

PAPER – 6 : INFORMATION TECHNOLOGY

Question No. 1 is compulsory.

Answer any four questions from remaining six questions

Question 1

- (a) Convert the following from one number system to another number system along with the working notes:

- (i) $(101.011)_2 = (\dots\dots\dots)_{10}$
- (ii) $(173.45)_{10} = (\dots\dots\dots)_8$
- (iii) $(3314.4)_{10} = (\dots\dots\dots)_{16}$
- (iv) $(4B23.3)_{16} = (\dots\dots\dots)_{10}$
- (v) $(0234.14)_8 = (\dots\dots\dots)_{10}$ (1×5 =5 Marks)

- (b) Give brief answer of the following:

- (i) What is the concept of Firmware?
- (ii) Give one application area where Hierarchical database structure is most successful.
- (iii) In communication protocol, what does Semantics stand for?
- (iv) Why L1 cache memory is better than L2 cache memory?
- (v) Give at least one condition where IT Act, 2000 shall not be applicable. (1×5=5 Marks)

- (c) Give one or more reasons of use for each of the following:

- (i) Driver
- (ii) Firewall
- (iii) Router
- (iv) Spooling Software
- (v) DDL (1×5=5 Marks)

- (d) Write True or False for each of the following with justification:

- (i) Thermal printer is an impact printer.
- (ii) DML is used for processing of data in database.
- (iii) Browser is a client hardware device used to look at various kinds of Internet resources.
- (iv) Smart terminals are non-user programmable.
- (v) Multiprocessing refers to the use of two or more CPUs to perform work.

(1×5=5 Marks)

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Answer

$$\begin{aligned}
 \text{(a) (i) } (101.011)_2 &= (\dots\dots\dots)_{10} \\
 (101.011)_2 &= 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3} \\
 &= 1 \times 4 + 0 \times 2 + 1 \times 1 + 0 \times 0.5 + 1 \times 0.25 + 1 \times 0.125 \\
 &= 4 + 0 + 1 + 0 + 0.25 + 0.125 \\
 &= (5.375)_{10} \\
 \text{(ii) } (173.45)_{10} &= (\dots\dots\dots)_8
 \end{aligned}$$

For the Integral Part

8	173	Remainder
8	21	5
8	2	5
	0	2

$$= (255)_8$$

Now, for the Fractional Part

$$0.45 \times 8 = \underline{3.60}$$

$$0.60 \times 8 = \underline{4.80}$$

$$0.80 \times 8 = \underline{6.40}$$

$$0.40 \times 8 = \underline{3.20}$$

$$0.20 \times 8 = \underline{1.60}$$

$$= (.34631)_8$$

So, the complete octal form of $(173.45)_{10}$ is as follows:

$$(173.45)_{10} = (255.34631)_8$$

$$\text{(iii) } (3314.4)_{10} = (\dots\dots\dots)_{16}$$

For the Integral Part

16	3314	Remainder
16	207	2
16	12	15 = F
	0	12 = C

$$= (CF2)_{16}$$

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Now, for the Fractional Part

$$\begin{aligned}0.4 \times 16 &= \underline{6}.4 \\0.4 \times 16 &= \underline{6}.4 \\0.4 \times 16 &= \underline{6}.4 \\0.4 \times 16 &= \underline{6}.4 \\&= (.6666)_{16}\end{aligned}$$

So, the complete hexadecimal form of $(3314.4)_{10}$ is as follows:

$$(3314.4)_{10} = (CF2.6666)_{16}$$

$$\begin{aligned}\text{(iv) } (4B23.3)_{16} &= (\dots\dots\dots)_{10} \\&= 4 \times 16^3 + 11 \times 16^2 + 2 \times 16^1 + 3 \times 16^0 + 3 \times 16^{-1} \\&= 4 \times 4096 + 11 \times 256 + 2 \times 16 + 3 \times 1 + 3 \times 0.0625 \\&= 16384 + 2816 + 32 + 3 + 0.1875 \\&= (19235.1875)_{10}\end{aligned}$$

$$\begin{aligned}\text{(v) } (0234.14)_8 &= (\dots\dots\dots)_{10} \\&= 0 \times 8^3 + 2 \times 8^2 + 3 \times 8^1 + 4 \times 8^0 + 1 \times 8^{-1} + 4 \times 8^{-2} \\&= 0 \times 512 + 2 \times 64 + 3 \times 8 + 4 \times 1 + 1 \times 0.125 + 4 \times 0.015625 \\&= 0 + 128 + 24 + 4 + 0.125 + 0.0625 \\&= (156.1875)_{10}\end{aligned}$$

