I Semester Diploma Examination, Oct./Nov.-2021
Fundamental of Computers:20CS11T
<u>Scheme of Valuation</u>

Qn.No	Question	CL	CO	Marks
Section-1				
1. a)	Define number system? Explain the characteristics of number system.	R	1	[2+8=10] [Definition:2 marks At least two valid Characteristics of each number system:2 marks]
b)	Convert the following: i) Binary to Decimal:11101_2 ii) Decimal to Binary: 456_{10} iii) Binary to Octal :10001_2 iv)Decimal to Octal: 567_{10} v) Hexadecimal to Decimal to:$7AC_{16}$	A	1	5*2 = 10 [2 marks each]
2. a)	Explain the following terms a) BCD b) EBCDIC c) ASCII d) UNICODE e) GRAY CODE	U	1	Any two relevant features of each code: 5*2 =10 [2 marks each]
b)	Draw a circuit to realize the expressions using AND gates, OR gates and invertors and write the truth table Y=$\overline{(\overline{A}.B)+(A.\overline{B})}$	U	1	6+4 =10 [Logic circuit diagram= 6marks] [Truth table=4marks]
Section-2				
3. a)	State the Laws and Rules of Boolean Algebra	U	1	Each rule/law- 1m: 10*1m =10m
b)	Describe half adder with logic diagram and truth table	U	2	2+4+4=10 [Description: 2marks] [Logic circuit :4 marks] [Truth table: 4 marks]
4. a)	Describe 4:1 multiplexer.	R	2	2+4=6 [Description: 2 marks] [Diagram/Truth Table: 4 marks]
b)	List the different types of Flip-flops.	U	2	4 [Any 4types : 4 marks each]
c)	Explain D-Flip-flop with truth table, logic symbol and logical circuit.	U	2	10 [Description:2 marks] [Truth table+ logic symbol + logiccircuit]= [4+2+2]
Section-3				
5. a)	Discuss the applications of counters	U	2	5 [Any 5 =5 marks each]
b)	What is decoder? Identify its applications	R	2	5 [Definition=2 marks] [Any 3 application =3marks]
c)	Construct a 4-bit SIPO (Serial in Parallel Out) shift register with logic circuit	A	2	10 [Explanation : 4 marks] [Diagram : 6marks]
6. a)	i)Discuss the characteristics of Computers. ii) List various applications of	U	3	5+5=10 [any 5 Characteristics = 5 marks each]

	Computers			[Any 5 Applications =5marks each]
b)	List and explain the different categories of computer network	U	3	1+3+3+3 List :1 marks Explanation of any 3 category :3 marks
Section-4				
7. a)	Explain the following i) Single user programming ii) Multi programming	U	3	5+5=10
b)	List and explain Flynn's Classification of Computers	U	4	5 List:1marks Explanation: 1mark each
c)	Briefly explain BIOS	U	4	5 Explanation :5 marks each
8. a)	Explain memory hierarchy of a computer with a diagram	U	4	4+6=10 Diagram : 4 marks Any 3-memorytype explanation: 2 marks each
b)	Describe functions of i)Realtime OS ii)Mobile Operating system	R	4	5+5=10 [5 marks each for explanation]
Section -5				
9. a)	Draw the block diagram of a computer and examine the working of functional unit	A	4	4+6=10 [Diagram: 4 marks] [Explanation:6 marks]
b)	Draw a flowchart to accept the age of a person and check whether he/she is a child, teenager or an adult. A person is a child if the age is less than or equal to 14.A person is a teenager if the age is between 15 and 17.A person is an adult if the age is greater than or equal to 18	U	5	3+4+3=10 Correct Symbols +logic + flowchart
10. a)	Define flowchart? Explain different symbols used in flowchart	R	5	2+8=10 Definition:2 marks [Any 4 symbols explanation: 2 marks each
b)	Write an algorithmfor finding largest of 3 numbers	U	5	10 Input variables + sequence +logic= 2 + 4 + 4 = 10marks

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<u>Model Answers</u>

Section- I

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1. a) Define number system? Explain the characteristics of number system.

Ans: The technique to represent and work with numbers is called as **number system. Four most common**

Types of number system are

1) Binary **number system** (Base- 2)
2) Octal **number system** (Base-8)
3) Decimal **number system** (Base- 10)
4) Hexadecimal **number system** (Base- 16)

Characteristics of binary number system:
- The binary number system is base 2 system where only digits 0 & 1 are used.
- All digital computers use this number system.
- Therefore, the data entered into computer is converted into its binary equivalent.
  Ex: - 01, 11, 10,110 etc.
- Binary number system is a **positional value system**.
- This means that each binary digit has its own value or weight expressed as a power of 2.

