
   - evaluate the users' experience with the product

   a) Prototypes
      i) Definition and Purpose
         - limited representation of a design that allows users to interact with it and to explore its usability
         - can take the form of a simple, paper-based storyboard of the interface screens to a computer-based, functionally reduced version of the actual system
         - Prototypes have several functions:
            - provide a way to test out different design ideas
            - act as a communication medium within the design team – the members can test their different ideas on the prototype and the team can discuss these ideas.
            - act as communication medium between designers and users or clients – using one or more prototypes designers can explain their own understanding of what the system should look like and what it should be able to do to users and clients. The users can then respond to that by explaining how the prototype does or does not address their needs.
            - help designers to choose between alternative designs.

      ii) Low-Fidelity Prototypes
         - cheap mock-up of a system
         - does not use the material that the final product will be built of and it may not even look a lot like the intended system
         - eg. Storyboards, sketching, index card, wizard of Oz

      iii) High-fidelity Prototypes
         - resemble the final system and usually use the same materials that would be used in the final product
         - requires software tools and programming skills
         - can gradually develop into the final product so the time and resources put into it can be worthwhile – this is called evolutionary prototyping.
         - time-consuming and can be expensive

b) Conceptual Design
- Involves turning the users' needs and requirements into a conceptual design
- It is not a description of the interface – it gives an idea of what users can do with a system and what concepts they need to be familiar with in order to use it
- principles to follow when doing the conceptual design, namely:
  - Keep an open mind but always think of the users and their context.
  - Discuss the design ideas with all stakeholders as often as possible.
  - Use low-fidelity prototyping to get quick feedback.
  - Continue doing the above over and over until you are sure you have the correct conceptual design.
- important factors in conceptual design are interface metaphors and the interface type

i) Interface Metaphors
- provides a structure that is similar to some aspects of a familiar entity, but that also has it own behaviours and properties.
- used to explain something that is hard to grasp by comparing it with something that is familiar and easy to grasp
- eg. Windows desktop– the computer screen is like a desktop and the folders and applications are like the things we could in real-life have on top of a desk

ii) Interface Types
- designers should preferably not be influenced by a specific, predetermined interface type
- Having a specific interface type in mind may stifle the design process and potentially good solutions may be overlooked

3) Evaluation of Interactive Systems
- Gathering data about the usability of a design or product by specified group of users for a particular activity within a specified environment.
- When evaluation is used remember:
  - The characteristics of the users
  - Types of activities
  - The environment of the study
  - The nature of the artifact being evaluated

a)

Formative Evaluation	**Summative Evaluation**
Evaluation during the design process	Evaluation at the end of the design process
To identify the difficulties that arise	To make the final judgment
Exploratory (General testing)	One or two major issues (Specific testing)

b) How to Evaluate
- can be done in laboratories or in the real-life environment where the system will be used
- Evaluation methods and the evaluation setting is closely linked.
- three main evaluation approaches:

Usability Testing	**Analytical Evaluation**	**Field Studies**
requires specialist skills in HCI.	• involves experts who use heuristics and their knowledge of typical users to predict usability problems • or walkthroughs where experts 'walk through' typical tasks.	Considerable amount of skill
typical users perform selected tasks while their actions are recorded. The evaluator analyses the data collected to judge performance, identify errors and explain user behaviour	• Researcher does not interact with the user to prevent biased results. Observes user performing a task	Asking questions via interviews and questionnaires.
Carried out in usability laboratories with sophisticated audio and video recording facilities, specialised hardware and software for recording and analysing users' behaviour when using a system Usability experiments are usually supplemented with interviews and satisfaction questionnaires.	Carried out in a laboratory	Carried out in or away from the working environment
No contact between users and tester	Users feel constrained by rules of testing	Users contact

- There are circumstances where combinations of the three techniques will be appropriate. Other evaluation techniques that can be combined with the three methods discussed above, or that can be performed as part of these methods, are