- (b) (i) Concept of Firmware: Firmware or micro-programs refer to a series of special program instructions. These programs deal with very low-level machine operations and thus essentially substitute for additional hardware. They are held in the CPU in a special control storage device.
- (ii) Hierarchical database structure: It usually processes structured, day-to-day operational data rapidly. Records are usually organized to maximize the speed with which large batch operations are processed. Thus, they are most suitable for payroll or sales invoices processing application.
- (iii) Semantics: In communication protocol, semantics refers to the type and order of messages used to ensure reliable and error free information transfer.
- (iv) Cache memory: L1 cache memory runs at processor's clock speed and therefore is very fast whereas L2 cache resides on the motherboard and delivers slower performance. Hence, L1 cache memory is better than L2 cache memory.
- (v) IT Act, 2000: IT Act, 2000 shall not apply to the following:
- a negotiable instrument as defined in section 13 of the Negotiable Instruments Act, 1881;
 - a power-of-attorney as defined in section 1A of the Powers-of-Attorney Act, 1882;

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- a trust as defined in section 3 of Indian Trusts Act, 1882;
 - a will as defined in Section(h) of section 2 of the Indian Succession Act, 1925 including any other testamentary disposition by whatever name called;
 - any contract for the sale or conveyance of immovable property or any interest in such property;
 - any such class of documents or transactions as may be notified by the Central Government in the Official Gazette.
- (c) (i) Driver: It is also known as software driver or device driver. It is a small program that translates the program's generic instructions into instructions for a specific piece of hardware. When a new hardware is introduced, the programmer of the operating system just writes a driver for it. Operating system has a library of device drivers, one for each specific hardware item.
- (ii) Firewall: A firewall is a hardware/software system that controls the flow of traffic between the Internet and the organization's internal Local Area Networks and systems. It is set up to enforce the specific desired security policies. It is an effective means of protecting the organization's internal resources from unwanted intrusion.
- (iii) Router: A router is a hardware device used to direct messages across a network. It supplies the user with the network management utilities. It also helps to administer the data flow by such means as redirecting data traffic to various peripheral devices or other computers by selecting appropriate routes in the event of possible network malfunctions or excessive use.
- (iv) Spooling Software: Spooling software is used to compensate the speed differences between the computer and its peripheral devices. These programs take the results of computer program and move them from primary memory to disk. The area on the disk where the program results are sent is called the output spooling area. Thus, the output device can be left to interact primarily with the disk unit, not the CPU. It can also be used on the input side.
- (v) DDL: Data Definition Language (DDL) is used to define the physical characteristics of each record - the fields within the record, each field's data type, each field's length and its logical name. It is also used to specify relationships among the records. It is essentially a link between the logical and physical structures of the database.
- (d) (i) False, as there is no striking device in the thermal printer.
- (ii) True, it provides the techniques for processing the database, such as retrieval, sorting, display, and deletion of data or record.
- (iii) False, it is a client software package instead of client hardware device.
- (iv) True, they contain a microprocessor and some internal storage to perform given task but are non-programmable by users.
- (v) True, multiprocessing involves the use of two or more central processing units, linked together, to perform coordinated work simultaneously.

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Question 2

Distinguish between the following:

- (i) Hardware and Software
- (ii) Data bus and Address bus
- (iii) Circuit switching and Packet switching
- (iv) Compiler and Interpreter
- (v) Social portal and Transaction portal

(4 x 5= 20 Marks)

Answer

- (i) Hardware and Software: The distinguished features are given below:

S.No.	Hardware	Software
1.	Physical components of a computer system are called hardware.	Collection of programs designed for a specific need is called software.
2.	Input devices, processing unit, output devices and auxiliary storage devices are different categories of hardware.	Software can be divided into three types - application software, system software and general-purpose software.
3.	Keyboard, mouse, printer, CPU, RAM etc. are examples of hardware.	Financial accounting software, operating system, MS-Word etc. are examples of software.
4.	Hardware is manufactured/assembled by hardware manufacturing companies/ hardware vendors.	Software is developed by software development firms.
5.	Hardware is independent of software.	Software cannot be developed/used without hardware i.e. software is dependent on hardware.
6.	Hardware repair requires hardware engineer.	Software development/modification requires software professionals like application programmer and system programmer.
7.	It is bulky and requires more storage space.	Software can be copied on CD/DVD, which is light-weight and transportable.
8.	Hardware is supported by uninterrupted power supply (UPS).	Software operation requires requisite hardware.
9.	Hardware can be assembled, Indian branded or of MNC brand.	Software can be licensed or pirated.

- (ii) Data bus and Address bus

Data Bus: The Data Bus is an electrical path or a group of parallel wires that connects the CPU, memory and other hardware devices on the motherboard for the purpose of transmission of data. The number of wires in the bus affects the speed at which data can travel between hardware components. On the data bus, each wire can transfer one bit at a time. An eight-wire bus can transfer eight bits simultaneously. Presently, 64-bit data bus is being used for transfer of data from 64-bit CPU.

