

APPLIED MATHEMATICS

G-105

Full Mark : 75 SCTE/NGL/R-2025-I

Pass Mark : 30

Time : 3 Hours

I. Choose the correct answer. (1 × 10 = 10)

1. A graph in which there is only one edge between pair of vertices is called a

- (a) Simple Graph (c) Multi Graph
(b) Pseudo graph (d) Weighted Graph

2. A graph with no edge has Chromatic Number

- (a) 1 (b) 2 (c) 0 (d) 3

3. The number of edges in the null graph is

- (a) 0 (b) 1 (c) 2 (d) 3

4. The operator E stands for

- (a) Forward Difference Operator (c) Shift Operator
(b) Backward Difference Operator (d) Inverse Operator

5. The order of the differential equation $y'' = 1 + y + y^2$ is

- (a) 0 (b) 1 (c) 2 (d) 3

6. The degree of the differential equation $(y')^2 + y^3 + y = 0$ is

- (a) 0 (b) 2 (c) 1 (d) 3

7. The differential equation $(x^2 - ay)dx - (ax - y^2)dy$ is exact.

- (a) True (b) False

8. The number of partitions of 4, $p(4)$ is

- (a) 2 (b) 4 (c) 5 (d) 7

9. The degree of the linear recurrence relation $c_0 a_n + c_1 a_{n-1} + c_2 a_{n-2} + \dots + c_k a_{n-k} = 0$ is

- (a) n (b) k (c) $n-k$ (d) 0

10. The generating function for $1 + x + x^2 + x^3 + \dots$ is

- (a) $\frac{1}{1-x}$ (b) $\frac{1}{1-2x}$ (c) $\frac{1}{1+2x}$ (d) $\frac{1}{1+x}$

II. Answer the following questions.**(2 × 8 = 16)**

1. Prove that $E = \Delta + 1$
2. Define a Bipartite graph. Give an example
3. Draw a 3-regular graph
4. Calculate the forward difference for the following data

x	0	2	4	6	8
y	5	9	6	20	50
				9	1

5. Define interpolation
6. Form the differential equation of the family of curves given by $x^2 + y^2 = 2ax$
7. State the principle of Inclusion and Exclusion
8. Find the closed form for the generating function $0, 0, 1, 1, 1, \dots$

III. Answer the following questions.**(3 × 11 = 33)**

1. Approximate the area under the curve $y = f(x)$ between $x = -4$ and $x = 2$ using Trapezoidal Rule with $n = 6$ subintervals. A function $f(x)$ is given in the table of values

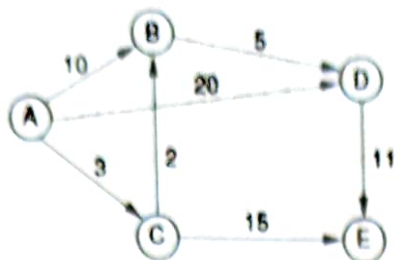
x	-	-	-	-	0	1	2
$f(x)$	0	4	5	3	10	11	2

2. A rocket is launched from the ground, its velocities were recorded as follows

t	0	10	20	30	40	50
v	0	20	60	120	200	300
		0	0	0	0	0

Find the acceleration at $t = 50$

3. Find the shortest path from A to E

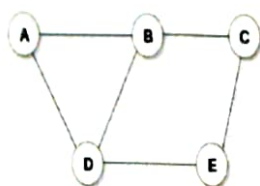


4. Draw the graph represented by

(a) Adjacency matrix $\begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

(b) Incidence matrix $\begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 \end{bmatrix}$

5. Find the number of vertices, the number of edges and degree of each vertex A, B, C, D, E of the following graph



6. Find the generating function for the sequence $1, a, a^2, a^3, \dots$ where a is a fixed constant
7. Using Lagrange's interpolation formula find the value of y corresponding to $x = 10$ from the following table

x	5	6	9	11
y	12	13	14	16

8. Solve the linear differential equation $\frac{dy}{dx} + 3y = e^{-2x}$
9. Solve $(xy^2 + x)dx + (yx^2 + y)dy = 0$ using variable separable Method

10. Find the first four terms of the recurrence relation

$$a_k = 2a_{k-1} + k, \text{ for all integers } k \geq 2, a_1 = 1$$

11. Use generating function to find the number of ways to select r objects of n different kinds if at least one object of each kind is selected.