Characteristics of Octal number system:

- It is also called as base 8 number system
- Uses eight digits from 0 to 7 (0,1,2,3,4,5,6,7).
- Octal number system is a **positional value system**.
- This means that each digit has its own value or weight expressed as a power of 8.

Characteristics of Decimal number system:

- It is a base 10 number system.
- It has 10 digits. They are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.
- Each position in a decimal number represents specific power of the base 10. Example 10^0
- Decimal Number System is easily readable, used by humans.
- So, we use this number system in our day-to-day life.
- Decimal number system is a **positional value system**.
- This means that each digit has its own value or weight expressed as a power of 10.

Characteristics of Hexadecimal number system:

- It is a base 16 number system
- It has a total of 16 digits, numbers from 0-9 and letters from A-F.
- They are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

- The letters represent A =10;B =11;C=12;D=13; E=14; F=15

- It is used to represent Computer memory addresses.

- It is also helpful to describe colors on web pages.

- Hexadecimal number system is a **positional value system**. This means that each digit has its own value or weight expressed as a power of 16.

1. **b) Convert the following:**

i) Binary to Decimal: 11101_2

$11101_2 = (1 * 2^4) + (1 * 2^3) + (1 * 2^2) + (0 * 2^1) + (1 * 2^0)$
$= 16 + 8 + 4 + 0 + 1$
$= 29_{10}$

ii) Decimal to Binary: 456_{10}

$(456)_{10} = (111001000)_2$

Step 1: Divide (456)10 successively by 2 until the quotient is 0:

456/2 = 228, remainder is 0
228/2 = 114, remainder is 0
114/2 = 57, remainder is 0
57/2 = 28, remainder is 1
28/2 = 14, remainder is 0
14/2 = 7, remainder is 0
7/2 = 3, remainder is 1
3/2 = 1, remainder is 1
1/2 = 0, remainder is 1

iii) Binary to Octal :

$10001_2 = 21_8$

To convert any octal number to its corresponding binary number, use 2 steps.

   i)   Break the binary number into 3-bit sections from LSB toMSB
   ii)   Convert the 3-bit binary number to its octalequivalent.

Binary Number	010	001
Octal number	2	1

iv)Decimal to Octal:

$567_{10} = 1067_8$

567 / 8 = 70 ,   remainder 7
  70 / 8 = 8 ,   remainder 6
   8 / 8 = 1 ,   remainder 0
   1 / 8 = 0 ,   remainder 1

v) Hexadecimal to Decimal to:

    A=10 is hexadecimal equivalent

    C=12 is hexadecimal equivalent

$7AC_{16} = (7 \times 16^2) + (A \times 16^1) + (C \times 16^0)$

$= 1792 + 160 + 12$

$= 1964_{10}$

2. **a) Explain the following terms**

    i.   **BCD**

    ➢ Stands for Binary Coded Decimal or 8421 code

    ➢ It is a weighted code

    ➢ In this code each decimal digit is represented by a 4-bit binary number.

    ➢ In BCD, with four bits we can represent sixteen numbers (0000 to 1111).

    ➢ But in BCD code only first ten of these are used (0000 to 1001).

    ➢ The remaining six code combinations i.e., 1010 to 1111 are invalid in BCD

    ➢ One of the early computer codes

Four bits to represent the first 10 decimal digits (0-9) to BCD code is shown below

Decimal Number	BCD (8421)Code
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

ii) EBCDIC

- Stands for Extended Binary Coded Decimal Interchange Code.

- It was first developed by IBM

- It uses 8-bit coding standard

- So, 2^8 = 256 possible combinations are available to represent numbers, alphabets (alphanumeric) & other symbols

- It was used in IBM mainframe computers.

- EBCDIC is less popular than ASCII and not compatible with modern coding

 iii) ASCII Code

- Stands for American Standard Code for Information Interchange.

- It is a most common format used in computers

- ASCII is of 2 types – ASCII -7 & ASCII-8 (Extended ASCII)

- ASCII-7 uses 7 bits .

- Therefore it can represent up to 2^7 alphanumeric characters & symbols.

- ASCII-8 uses 8 bits .

- Therefore it can represent up to 2^8 alphanumeric characters & symbols.

- It is compatible with modern coding schemes like UNICODE

- Example: ASCII code for character a is 97 represented as 1100001 in binary

iv) UNICODE

- Unicode is a universal character encoding standard that assigns a code to every character and symbol in every language in the world.

- The most used ones are UTF-8, UTF-16 and UTF-32

- Defines codes for multilingual languages, special characters, mathematical symbols.

- It has a capacity to encode million characters

v)   GRAY CODE

- It is also called as Reflected binary code

- Gray code is not weighted that means it does not depend on positional value of digit.

- This is a cyclic variable code that means every transition from one value to the next value involves only one bit change.