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Address Bus: The Address Bus is a set of wires that connects the CPU and RAM and carries the memory addresses of the memory locations from where data can be retrieved or stored. Number of wires in the address bus determines the maximum number of memory locations the CPU can address. For example, with an 8-bit address bus, CPU can address 256 memory locations. Today CPUs have 32-bit address bus that can address 2^{32} , i.e. 4×10^9 or 4 GB of RAM.

(iii) Circuit switching and Packet switching: The distinguished features are given below:

S.No.	Circuit switching	Packet switching
1.	It is a transmission technique in which a dedicated communication channel is set up between the sender and the receiver.	It refers to a transmission technique in which a sender can send a message without establishing a connection with the recipient.
2.	The resources remain dedicated to the circuit during the entire transfer even if there is no data transmission.	Message is broken down into transmission units called packets which are routed individually through the network depending upon the availability of a channel for each packet.
3.	Entire message follows the same path.	Each packet may follow different route.
4.	For small volume of data, bandwidth remains under-utilized, hence there is wastage of resources.	It is a sophisticated means of maximizing the transmission capacity of the channel/network.
5.	A single circuit is used for the duration of the call.	Sophisticated error and flow control procedures are applied on each link by the network.
6.	Example is telephone communication.	Example is VoIP communication.

(iv) Compiler and Interpreter: The distinguished features are stated below:

S.No.	Compiler	Interpreter
1.	A compiler translates the entire program into machine language before the program is executed.	An interpreter translates the program a line at a time as it is being run. Each statement is translated into machine language just before it is executed.
2.	Programs can be executed more swiftly since they are translated before execution.	Program execution is slow as translation is done while executing.
3.	Machine language programs can be saved on disk for future use.	Machine language programs are produced while executing, hence they cannot be saved.
4.	It is hard to debug programs since the error messages are received only after complete compilation and it is difficult to locate errors from those messages.	Debugging programs is easier as interpreter stops on the line in which error is encountered. It can exactly show the statement which triggered the error.

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5.	It goes through compile, link-edit and execution stages which are time-consuming.	Direct machine code is produced. Hence, they are usually easier and faster to use.
6.	A compiler for a 3GL requires more storage space in primary memory.	An interpreter for a 3GL does not require much storage space in primary memory.
7.	Compilers are basically utilized by mainframes.	Interpreters are usually used by personal or small business computers.
8.	A compiler forms a part of the system software which is stored on backing storage.	An interpreter is stored on a ROM chip; hence it is more firmware than software.

(v) Social portal and Transaction portal

Social portal: Social portals are customer-to-business e-commerce applications which enable consumers to find online information about existing and new products and services. This also includes applications that enable consumers to communicate with each other through electronic mail, video conferencing, and newsgroups etc. to get more details and user experiences with products and services.

Transaction portal: Transaction portals include customer-to-business e-commerce applications that enable and facilitate the completion of transactions between buyers and sellers. In electronically facilitated consumer-to-business transactions, customers learn about products through electronic publishing, buy products with electronic cash and other secure payment systems, and even have information goods delivered over the network.

Question 3

- (a) Discuss the managerial problems of File processing system. (5 Marks)
- (b) Explain the salient features of Bus networking topology. (5 Marks)
- (c) A labourer in a manufacturing company gets his wage as per following calculations:

Basic pay = $10 \times N$ if $N \leq 10$
 = $12 \times N$ if $N \leq 15$
 = $15 \times N$ if $N > 15$

He is also awarded a quality related bonus as per following norms:

If $QI \leq 0.5$; Bonus = 0.0
If $QI \leq 0.75$; Bonus = 10% of basic pay
If $QI \leq 0.9$; Bonus = 20% of basic pay
If $QI > 0.9$; Bonus = 30% of basic pay