IV. Answer the following questions:

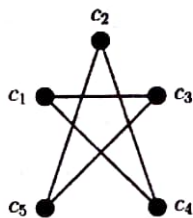
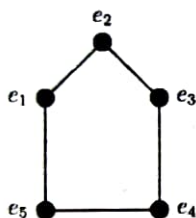
(4 × 4 = 16)

1. Using Newton's forward interpolation formula find the cubic polynomial which takes on the following values

x	0	1	2	3
y	1	2	1	10

Also find $f(1.5)$

2. Show that the given pairs of graphs are isomorphic



3. Solve $\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 9y = 5e^{3x}$

4. Use generating function to solve the recurrence relation

$$a_n = 3a_{n-1} + 2; a_0 = 1$$

DIGITAL CIRCUITS

CSE-411

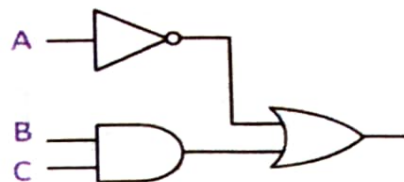
Full Mark : 75 **SCTE/NGL/R-2025-I**

Pass Mark : 30

Time : 3 Hours

A. Multiple Choice Question (15 X 1 = 15)

1. The radix (base) of the hexadecimal number system is
a) 2 b) 8 c) 10 d) 16
2. What is the 2's complement representation of 101101?
a) 010001 b) 010011 c) 010110 d) 10011
3. What will be the result of multiplying the binary numbers 101 and 11?
a) 1110 b) 1001 c) 1111 d) 1011
4. Which of the following is a Commutative Law in Boolean algebra?
a) $A + B = B + A$ b) $A(B + C) = AB + AC$
c) $A + A' = 1$ d) $A + 0 = A$
5. What will the output of the following inputs (ABC) to the logic diagram?



- a) $A' \cdot (B+C)$ b) $A + (B.C)$ c) $(A'+B).C$ d) $A' + (B.C)$
6. How many NAND Gates are required to realise the XOR Gate?
a) 5 b) 4 c) 3 d) 6
7. Which of the following data represents a valid even parity bit?
(The MSB is the Parity bit)
a) 11100 b) 00111 c) 10111 d) 01011

8. A wristwatch is designed to run on a small button cell battery for months without replacement. Which logic family would be the most suitable choice for its internal digital circuits?
 a) TTL b) CMOS c) ECL d) RTL
9. Which among the following memory uses capacitors to store charge?
 a) DRAM b) SRAM c) BOTH d) NONE
10. Programmable Logic Array (PLA) is a combinational circuit with programmable _____ arrays?
 a) AND & OR b) NAND & NOR
 c) OR & NOT d) NAND & AND
11. Why is a demultiplexer often called a "data distributor"?
 a) It combines several input data into one output line.
 b) It distributes a single input data to one of many outputs.
 c) It generates parity bits for error detection.
 d) It converts binary inputs into coded outputs.
12. Which of the following is not a type of Analog-to-Digital Converter (ADC)?
 a) Dual slope type b) Successive approximation type
 c) R-2R ladder d) Flash type
13. Which type of signal can be used to represent continuous signals like sound, temperature, or voltage?
 a) Analog b) Digital c) None d) Both
14. What is the function of a decoder driver in display systems?
 a) Store data b) Convert input signals to display signals
 c) Supply power d) Increase clock speed
15. Which of the following is not a type of display?
 a) LED b) LCD c) BJT d) Dot matrix

B. Short Answer Type Question.**(15 X 2 = 30)**

1. List any four different types of codes used in digital systems.
2. Give the 2421 code and 8421 code representation of $(9)_{10}$.
3. Define maxterms and minterms.
4. Express the given Boolean function as a product of maxterms
 $F = xy + x'y$
5. Write down two applications of Encoders.
6. Define half subtractor and full subtractor?
7. What is the purpose of a parity generator and a parity checker?
8. List any two differences between TTL and CMOS logic families.
9. Why is the high-impedance (Z) state in a tristate logic gate important?
10. Differentiate between flipflops and latches.
11. Explain how the Master-Slave flip-flop overcomes the problem of race conditions in sequential circuits.
12. Why is a synchronous counter faster than an asynchronous counter?
13. Write any two characteristics of a Digital-to-Analog Converter (DAC).
14. How is multiplexing of displays achieved?
15. Design a pattern to display the letter 'H' on a 5×7 dot-matrix display. Indicate which dots should be turned on.

C. Long Answer Type Questions**(10 x 3 = 30)**

1. Convert the hexadecimal number **CAB** into
 - a. Decimal
 - b. Binary
 - c. Octal
2. Simplify the given Boolean function using K-Map
 $F(x, y, z) = \sum (0, 2, 4, 5, 6)$
3. Design a 4 - input multiplexer and construct its truth table.
4. Construct a 4-to-2 decoder using logic gates and provide its truth table.

- 5/3. Discuss the different types of shift registers in sequential circuits?
- 6/4. Briefly describe the different types of ROM.
- 7/5. With neat logic diagram, design a 3-bit asynchronous up/down counter?
- 8/6. Design a JK Flip-Flop and draw its timing diagram.
- 9/7. Explain the working and principle of the Weighted Resistor Digital-to-Analog Conversion (DAC)
- 10/8. Design a Counter type ADC and briefly explain its working.