Scenario-Based Evaluation	**Query Techniques**	**Heuristic Evaluation**	**Cooperative evaluation techniques**
Simple to use	Considerable amount of skill	Considerable amount of skill	Simple to use
Users provide feedback on scenario based tasks, and provide feedback about the use of the perform critical tasks	Asking questions via interviews and questionnaires.	Design experts evaluate the user interface according to usability principles known as heuristics	Researcher and user sit together to work through tasks related to the system
Carried out in users working environment	Carried out in or away from the working environment	Carried out in or away from the working environment	Carried out in user's working environment or in a quiet room away from it
Users help	Users contact	Users have no contact	Users feel part of a design process

Process of heuristic evaluation involves three steps:
1. Briefing: experts are told what to do.
2. Evaluation: each expert spends a few hours taking at least two passes through the interface, using the heuristics to identify problems.
3. Debriefing: experts meet to discuss their evaluations, prioritize problems and suggest solutions.

Nielsen's evaluation heuristics:
1. How good is the visibility of system status?
2. Is there a clear match between the system and the real world?
3. Does the user have control when needed and are they free to explore when necessary?
4. Does the user interface display consistency and adherence to standards?
5. Does the interface help users recognise, diagnose, and recover from errors?
6. How good is the error prevention?
7. Does the interface rely on recognition rather than on recall?
8. How flexibility and efficient is it to use?
9. How good is the interface in terms of aesthetics and minimalist (clear and simple) design?
10. Is there adequate help and documentation available?

UNIT 5 SOCIAL ASPECTS OF COMPUTER USE

1. The Impact of Information Technology on Society
    a. E-commerce and business
        - Advantages:
            - Physical distance no longer puts a restriction on the way businesses are structured.
            - Network infrastructure and online availability of services and information have made sales clerks, stock brokers and travel agents redundant.
            - The fact that products such as software and music can be 'shipped' electronically has reduced the need for distribution and shipping companies
            - No physical store needs to be set up and maintained.
            - Simplification of order placement and execution.
            - Providing 24 hour customer support.
            - Staffing requirements are reduced.
            - A retail business does not need to carry the inventory of a physical store.
            - No restriction on retail hours

        - Disadvantage:
            - opportunities for fraud and theft

    b. Our working lives
        - Communication and Groupware
            - Electronic mechanisms for communication such as e-mail and Skype that allow workers to correspond cheaply and instantly over long distances
            - Web 2.0 technology is commonly used by organisations to support collaborative work
            - collaboration through computer technology - Computer Supported Cooperative Work (CSCW)
            - CSCW is concerned with the principles according to which computer technology support communication and group work
            - Groupware - physical systems through which CSCW manifests are collectively
        - Access
            - Easy access to information
            - electronic availability of company reports and policies on internal networks
            - e-mail - easier for employees at lower levels to communicate with their superiors - managers have become more accessible

        - Office Hours and Location
            - Mobile technology allows people to do their work anywhere, any time and a centralised office may not be important any longer
            - cut down on office space and it will be advantageous to employees who will have more flexible work hours
            - Being connected at all times heightens the need for skills such as prioritising, focusing and working without interruption

    c. Education
        - Eg MyUnisa
        - Vast amount of educational resources available on the Internet.
        - more low quality, unreliable information than there are trustworthy academic sources

    d. Information processing
        - process huge amounts of data in relatively short periods of time
        - possible to develop computer models of complex systems
        - human genome project provides another example of research that required this kind of computing power. Without this capacity the aim of establishing a human DNA sequence could not have been reached
        - The advantages for society of being able to model complex systems include (Muglia, 2010):
            - ✓ Improved the understanding of pandemics, contagion and global health trends.

- ✓ Better prediction of the impact of climate change on the environment, the economy and on humans in general.
- ✓ Better prediction of natural disasters and their impact so that effective response plans can be set up.