Where N = Number of items manufactured

QI = Quality index

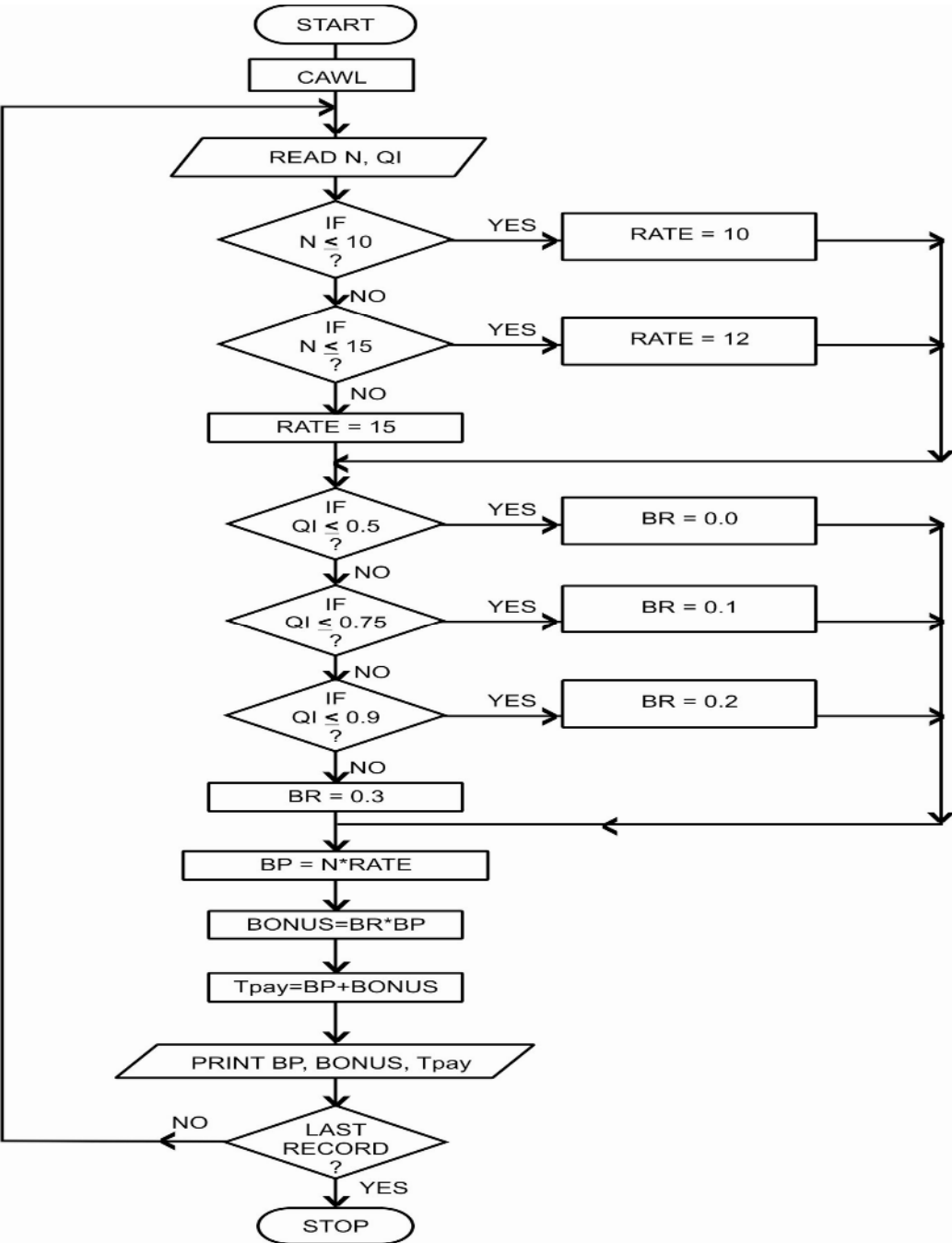
For the above conditions, draw a flow chart to calculate and print basic pay, bonus and total pay received by the labourer. (10 Marks)

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Answer

- (a) In file processing environment, data needed for each user application was stored in independent data files. Processing consisted of using separate computer programs that updated these independent data files and used them to produce the documents and reports required by each separate user application. This approach has following managerial problems that limit its efficiency and effectiveness for end user applications:
- (i) Data duplication: Independent data files include a lot of duplicated data; the same data is recorded and stored in several files. This data redundancy causes problems when data has to be updated, since separate file maintenance programs have to be developed and coordinated to ensure that each file is properly maintained.
 - (ii) Lack of data integration: Having data in independent files makes it difficult to provide end users with information for ad hoc requests that require accessing data stored in several different files. Special computer programs are needed to retrieve data from each independent file, which is difficult, time-consuming and expensive.
 - (iii) Data dependence: In this approach, major components of a system, i.e. the organization of files, their physical storage, hardware, and the application software used to access those files depend on one another in significant ways. Thus, if changes are made in the format and structure of data and records in a file, changes have to be made in all the programs that use this file. Thus program maintenance effort is a major burden of file processing systems.
 - (iv) Other problems: Data elements are generally defined differently by different end users and applications. This causes serious inconsistency in the development of programs, which access such data. In addition, the integrity of the data is suspected because there is no control over their use and maintenance by authorized end users.
- (b) In Bus network topology, a single network cable runs in the building and all nodes are linked along with this communication line with two endpoints called the bus or backbone. Two ends of the cable are terminated with terminators.
- The salient features of bus network are as follows:
- (i) This structure is reliable in very small networks as well as easy to use and understand.
 - (ii) It requires the least amount of cable to connect the computers together and therefore is less expensive.
 - (iii) It is easy to extend by joining cables with a connector or repeater.
 - (iv) Heavy network traffic can slow a bus network considerably. Since any computer can transmit data at any time, computers interrupting each other can use a lot of bandwidth.
 - (v) Bus networks do not coordinate when information is sent.
 - (vi) It is difficult to troubleshoot. A cable break or malfunctioning computer is difficult to detect, hence it can cause the whole network to stop functioning.
 - (vii) Each connection between two cables weakens the electrical signal.
- (c) The flowchart is given on the next page.