(b)Draw a circuit to realize the expressions using AND gates, OR gates and invertors and write the truth table Y= $\overline{(\overline{A}.B\,) + (A.\overline{B})}$

$\overline{A}$. B

$A.\overline{B}$
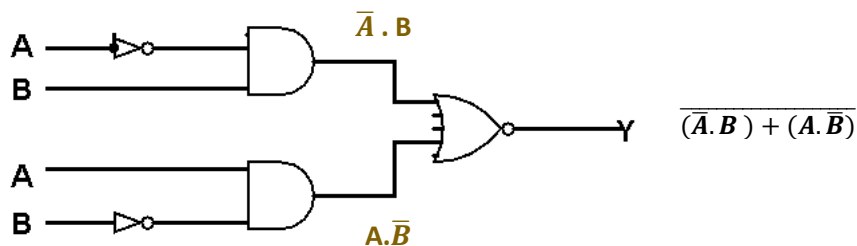
$\overline{(\overline{A}.B\,) + (A.\overline{B})}$

Truth table:

A	B	$\overline{A}$. B	A.$\overline{B}$	$\overline{A}$. B + A.$\overline{B}$	Y=$\overline{(\overline{A}.B\,) + (A.\overline{B})}$
0	0	0	0	0	1
0	1	1	0	1	0
1	0	0	1	1	0
1	1	0	0	0	1

Y=$\overline{A \oplus B}$

SECTION-2

3.   a) State the Laws and Rules of Boolean Algebra

Rules and laws of Boolean Algebra

Name	AND form	OR Form
Identity law	1.A=A	0+A=A

Null Law	0.A=0	1+A=1
Idempotent law	A.A=A	A+A=A
Inverse law	A.$\bar{A}$ = 0	A+$\bar{A}$ = 1
Commutative law	A.B=BA	A+B=B+A
Associative law	(AB)C=A(BC)	(A+B)+C=A+(B+C)
Distributive law	A+BC = (A+B)(A+C)	A(B+C)=AB+AC
Absorption law	A(A+B)=A	A+AB=A
De Morgan's law	$\overline{AB}$ =$\bar{A}$ + $\bar{B}$	$\overline{A+B}$ =$\bar{A}\bar{B}$

b) Describe half adder with logic diagram and truth table.

Ans: A combinational circuit that performs the arithmetic addition of two binary bits is called a half-Adder. The half adder needs two binary inputs and produces two binary outputs Sum and Carry.

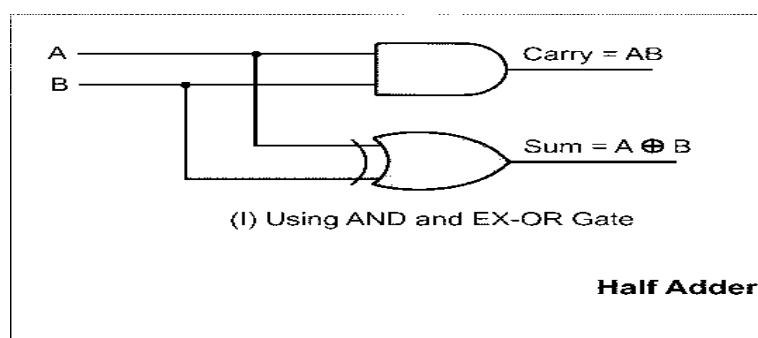The Block diagram and truth Table for half adder is as shown below.

Inputs		Outputs	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1
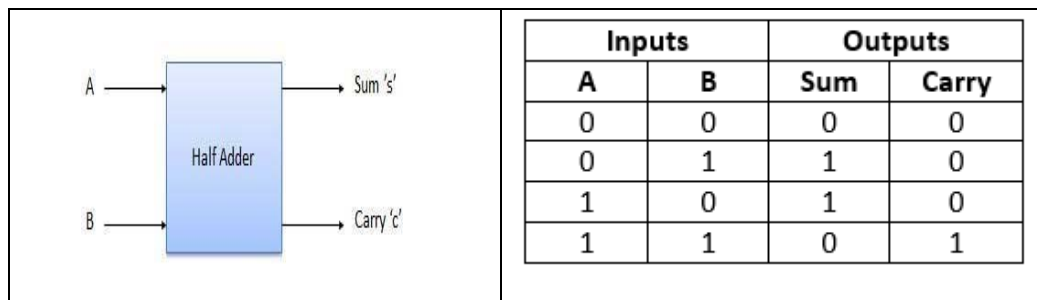
The simplified Boolean functions for two outputs can be obtained directly from the above truth table.
Sum= A XOR B
Carry = A AND B

Logic diagram:


Carry = AB

Sum = A ⊕ B

(I) Using AND and EX-OR Gate

Half Adder

4. a) Describe 4 to 1 multiplexer.