- Eg. Google earth

e. Problems associated with advanced computer technology

i. Privacy and Security Issues

- Digital info is freely accessed
- spam – unsolicited mass mail that is sent to millions of users daily
- increasing value of the information being stored and transferred across the world's computer networks is also increasing the importance of security
  - ✓ malware - Software that is developed for the sole purpose of doing harm or gaining unlawful access to information
  - ✓ Trojan horses: malicious piece of code is hidden inside a program that appears to offer other facilities
  - ✓ Time bombs: piece of hidden program code designed to run at some time in the future, causing damage to, or loss of, the computer system - left as a means of retaliating when an employee is dismissed
  - ✓ Worms: self-replicating programs - does not need a host to cause harm

ii. Information Overload

- New information leads to new invention, and consequently, contributes to the evolution of humankind
- spending large amounts of time searching through and taking in irrelevant or useless information just because it is there
- access to harmful information

iii. Dependence on Technology

- Modern society is almost entirely supported by information technology
- breakdown of technological infrastructure will lead to serious disruption of economic and social systems

2. Social Networking Technologies
   a. Chat Rooms - locations on the Internet where people meet to have online conversations in real time
   b. Instant messaging (IM) - real-time communication tool that allows two or more users who are connected to the system to interact with each other synchronously
   c. Blogs - online journals. Individuals use them as diaries or to comment on specific topics
   d. Social Networking Sites - web communities or online communities
      - advantages of social networking sites:
        - ❖ Low cost of creating a web presence.
        - ❖ Making personal connections – for example, by searching for people who share your interests or becoming friends with 'friends of friends'. You can also reconnect with long lost friends. For many people social network sites are their primary mechanism to find a date.
        - ❖ Making connections for career purposes – it is quite easy to identify people who work in your field by searching through their profiles.
        - ❖ For businesses it has the advantage that they can get additional information on someone before employing them. It is a way to find out if people have lied in their applications or CVs
      - Disadvantages
        - ❖ Lack of anonymity or privacy.
        - ❖ Identity theft – some people place enough information on these sites to allow others to get all the necessary information to assume that identity.
        - ❖ It wastes time, to such an extent that some companies block access to these sites during working hours.
        - ❖ Mining of users' data for advertising purposes.
        - ❖ Cyberbullying – it is much easier to harass someone through an online network than it is in the real world.
        - ❖ Cyberstalking.

- ❖ Inappropriate content such as political propaganda. Countries such as Syria, China, Iran, and Vietnam have banned the use of Facebook

3. The Digital Divide
    - unequal access to technology that separates people into those who have it and those who do not
    - contributing factors are financial constraints, lack of skills, unavailability of basic infrastructure (e.g. electricity) and carelessly designed systems
    - Lack of adequate cognitive resources is an important contributor to the digital divide
    - The digital divide is not only a reflection of the separation between developed and developing economies. It can also exist among population groups within the same nation.

Unit 1 Structured Questions

1. Define HCI.
2. Name and describe six HCI related concepts.
3. What do you understand by the statement 'HCI is a multidisciplinary and interdisciplinary subject'
4. Describe the aspects of computer use currently affecting HCI.
5. State the identified major transformations in computing that will affect the field of HCI.
6. List the expertise that should be involved in designing interactive systems.

Unit 2 Structured Questions

1. State and describe three interacting systems in human information processing.
2. Define short term memory and long term memory. State how they may influence interface design.
3. State five physical attributes on human beings that may have an influence on the use of computer systems.
4. Describe how culture, personality, gender and age make computer users differ.
5. List the kinds of errors humans make and describe why the make each.

Unit 3 Structured Questions

1. What is evolutionary design?
2. State common design mistakes.
3. Describe five design concepts used as mechanisms of reducing design problems.
4. Give the difference between low-level detailed rules and high-level directing principles in design guidelines.
5. State principles that affect learnability, flexibility and robustness.
6. Describe two types of design goals in interaction design.

Unit 4 Structured Questions

1. Describe the 11 different interface types that current computer systems can have.
2. Give examples of specific interaction design techniques.
3. What is a prototype? Give examples of prototypes
4. State the methods used in evaluation of interactive systems.
5. Outline the main characteristics of the major evaluation techniques, including their advantages and disadvantages
6. Outline the key differences between different approaches to evaluation.