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Abbreviations:

CAWL	- Clear All Working Locations	N	- Number of Items Manufactured
QI	- Quality Index	BR	- Bonus Rate
BP	- Basic Pay	Tpay	- Total Pay

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Question 4

- (a) In what ways issue of data center down time can be resolved efficiently? (5 Marks)
- (b) Discuss the importance of 'Data volume and usage analysis' in the design of database. (5 Marks)
- (c) What do you mean by database? Describe any four components of a database environment. (10 Marks)

Answer

- (a) Data centers must have proper disaster recovery systems to minimize downtime for its customers. Downtime can be eliminated by having proper disaster recovery plans for mission- critical data. The different types of Disaster Recovery Plans (DRP) are:
 - (i) Cold Site: It is an alternative facility that is devoid of any resources or equipments, except air conditioning and raised flooring. In this DRP, equivalent hardware is installed at disaster site immediately but lost data cannot be restored.
 - (ii) Warm Site: It is an alternative processing site that is only partially equipped. In this DRP, organization data is copied on another site in periodic intervals so that in case of disaster, data can be restored from another site but the changes made in the data by the organization between the last backup time and current time is lost. Therefore, after the restoration of data, updation is required in the data to make it live data. Warm site can be shared (sharing servers equipment) or dedicated (own servers).
 - (iii) Hot Site: It is an alternative facility that has the equipments and resources to recover business functions that are affected by a disaster. In this DRP, mirror image of data is stored simultaneously at another site with the storage of data at current location. Therefore, data can be restored immediately in case of any disaster and downtime is avoided.
- (b) Data Volume and Usage Analysis: The physical design of database requires certain information that should have been collected and produced during initial phases of system development. These include:
 - (i) Normalized relations, including volume estimates
 - (ii) Definition of each attribute
 - (iii) Description of where and when data are used, entered, retrieved, deleted and updated
 - (iv) Requirement for response time and data security, backup, recovery and integrity etc.
 - (v) Description of the technologies (database management systems) used for implementing the database

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The above information can be generated by data volume and usage analysis. Thus, data-volume and frequency-of-use statistics are critical inputs. The first step one needs to take in the physical design of the database is to estimate the size and usage patterns of the database.

The volume and frequency statistics are generated during the system analysis phase of the system development process when system analysts are studying current and proposed data processing activities. The data volume statistics represent the size of the business and should be calculated assuming business growth over a considerable period of time. The access frequencies are estimated from the timing of events, transaction volumes, and reporting and querying activities. Ad-hoc queries may increase frequency of usage. The data volume and usage analysis helps in identifying the key areas where the greatest attention needs to be given in order to achieve the best possible performance.

- (c) A data base is a repository for related collection of data. It is a computer file system that uses a particular file organization to facilitate rapid updating of individual records, simultaneous updating of related records, easy access to all records, by all application programs, and rapid access to all stored data which must be brought together for a particular routine report or inquiry or a special-purpose report or inquiry.

The database environment has following components:

- (i) Database files: These files have data elements stored in database file organization formats. The database is created in such a way so as to balance the data management objectives of speed, multiple access paths, minimum storage, program-data independence, and preservation of data integrity. Different database systems have different ways of representing data physically on disk. These physical representations can be complex. Basically, the Database Management System (DBMS) tries to store data in ways that facilitate rapid access while economizing on storage.
- (ii) A database management system (DBMS): A DBMS is a set of system software programs that manages the data base files. The DBMS accesses the files, updates the records, and retrieves data as requested. The DBMS ensures that only those areas are accessed for which clearance has been granted. It has the responsibility for data security since database is accessed by many users.
- (iii) Users: Users consist of both the traditional users and application programmers. Users interact with the DBMS indirectly via application programs or directly via a simply query language. The user's interaction with the DBMS includes the definition of the logical relationships in the database, input and maintenance of data, changing and deletion, and manipulation of data.
- (iv) Host language interface systems: This is the part of the DBMS that communicates with the application programs. The host language interface interprets instructions in high-level language application programs that request data from the

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files so that the needed data can be retrieved. During this process, the computer's operating system interacts with the DBMS.