Multiplexer means many to one. A multiplexer is a circuit used to select and route any one of the several input signals to a single output.

A 4: 1 multiplexer consists of 4 data lines D0 to D3.Two select lines as S_0 and S_1/ C_0& $C_1$and a single output line. The figure below shows the block diagram of a 4:1 multiplexer in which the multiplexer decodes the input through select line.
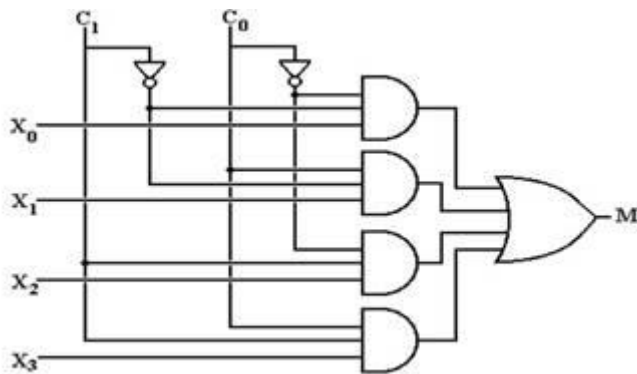
The truth table of a 4-to-1 multiplexer is shown below in which 4 input combinations 00, 10,01 and 11 on the select lines respectively switches the D0 , D1, D2,D3 to the ouput .That means when S0=0 and S1=0,the output at Y is D0, similarly Y is D1 if the select inputs S0=0 and S1=1 and so on.

Select Data Inputs		Output
S_1	S_0	Y
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3
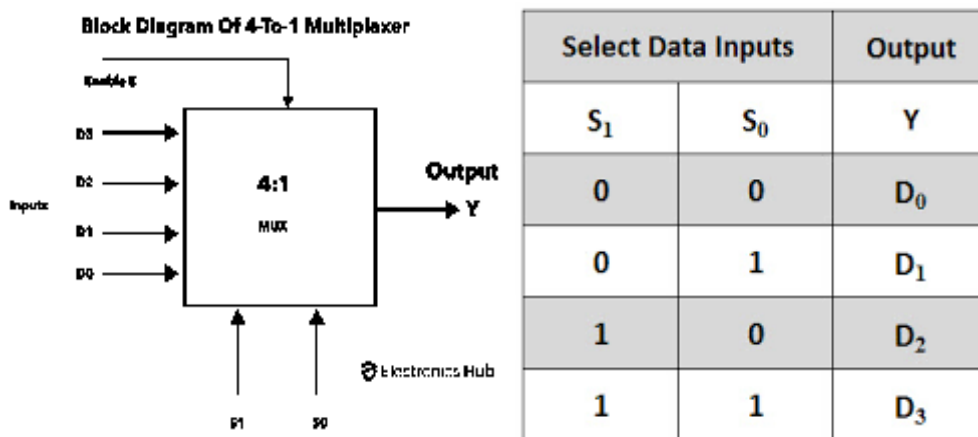
4. **b) List different types of flip-flops.**

Different types of flip flops are-

- Set -Reset (SR) flip flop or Latch
- Clocked SR flip flop
- JK flip flop
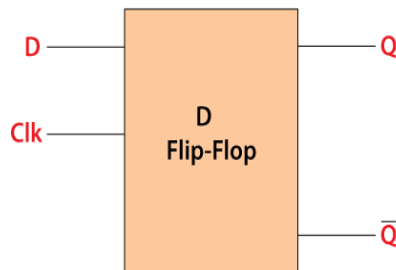- Master Slave JK flip flop
- D flip flop
- T flip flop

5. **c) Explain D-flip flop with truth table and logic symbol and logic circuit.**

- When an inverter is connected between the "SET" and the "RESET" inputs of clocked S R flip flop which produces another type of flip flop circuit known as a D flip flop or Data flip flop. It ensures that inputs S and R, are never equal to one at the same time.

- The D-type flip-flop has only one input referred to as the "D", or data input, plus a clock input, CLK along with the usual two outputs, Q and Q`.
- The D-type flip-flop transfers its digital data between the input and its outputs, after a delay of one clock pulse.