Unit 5 Structured Questions

1. State the impact of technology on E-commerce, Our working life, Education, Information processing and Privacy and Security.
2. Identify the problems for society that are associated with advanced computer technology.
3. What are social networking websites? Give examples and mentioned their advantages and disadvantages.
4. Define 'digital divide'.
5. Describe the causes of digital divide and suggest how it can be addressed.

Unit 1. Multiple choice questions

1. Who was the first person to develop a calculating device
a. Wilhelm Shickard
b. Al-Kashi
c. Blaise Pascal

2. Blaise Pascal built a machine
a. That does multiplication and division
b. That does addition and subtraction
c. That calculates the conjunction of the planets

3. What name was given to the first computer developed by Charles Babbage?
a. Analytical Engine
b. Difference Engine
c. Punched card

4. Which company was the first and biggest computer company?
a. Microsoft Company
b. Hewlett Packard (HP) company
c. Computer-Tabulating-Recording company

5. Eniac machine was the first
a. Machine to punch cards
b. All-electronic digital computer
c. Indexing machne

6. IMB developed the first programming language called
a. FORTRAN
b. High level language
c. Pascal

7. Doug Engelbart and Ted Nelson both took the concept of the Memex system and elaborated on it in different ways. Ted Nelson elaborated on
a. Links and interconnections
b. Hierarchic structure of documents
c. Augmenting human intellect

8. Apple 1 was_____'s first personal computer
a. Bill gates
b. Ted Nelson
c. Steven Wozniak

9. ARPANET developed by Rand Corporation in 1962 was meant to
a. Promote communication after nuclear holocaust
b. Promote development of intenet
c. Promote supply of military weapons

10. Computer systems that become part of the environment and are embedded in everyday objects are called
a. Advanced operating systems
b. Ubiquitous computing
c. Distributed systems

11. Young generations are increasingly developing dependency on technology. This is negatively affecting their
a. Mental calculating skills
b. Understanding skills
c. Reading skills

12. Preece et al. (2007) defined it as " designing interactive products to support the way people communicate and interact in their everyday and working lives"
a. Usability
b. User experience
c. Interaction design

13. Which of the following statement about early history of computing are TRUE?
    1 The early history of computing can be traced back to the narrow arms of Mathematicians, astronomers and logicians who had calculations to be performed
    2 Punched cards became the first solution to a user interface problem
    3 Colossus (1943) was regarded as the first truly interactive computer
    4 The term 'computer' was used to describe people who manually performed calculations

Options

a. 1 and 2 only
b. 1,2 and 3 only
c. 1,3 and 4 only
d. 1,2 and 4 only
e. 1,2,3 and 4

14. Usability principle that refers to the resources expended in relation to the accuracy and completeness of goals achieved is called_____.
    a. Effectiveness
    b. Efficiency
    c. Satisfaction
    d. Perception
    e. Cognition

15. Which of the following statement(s) involving HCI is not TRUE?
    1 The ideal designer of interactive systems should have expertise in a veriety of topics
    2 HCI emerged in the early 1970s as a specialty area in Computer Science
    3 HCI is concerned with studying and improving the main factors that influence the effectiveness and efficiency of computer use.

    Options

    a. 1 only
    b. 2 only
    c. 3 only
    d. 1 and 2 only
    e. 2 and 3 only

Unit 2. Multiple choice questions

1. _____have to make sure that people can see or hear displays if they are to use them.
    a. Programmers
    b. Designers
    c. Developers

2. A variety of processes taking place in our heads is affecting our _____
    a. Cognition
    b. Psychology
    c. Perception

3. Attentioned is influenced by the way information is _____as well as by people's goals
    a. Perceived
    b. Received
    c. Presented

4. interface designing reduces load on STM by using
    a. prompts on display
    b. small lines on display
    c. different colours on display

5. 'Forgot my password' button that prompts with a question is an example of
    a. Knowledge in the head
    b. Knowledge in the world
    c. Knowledge in the short memory