- (v) Application Programs: These programs perform various operations but they are independent of the data files and use standard data definitions. This independence and standardization make rapid special purpose program development easier and faster.
- (vi) Natural language interface systems: The natural language such as query language permits online update and inquiry by users. This language is often termed 'English-like' because it consists of commands in simple English rather than symbols and equations. Most of the commands are pre-programmed and are activated when user keys in combinations of English words used to accomplish an inquiry task. Query languages also permit online programming of simple routines and generation of elementary or complex special-purpose reports.
- (vii) Data dictionary / directory: Data dictionary is a centralized depository of information about the data in the database. It contains the scheme of the data base, i.e. the name of each item, definition and description of attributes along with the name of the programs that use them, and who is responsible for the data; authorization tables that specify users and the data and programs authorized for their use. It also keeps track of where this data is stored on the disk.

Question 5

- (a) Distinguish between the following with respect to word processing:
 - (i) Text editor and Word Processor.
 - (ii) Type face and Font. (3+2=5 Marks)
- (b) What are the different views available in MS-POWER POINT to make the presentation? How can one switch over from one view to another view? (5 Marks)
- (c) Explain the use of following tools related to MS-WORD:
 - (i) Drop cap
 - (ii) Section break
 - (iii) AutoText
 - (iv) Autofit
 - (v) Bullet (1×5=5 Marks)
- (d) Define the following functions with respect to Spread Sheet:
 - (i) NPER
 - (ii) PROPER
 - (iii) PMT
 - (iv) ROUND
 - (v) POWER (1×5=5 Marks)

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Answer

(a) (i) Text editor and Word processor

Text Editor: Text editors can edit plain text only without any formatting features. To change the line, the user must press ENTER key. They are good for short documents or email text bodies, HTML web pages and programs. They are designed to manipulate non-document instructions in computer programs or data. They lack the text formatting and document printing capabilities. The most common text editor is Notepad.

Word Processor: Word processors edit text and allow embedded formatting for words, paragraphs and whole documents. They also support word wrap, margins and different typefaces in the same document. They are specifically designed to prepare such document material as letters and reports. They offer document printing capabilities also. The most common word processor is MS-Word.

(ii) Type face and Font

Type face: A typeface is a set of characters making up an alphabet that all share similar design characteristics without specifying anything about size, weight, style etc.

Font: A font is a typeface of a particular point size, weight and style.

For example, "Times-Roman" is a typeface, but "Times-Roman, 12-point, bold and italic" is a font.

(b) MS-Power Point comes with five different views to help in creating better presentations. These are briefly discussed below:

- (i) **Normal View:** It is a tri-pane view which offers the slide view, the outline view and the Notes pane. It is useful when there is a need to frequently switch between text and objects on the slide. This view allows editing text both on the slide and the outline view. The slide is also large enough to insert objects.
- (ii) **Outline View:** It gives the largest pane for text; hence it is the most comfortable view for working on text. The user can view the text on all slides at once. One can move the slides around in this view. The standard and formatting toolbars are available for editing text. The user can therefore work on the text just like MS-Word. One can even check spellings and use Find and Replace features to modify text. In this view, the slide is visible only in miniature form. Notes can also be added.
- (iii) **Slide View:** It allows the user to see how the text and objects, that have been created, will appear on each slide. The user can work on only one slide at a time in this view. It is convenient to insert objects and modify them. Sometimes, the text inserted on a slide using outline view, runs into too many lines on the slide and even runs out of the slide. In such cases, it is required to trim the text or use an additional slide. The user can edit the text on each slide in the Slide view.

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- (iv) Slide Sorter View: To view all the slides at one time, slide sorter view can be used. Though it is not possible to rearrange the text or objects on individual slides in this view, but one can move the slides around. If it is desired to see the visual effect of the rearrangement, then the slide sorter view is most useful.
- (v) Slide Show View: This view displays the slides in a sequence, moving from one slide to another, transitioning with special effects that have been set, and moving at a preset timing that can be controlled.

One can easily switch between the various views by using the buttons on the left hand corner of the horizontal scroll bar.