Symbol

Circuit Diagram of D -flip flop

Logic diagram and Truth Table

Clock	D	Q	Q'	Description
↓ » 0	X	Q	Q'	Memory no change
↑ » 1	0	0	1	Reset Q » 0
↑ » 1	1	1	0	Set Q » 1
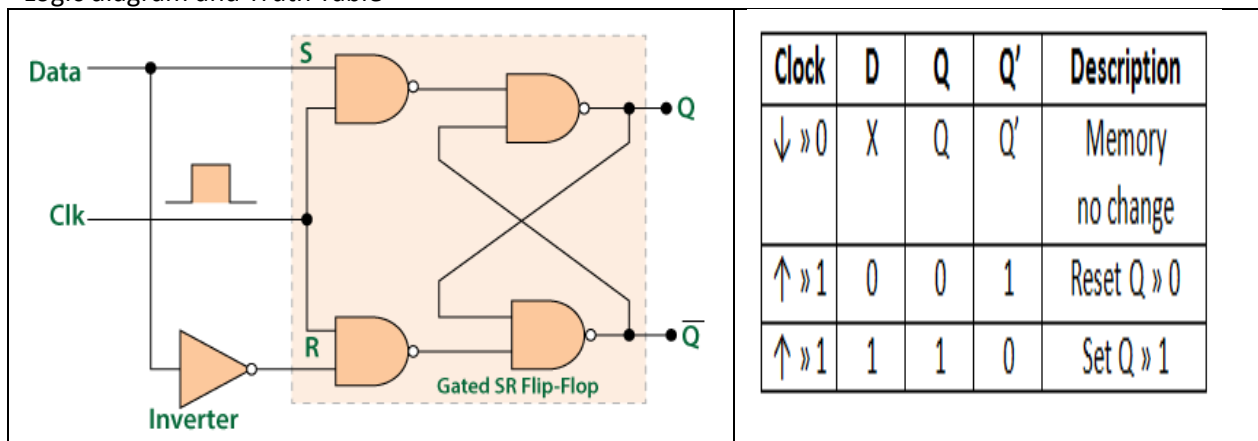
o   When the clock is low or 0, the output is no change or in previous state.

o   When the clock is high or 1, and D input is low or 0, then output Q = 0. The flip flop is in reset state.

o   When the clock is triggered or high, and D input is high or 1, output Q = 1. The flip flop is in set state.

SECTION-3

5. a) Discuss the application of counters.

Counters are mainly used in digital electronics for counting purpose.

Applications of counters are

- Frequency counters used to accurately measure frequency of repetitive signals
- BCD counters used in Digital clocks
- Analog to digital convertors used in computers, cell phones, scientific instruments
- Frequency divider circuits

- Timers in electronic devices like ovens and washing machines
- Digital triangular wave generator by using counters

b) What is decoder? Identify its applications

A decoder is **a combinational logic circuit that is used to change the code into a set of signals**. It is the reverse process of an encoder. A decoder circuit takes multiple inputs and gives multiple outputs. A decoder circuit takes binary data of 'n' inputs into '2^n' unique output.
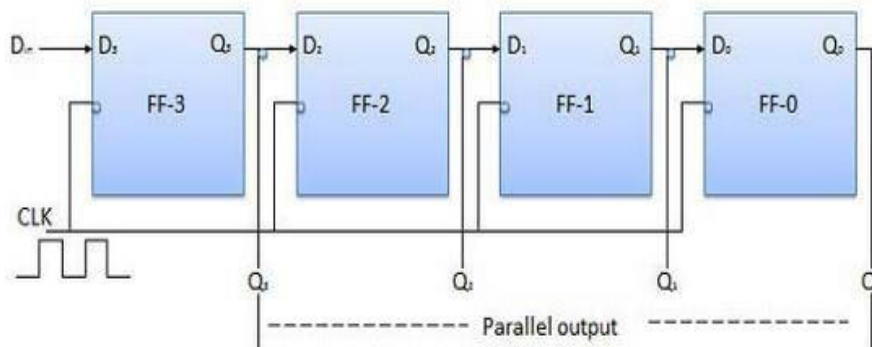
Applications of decoder

- It is used in computers.
- It is used microprocessor memory systems
- It is used in code conversions
- Also used in data distributions
- Used in timing or sequencing signals to turn devices on or off.

c) Construct a 4 bit SIPO (Serial in Parallel Out Shift Register with logic circuit.

- In such types of shift register, the data is entered serially and taken out in parallel fashion.
- Data is loaded bit by bit. The outputs are disabled as long as the data is loading.
- As soon as the data loading gets completed, all the flip-flops contain their required data, the outputs are enabled so that all the loaded data is made available over all the output lines at the same time.
- 4 clock cycles are required to load a four-bit word. Hence the speed of operation of SIPO mode is same as that of SISO mode.

The block diagram of 4 bit SIPO shift register is shown below

6. a)i)Discuss the characteristics of computers
- **Speed**
- **Accuracy**
- **Diligence**
- **Versatility**
- **Reliability**
- **Storage Capacity**

ii)**List various applications of computers**

Computers are used in

- Science
- Education
- Health Care and medicine
- Military
- Communication
- Government
- Engineering Design
- Business:
- Banking

b) List and explain the different categories of computer network

Computer network can be categorized by their size. A computer network is mainly of four types:

- LAN(Local Area Network)
- PAN(Personal Area Network)
- MAN(Metropolitan Area Network)
- WAN(Wide Area Network)

LAN(Local Area Network)
- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.
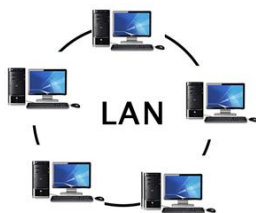
PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.

- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.

- Personal Area Network covers an area of 30 feet.

- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

MAN(Metropolitan Area Network)

- o A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- o Government agencies use MAN to connect to the citizens and private industries.
- o In MAN, various LANs are connected to each other through a telephone exchange line.
- o The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.
- o It has a higher range than Local Area Network(LAN).
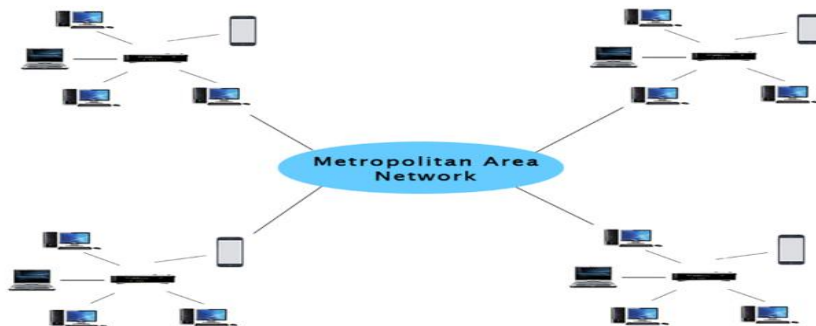
WAN(Wide Area Network)

- o A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- o A Wide Area Network is quite bigger network than the LAN.
- o A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- o The internet is one of the biggest WAN in the world.
- o A Wide Area Network is widely used in the field of Business, government, and education.
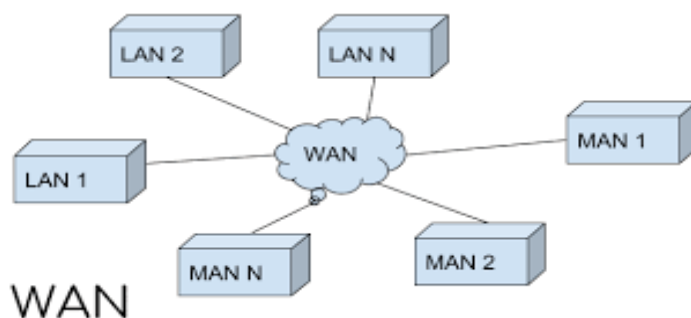
SECTION-4

7.a) Explain the following:

i) Single user programming:

- It is usually done by a single person for his personal use.

- A single task or one program or application can be run at a time.

- So, it is not as useful for a computer or other device intended to run multiple programs at once.

- The operating system used here occupies less space in memory.

- It is cost-effective.

- This technique is suitable for home, small offices etc.

ii) Multi Programming

- the technique of executing several programs concurrently in a single computer system.

- This technique provides facility to store and execute more than one program in the Central Processing Unit (CPU) simultaneously.

- Multiprogramming improves CPU utilization as it organizes a number of jobs where CPU always has one to execute.

- Increased Throughput – Throughput means total number of programs executed over a fixed period of time.

b) List and explain Flynn's classification of computers

Flynn's classification divides computers into four major groups that are:

- Single instruction stream, single data stream (SISD)

- Single instruction stream, multiple data stream (SIMD)

- Multiple instruction stream, single data stream (MISD)

- Multiple instruction stream, multiple data stream (MIMD)

SISD: It represents the organization of a single computer containing a control unit, a processor unit, and a memory unit. Instructions are executed sequentially. They do not have parallel processing capabilities. Most conventional computers have SISD architecture.

SIMD: It represents an organization that includes many processing units under the supervision of a common control unit. All processors receive the same instruction from the control unit but operate on different items of data.

MISD: MISD structure is only of theoretical interest since no practical system has been constructed. In MISD, multiple processing units operate on one single-data stream.

MIMD: In this organization, all processors in a parallel computer can execute different instructions and operate on various data at the same time.

c) Briefly explain BIOS

- BIOS, which stands for **Basic Input Output System**, is software stored on a small memory chip on the motherboard.
- When BIOS boots up a computer, it first determines whether all of the necessary attachments are in place and operational.
- BIOS is responsible for the POST (Power-on Self-Test) and therefore makes it the very first software to run when a computer is started.
- The BIOS firmware is non-volatile, meaning that its settings are saved and recoverable even after power has been removed from the device.

- It tests the hardware of the computer before loading the OS. Bootstrap loader. It locates the OS.

8.a) Explain memory hierarchy with a diagram.

A memory unit is an essential component in any computer for storing programs and data.