6. The degree to which an interactive product is usable by people with disability was defined by Preece et al. in 2007 as
    a. Usability
    b. Accessibility
    c. Visibility

7. physically impaired users who can move their heads only require _____ to translate control onscreen cursor movements
   a. touch screen
   b. gravity fields
   c. eye tracking devices

8. Symbols, colours, functionality and sound are examples of _____factors that need to be addressed before a software packadge can be internationalised or localised
   a. Localisation
   b. Overt
   c. Covert

9. Adults' main reasons for using computers are to improve productivity and to communicate and children were found to use computers for_____
   a. Communicating
   b. Enjoyment
   c. Learning

10. When designing computer systems for expert users, designers should provide
   a. Higher level of support
   b. Consistency with previous interfaces
   c. For errors that occur during interaction

11. An error resulting from correct goal and incorrect action is called
   a. Mistake
   b. Slip
   c. Incorrect plan

12. A _____error occurs when you do something that has a lot in common with what you wanted to do, instead of the intended activity.
   a. Description
   b. Capture
   c. Mode

Unit 3 Multiple choice questions

1. Computer keyboard is arranged in the QUERTY order. Initially the type writer keyboard was in alphabetical order but later changed to QUERTY because
   a. Users were being slowed by alphabetical order
   b. Users were making a lot of mistakes
   c. The parts of type writer keyboard were jamming when typing fast

2. Scissors has one big hole and one smaller one. This is an example of _____ in designing.
   a. Constraint
   b. Mapping
   c. Affordance

3. A red traffic light preventing a driver from proceeding is _____ in the design solutions
   a. Constraint
   b. Mapping
   c. Affordance

4. _____ help designers to improve the usability of their products by giving rules according to which they can make design decisions
   a. Guidelines
   b. Affordance
   c. Feedback

5. Feedback is an example of _____in designing
   a. Constraint
   b. Principle
   c. Design solutions (concepts)

6. Rules that are detailed and application specific which may not need interpretation are referred to as
   a. High-level principles
   b. Low-level rules
   c. standards

7. the relationship between device's controls and their movements is called_____
   a. visibility
   b. constraint
   c. mapping

8. What is learnability?
   a. The many ways in which interaction between users and the system can take place
   b. The ease with which users can enter a new system and reach a maximal level of performance
   c. Relationship between two things

9. Which one is not Preece et al usability goal
   a. Responsiveness
   b. Utility
   c. Safety

10. One way of reducing loss in productivity due to errors is
   a. Avoiding the errors
   b. Train users so that they do not make errors
   c. Improve the error messages provided by the computer system.

11. Principles that affect flexibility are……
   1. Predictability
   2. Substitutivity
   3. Task conformance
   4. Dialogue initiative

Options
   a. 1 and 2 only
   b. 1 and 3 only
   c. 1 and 4 only
   d. 2 and 3 only
   e. 2 and 4 only

12. Techniques that reduce errors by ensuring complete and correct actions……
   1. Correct mappings
   2. Complete sequences
   3. Correct matching pairs
   4. Correct commands

Options
   a. 1, 2 and 3 only
   b. 1, 2 and 4 only
   c. 2, 3 and 4 only
   d. 1, 3 and 4 only
   e. 1, 2, 3 and 4

13. You designed the user interface of a student record system. You choose a green colour for the button to close a record. In choosing green to close down, you are violating a ……
   a. Physical constraint
   b. Semantic constraint
   c. Cultural constraint
   d. Logical constraint
   e. Forcing function

Unit 4 Multiple choice questions

1. The term graphical User Interface (GUI) refers to
   a. Pictures and tables in the computer
   b. Interactive system that uses pictures to communicate
   c. System that draws and uses pictures

2. _____ is an example of Graphical User Interface weakness
   a. Visibility
   b. Interactivity
   c. Ambiguity

3. Web-based interfaces are located on
   a. Websites
   b. Web browsers
   c. Servers

4. An interface that is used in systems that provide specific information is _____
   a. Web-based interface
   b. Speech interface
   c. Mobile Interface