- (c) (i) Drop Cap: It is a kind of formatting tool used in MS-Word in which the first character of a word at the beginning of a chapter or article is enlarged, often reaching to the lines below it.
- (ii) Section break: A section break is inserted when one wants to change the page layout (page size or the header and footer information) of a part of the document. Word automatically sets section breaks when one changes the number of columns and wants it to apply from a particular point forward in the document. Similarly, automatic section breaks are set when the Page Setup options are changed and are to apply only to one part of the document while leaving another part unaffected.
- (iii) AutoText: It is a language tool which allows the user to store formatted text, even paragraphs and graphics. These can be recalled by pressing some keys. It has a dictionary of its own and can be customized. It has an AutoComplete tip that will complete the text without having to type the entire word.
- (iv) Autofit: It is a feature used in table formatting. It tries to find out the widest line of text in the column and then tries to adjust or accommodate it. It automatically wraps the text in the cells so as to keep the columns within the page margins.
- (v) Bullet: Bullet is a text formatting tool used in MS-Word to highlight each new point in the list. Using bullets, it is convenient to state the ideas point-by-point. There are several options for the bullets. It is also possible to have multilevel bullets.
- (d) (i) NPER (rate, pmt, pv, fv, type): It is a financial function which returns the number of periods for an investment based on periodic, constant payments and a constant interest rate.
- (ii) PROPER (text): It is a text function which capitalizes the first letter in each word of a text string and converts all other letters to lowercase letters. e.g. PROPER ("eXAmiNatioN") will return "Examination".
- (iii) PMT (rate, nper, pv, fv, type): It is a financial function that is used to calculate the payment for a loan based on constant payments and a constant interest rate.
- (iv) ROUND (x, n): It is a mathematical function used to round off the number x to n number of decimal places. For example, if $x = 2.1553$ and $n = 2$, ROUND (x, n) will return 2.16.

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- (v) POWER (number, power): It is a mathematical function which calculates the value of one number raised to the power of another number. POWER (x, y) returns x^y . For example, POWER (2,3) will return 8.

Question 6

- (a) Explain an auditing technique suitable for on-line real-time applications such as banking. (5 Marks)
- (b) Explain the various features required in a Generalized Audit Package. (5 Marks)
- (c) Describe the compositions and powers of Cyber Regulation Appellate Tribunal. (5 Marks)
- (d) List the possible threats and vulnerabilities to the security of system assets. (5 Marks)

Answer

- (a) In an on-line real-time application such as banking, a large volume of data is processed. In such case, embedded audit technique is found most suitable as it permits continuous and timely audit testing of large volumes of data. Embedded audit facilities consist of program procedures written by the auditor, which can be specifically designed modules to select and record data for subsequent analysis and evaluation. These modules are inserted into the client's application programs and are executed simultaneously with those programs. The main purpose of this technique is to review transactions as they are processed, to select items according to criteria specified in the resident code, and to write details of these items to an output file for subsequent audit examination. The embedded audit code can neither be altered nor can be bypassed with usual run and the output file of chosen items is maintained intact.

This technique can be used as part of a substantive approach, to test the validity and accuracy of input data processed through a system, and as part of a compliance approach, to confirm the operation of controls within the system.

- (b) A Generalized Audit Package (GAP) aids and assists the auditor in carrying out audit. These packages should have the following features:
- (i) Be able to run over a wide platform of hardware, operating systems and database environment.
 - (ii) Wide access to various types of databases.
 - (iii) Can extract and analyze data as per set parameters as defined by the auditor.
 - (iv) Be able to do footings and cross-footing of any specified data field(s).
 - (v) Be able to do random selection and classification of data as required.
 - (vi) Can aid in sample selection.
 - (vii) Can pick out exceptional data based on pre-defined criteria.
 - (viii) Be able to print reports as required.
 - (ix) Be able to compare current version of a file with previous year's version.

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- (c) The Cyber Regulations Appellate Tribunal consists of one person only, called the Presiding Officer of the Tribunal, who is appointed by notification by the Central Government. Such a person must be qualified to be a judge of a High Court or is or has been a member of the Indian Legal Service in the post in grade I for at least three years. He/she can hold office for a term of five years or up to a maximum age limit of 65 years, whichever is earlier.

Under Section 58, the Tribunal has the powers of the Civil Court under the Code of Civil Procedure, 1908. Some of the powers specified are in respect of the following matters:

- (i) summoning and enforcing the attendance of any person and examining him on oath,
- (ii) requiring production of documents and other electronic records,
- (iii) receiving evidence on affidavits,
- (iv) reviewing its decisions,
- (v) issuing commissions for examination of witness, etc.

Section 61 provides that no court shall have jurisdiction to entertain any suit or proceeding in respect of any matter which an adjudicating officer has jurisdiction to determine.