Typically, a memory unit can be of two categories:

1. **Main (primary) Memory**: The memory unit that establishes direct communication with the CPU. The main memory is often referred to as RAM (Random Access Memory).

2. **Auxiliary (secondary) Memory**: The memory units that provide backup storage are called **Auxiliary Memory**. For Example, magnetic disks and magnetic tapes are the most commonly used auxiliary memories.
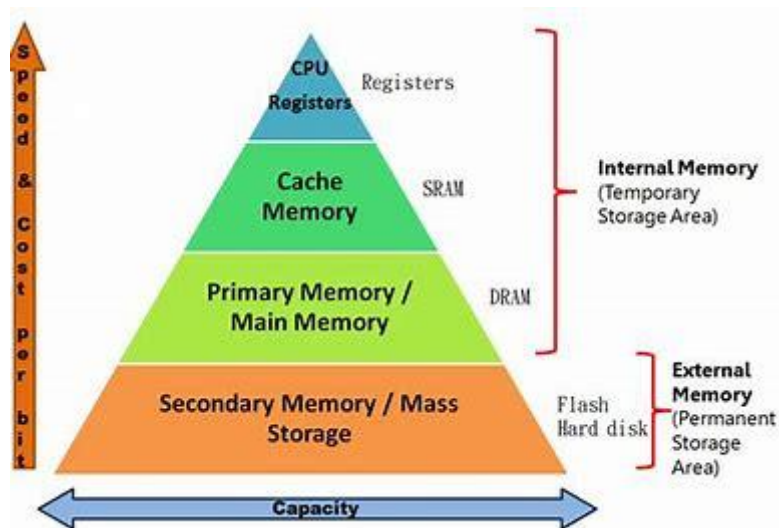
 MEMORY HIERARCHY

Registers
- It consist of a small amount of fast storage, although some registers have specific hardware functions, and may be read-only or write-only.

Cache Memory

- The data or contents frequently used by CPU are stored in the cache
- So, the processor can easily access that data in a shorter time.
- Whenever the CPU requires access required data ,it first checks into the cache memory, If the data is found in the cache memory, it is read .
- Example : L1 cache,L2 cache,L3 cache.

Main Memory

- The main memory is also called as **primary memory**
- It is a fast memory used to store runtime programs and data.
- It uses semiconductor integrated circuits. Example: RAM (Random Access Memory)

Secondary (Auxiliary)Memory

- Auxiliary memory is used for back up storage.
- It is the low-cost, high storage -capacity and slowest-access used in a computer system.
- Auxiliary memory provides storage of programs and data kept for long-term storage or when not in immediate use.
- The most common examples of auxiliary memories are magnetic tapes and magnetic disks.
- A magnetic disk uses a magnetization process to write, rewrite and access data. For example, hard drives, zip disks, and floppy disks.
- Magnetic tape is a storage medium that allows for data archiving, collection, and backup for different kinds of data.

b) Describe the functions of

i) Real time Operating System:

- These OS serve real-time systems.
- The time interval required to process & respond is very small. This time interval is called response time.
- Real-time systems are used in time requirements are very strict like missile systems, air traffic control systems, robots, etc.

Two types of Real-Time Operating System which are as follows:

- Hard Real-Time Systems:
  - These OS are meant for applications where time requirement is very strict.
  - They are built for life saving like automatic parachutes or airbags which are required to be readily available in case of any accident.
- Soft Real-Time Systems:
  These OSs are for applications where for time-constraint is less strict.

ii) Mobile operating systems

- Mobile OS are those OS which are designed to power smartphones, tablets, and wearables devices.
- A mobile OS typically starts up when a device powers on, presenting a screen with icons or tiles that present information and provide application access.
- Some most famous mobile operating systems are Android and iOS, but others include BlackBerry, Web, and watchOS.
- Android OS is the most popular operating system as of today. It is a mobile based Linux kernel and open-source software. It was developed by Google

SECTION-5

9. a) Draw the block diagram of a computer and examine the working of functional unit
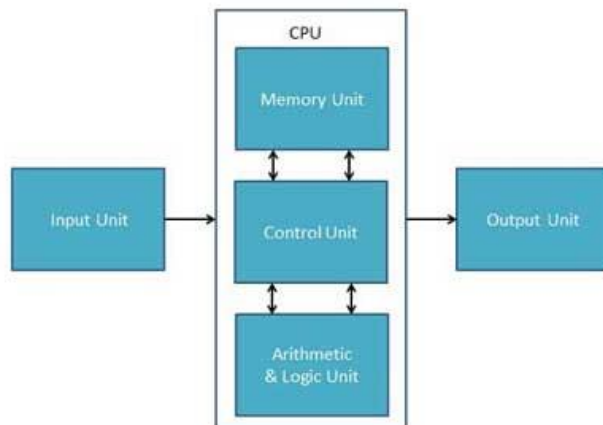
- o   A computer consists of five main components namely,
- o   Input unit, Central Processing Unit, Memory unit Arithmetic & logical unit, Control unit and an Output unit.