5. Shareable interface _____
   a. Allows more than one user to interact with the system
   b. Uses different ways of interacting
   c. Encompasses broad range of systems and interfaces

6. Aibo dog can perform playful behaviour through the use of
   a. Wearable interface
   b. Mixed reality interface
   c. Robotic interface

7. A _____ take the form of a simple, paper-based storyboard of the interface screen and represent a design
   a. Mixed interface
   b. Initial design
   c. Prototype

8. According to Williges and Williges (1984)_____ reduces code generation and modification effort
   a. Identifying user requirements early
   b. Evaluating user requirements
   c. Developing alternative designs

9. Which of the following is not a low-fidelity prototype
   a. Storyboard
   b. Wizard of Oz
   c. Visual basic

10. A(n) _____ is an important component of a conceptual model that provides structure that is similar to some aspects of a familiar entity
   a. Model design
   b. Interface metaphor
   c. Story book weaver

11. Any design should be _____ and all systems tested to ensure that they meet the user's requirements
   a. Evaluated
   b. Assessed
   c. Analysed

12. _____ evaluation is done at the end of the design cycle and tests the end product
   a. Summative
   b. Technical
   c. Formative

13. Which of the following is not an evaluation method or approach
   a. Interviews
   b. Usibility testing
   c. Analytical evaluation.

14. The disadvantage of multimodal interfaces are……

1. Inputs needs to be calibrated for accurate interpretation
2. They are complex and difficult to implement
3. Voice responses may appear unnatural
4. They are very expensive

Options

a. 1, 2 and 4 only
b. 1, 3 and 4 only
c. 2, 3 and 4 only
d. 1, 2 and 3 only
e. 1, 2, 3 and 4

15. Which statements are correct about cooperative evaluation techniques?

1. They are useful during the formative stages of design
2. They are a good means of eliciting user feedback on partial implementation
3. They provide quantitative feedback
4. They are effective if designers are unaware of the political and other pressures that might bias a user's response.

Options

a. 1 and 2 only
b. 2 and 3 only
c. 3 and 4 only
d. 1, 2 and 3 only
e. 2, 3 and 4 only

Unit 5 Multiple choice questions

1. E-commerce has improved the wanted and the unwanted things in business. Some of the unwanted include fraud and _____

a. Customers
b. Theft
c. Transactions

2. The utilisation of Web 2.0 within a secure environment developed_____

a. Enterprise 2.0
b. Web 2.0
c. World Wide Web

3. _____ is concerned with the principles according to which computer technology support communication and group work.

a. WWW
b. Web 2.0
c. CSCW

4. _____ arises when one users frustrates another user by getting in their way.

a. Interference
b. Contention
c. Synchronous

5. Unsolicited mass mail that is sent to many people daily.

a. Spam
b. Virus
c. Email

6. Self-replicating programs that do not need a host to cause harm.

a. Virus
b. Worm
c. Time bomb

7. Which of the following is not a malware?

a. Trojan horse
b. Worm
c. Avira

8. _____ are locations on the internet where people meet to have conversations.
   a. Teleconference
   b. Chat rooms
   c. Discussion forum

9. _____ refers to unequal access to technology that separates people.
   a. Internet
   b. Digital divide
   c. Myspace

10. Which of the following is a social network site?
   a. Myspace
   b. Myunisa
   c. Mydocument

11. Which of the following are problems associated with the information age?
   1. Information overload
   2. Dependence on technology
   3. Threats to privacy of personal information
   4. Greater interconnection of computers provides more opportunities for malicious users

Option
   a. 1,2 and 4 only
   b. 1,2 and 3 only
   c. 2,3 and 4 only
   d. 1,2,3 and 4
   e. 1 and 2 only

12. An online business reduces costs compared to a physical business because of:
   1. Simplification of order placement and execution
   2. 24 hour customer support
   3. Reduced staffing requirements
   4. Unrestricted retailing hours

Options
   a. 1,2 and 3 only
   b. 2,3 and 4 only
   c. 1,2 and 4 only
   d. 1 and 2 only
   e. 1,2,3 and 4