- (d) The various possible threats and vulnerabilities to the security of system assets can be broadly divided into nine categories:
- (i) Fire
 - (ii) Water
 - (iii) Energy variations like voltage fluctuations, circuit breakage, etc.
 - (iv) Structural damages
 - (v) Pollution
 - (vi) Intrusion like physical intrusion and eavesdropping which can be eliminated/minimized by physical access controls, prevention of electromagnetic emission and providing the facilities with their proper locations/sites
 - (vii) Viruses and Worms
 - (viii) Misuse of software, data and services which can be avoided by preparing an employees' code of conduct
 - (ix) Hackers, the expected loss from whose activities can be mitigated only by robust logical access controls

Question 7

Write short notes on any four of the following:

- (i) Bubble Memory
- (ii) MICR

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- (iii) Storage Area Network
- (iv) Object Oriented Database
- (v) Encryption

(5×4=20 Marks)

Answer

- (i) **Bubble Memory:** Bubble memory is composed of small magnetic domains (bubbles) formed on a thin single-crystal film of synthetic garnet. These magnetic bubbles, which are actually magnetically charged cylinders, can be moved across the garnet film by electric charges. The presence or absence of a bubble can be used to indicate whether a bit is 'on' or 'off'.

Since data stored in a bubble memory is retained when power is turned off, it can be used for auxiliary storage. It has high potential due to following other features:

- (i) low production costs
 - (ii) direct access capabilities
 - (iii) small size
 - (iv) lightweight
 - (v) requires less power
 - (vi) useful as an auxiliary storage in portable computers
- (ii) **MICR:** Magnetic Ink Character Recognition (MICR) employs a system of printed characters which are easily decipherable by human beings as well as a machine reader. A special printing font is used to represent characters. In this font, each character is composed of vertical bars. The characters are printed in special ink, which contains a magnetizable material. When a character is subsequently read, it is passed beneath a reading head and big and small gaps send in different types of impulses represented by 1 bit and 0 bit respectively. This method is primarily used in banking industry and most cheques are now processed under the MICR approach. MICR data are used for input purposes and not for output purposes.

Advantages of MICR:

- (a) MICR possesses a very high reading accuracy. Cheques may be smeared, stamped, roughly handled yet they are accurately read.
- (b) Cheques can be handled directly without transcribing them on floppy disk, magnetic tape etc.
- (c) Cheques can be read both by human beings and machines.

Disadvantages of MICR:

- (a) MICR has not found much favour from business.
- (b) Damaged documents, cheques not encoded with amount etc. have still to be clerically processed.

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(iii) **Storage Area Network:** A storage area network (SAN) is a dedicated, centrally managed, secure information infrastructure, which enables multiple interconnections of servers and storage systems. A SAN has following salient features:

- Facilitates universal access and sharing of resources.
- Supports unpredictable, explosive information technology growth.
- Provides affordable 24 hours × 365 days availability.
- Simplifies and centralizes resource management.
- Improves information protection and disaster tolerance.
- Enhances security and data integrity of new computing architectures.

Move to SAN has been motivated by following factors:

- E-business – securely transforming internal business processes and improving business relationships to expedite the buying and selling of goods, services and information.
- Globalization – the extension of IT systems across international boundaries.
- Zero latency – the need to exchange information immediately for competitive advantage.
- Transformation – the ability to continually adapt, while immediately accessing and processing information to drive successful business decisions.

Benefits of SAN include:

- Increase in overall system efficiency
- Improved system administration
- Improved availability of resources at lowest cost
- Increased business flexibility

(iv) **Object Oriented Database:** File and database structures evolved continuously in order to be suitable to changing application needs. Today, databases with relational qualities that are capable of manipulating text, data, objects, images, and even video and sound clips are needed by many organizations. Many engineering applications viz. computer-aided design (CAD), computer-aided engineering (CAE), expert systems, image-processing systems, and multimedia systems etc. produce information that often defies traditional file and database structures. So a new structure is needed to handle such information. Object-oriented database (OODB) is one alternative to this.

OODB is a natural extension of object-oriented programming (OOP). OODB systems can be either active or passive. In an active OODB, every object is described by a set of attributes describing what the object is. The behaviours of the object are also included. Objects with similar attributes and behaviours can be grouped into classes and the attributes and behaviours of one object within a class can be inherited by other objects within the same class, which can speed up application development.

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OODB provides application developers with a repository of reusable objects that only need to be created once. This allows new applications to be put together by appropriately arranging the objects stored in the OODB. This can greatly accelerate application development time and reduce the application backlogs.

- (v) **Encryption:** Encryption refers to algorithmic schemes that encode plain text into non-readable form or cipher text, providing privacy. The receiver of the encrypted text uses a “key” to decrypt the message, returning it to its original plain text form. Until the advent of the Internet, encryption was rarely used by the public. Today, with online marketing, banking and other services, encryption is widely used.

Encryption allows information to transit the Internet while being protected from interception by eavesdroppers. There are two basic approaches to encryption as discussed below:

- (a) Hardware encryption devices are used to support high-speed traffic. If the Internet is being used to exchange information among branch offices or development collaborators, for instance, use of such devices can ensure that all traffic between these offices is secure.
- (b) Software encryption is typically employed in conjunction with specific applications. For example, certain electronic mail packages provide the facility of encryption and decryption for message security.