Input unit
- o   Input units are used to read the data by computer.
- o   The most commonly used input devices are keyboards, mouse, joysticks, trackballs, microphones, etc.

Central processing unit
- o   Central processing unit or CPU within a computer.
- o   It performs basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.
- o   It is a brain of the computer
- o   It consists of Memory unit, Control unit and ALU.

Memory unit
- o   The Memory unit can be referred to as the storage unit of computer.
- o   Here programs and data are stored.
- o   The Memory unit can be of two types namely
  - ➢   primary memory and secondary memory. (Auxiliary memory)

Arithmetic & logical unit

- o   All the arithmetic and logical operations of a computer are executed in the ALU (Arithmetic and Logical Unit) of the processor.

- o   It performs arithmetic operations like addition, subtraction, multiplication, division and also the logical operations like AND, OR, NOT operations.

Control unit

- o   The control unit is a belongs to of a computer's central processing unit

- o   It controls & coordinates the operation of the processor.

- o   It tells other units like memory unit , ALU unit and input and output devices how to respond to a program's instructions.

- o   The control unit is also known as the nerve center of a computer system.

Output Unit

- o   The output unit is used to send the processed results to the user.
- o   Output devices display information through monitor, printer, projector etc.
- o   These devices display information generated within a computer.
- o   The most common example of an output device is a monitor.

9. b)Draw a flowchart to accept the age of a person and check whether he/she is a child, teenager or an adult. A person is a child if the age is less than or equal to 14.A person is a teenager if the age is between 15 and 17.A person is an adult if the age is greater than or equal to 18
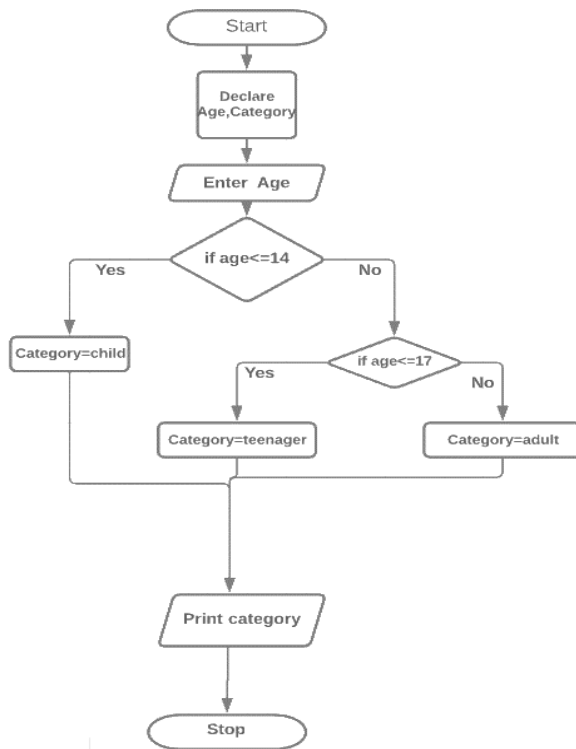
10.a) Define flowchart. Explain different symbols used in flowchart

A flowchart is a pictorial representation of the steps of an algorithm used to solve a particular problem. The different symbols used in flowchart

Symbol	Symbol Name	Description
→ ←	Flow Lines	Used to connect symbols
(terminal)	Terminal	Used to start, pause or halt in the program logic
▱	Input/output	Represents the information entering or leaving the system
▭	Processing	Represents arithmetic and logical instructions
◇	Decision	Represents a decision to be made
○	Connector	Used to Join different flow lines
▯	Sub function	used to call function

(b) **Write an algorithm for finding largest of three numbers.**

Step1: Start

Step2: Read numbers A, B and C

Step3: Check whether A > B and A > C if true, then largest = A, go to step6

Step4: Check whether B > A and B > c if true, then largest = B, go to step6

Step5: Check whether C > A and C > B if true, then largest = C, go to step 6

Step6: Print largest

Step 7: End

[Note:-

The Above flowchart and algorithm can be written in different ways please check the logic and give the marks to students]

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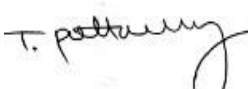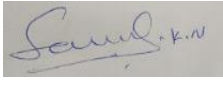
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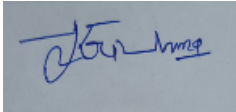
Certified that the model answers prepared by me for subject code 20CS11T is from prescribed text books and model answers and scheme of valuation prepared by me is correct.

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Signature of Chief Reviewer/Paper setter
Reshma Attavar
Lecturer,Department of CSE
Govt. Polytechnic Ramanagara

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