COMPUTER ARCHITECTURE & ORGANIZATION

CSE -404

Full Marks : 75 SCTE/NGL/R-2025-I

Pass Marks : 30

Time : 3 Hours

A. Multiple Choice Questions: (1x19=19)

1. Analytical Engine, the first fully automatic calculating machine was developed by:
 - a) Charles Babbage
 - b) Blaise Pascal
 - c) John Von Neumann
 - d) Gottfried Wilhelm Leibniz
2. Which component was the key technology used in the second generation of computers?
 - a) Integrated Circuits (IC's)
 - b) Vacuum Tubes
 - c) Transistors
 - d) Microprocessor
3. 2's complements of (1000)₂ is:
 - a) 0001
 - b) 0101
 - c) 0111
 - d) 1000
4. A floating-point number is said to be normalized, if the Most Significant Bit (MSB) of the mantissa is:
 - a) 1
 - b) 0
 - c) -1
 - d) 2
5. The control unit acts as the "Brain" of the computer by:
 - a) Calculating numerical values for program
 - b) Managing the memory and storage devices
 - c) Deciphering instructions and telling other components what to do and when.
 - d) Communications directly with external peripheral devices
6. If a hardwired control unit is designed to be fast, which type of architecture is often based on it?
 - a) Complex Instructions Set Computer (CISC)
 - b) A Personal Desktop Computer (PDC)
 - c) Reduce Instructions Set Computer (RISC)
 - d) Micro-controller like the 8085

7. How does indirect addressing differ from direct addressing?
 - a) Direct addressing uses a base register, while indirect addressing uses an indirect register
 - b) Direct Addressing specifies the Operands Address Directly, whereas, Indirect Addressing specifies the memory location that holds the Operand's address
 - c) Indirect Addressing involves the program counter, while Direct Addressing does not
 - d) Direct addressing uses pointers, while Indirect Addressing uses constants
8. The 8085 microprocessors has:
 - a) 8-bits data bus, 16-bits address bus
 - b) 8-bits data bus, 8-bits address bus
 - c) 16-bits data address bus, 8-bits address bus
 - d) 16-bits data bus, 16-bits address bus
9. What is the primary function of the ALE signal in the Intel 8085 microprocessor?
 - a) Indicates the end of an instruction cycle
 - b) Demultiplexes the address bus and data bus
 - c) Signals a "READY STATE" for the CPU operation
 - d) Requests a "MEMORY READ" operation
10. If the sign flag(s) is set 1, what does it indicates about the result of an operation?
 - a) The result is Zero
 - b) The result is Negative
 - c) A carry occurred during the operation
 - d) An even number of 1's are present in the result
11. Where is a cache memory located relative to the CPU and RAM?
 - a) After the main memory (RAM)
 - b) Before the CPU
 - c) Between the CPU and the main memory (RAM)
 - d) On a separate bus connected to the graphics card
12. A CPU needs to access data that is not in the cache, what is the next step in the memory hierarchy?
 - a) The data is retrieved from the CPU register
 - b) The data is retrieved from the main memory
 - c) The data is retrieved from the optical disk
 - d) The CPU will halt

13. If a power surge causes a computer to shut down, what happens to the data stored in RAM?
 - a) It remains intact because RAM is non-volatile
 - b) It is permanently lost because RAM is volatile
 - c) It is transferred to the hard drive for temporary storage
 - d) It is erased from the processor's cache
14. Why is the binary system (0's and 1's) the foundation of modern computing?
 - a) Because it's the only system human can understand
 - b) Because it's easy to represent with two distinct electrical states (ON & OFF) in hardware
 - c) Because high-level languages are written using only two digits
 - d) Because it allows for complex mathematical operation to be performed
15. Which of the following groups contains only output devices?

a) Keyboard, Mouse, Scanner	b) Monitor, Printer, Speaker
c) Microphone, Keyboard, Touchpad	d) Printer, Keyboard, Monitor
16. Why is the keyboard considered as fundamental input device?
 - a) It provides audio output
 - b) It allows users to directly input text and commands
 - c) It creates hard copies
 - d) It converts handwriting into digital text
17. Which input device is used to navigate and interact with graphical user interface?

a) Mouse	b) Keyboard
c) Joystick	d) Scanner
18. Hard Disk drives are a type of:

a) Primary storage	b) Secondary storage
c) CPU register	d) Cache memory
19. The family of Intel microprocessors commonly used in Personal Computers (PC's) is:

a) Zi-log Z80	b) Motorola 68000
c) Intel Core Series	d) AMD Athlon

B. SHORT ANSWER QUESTIONS:

1. Who is known as the "Father" of Computer's for his pioneering work in mechanical computing devices? (2)
2. Why is Artificial Intelligence (AI) considered a defining characteristic of the fifth-generation of computers? (2)

3. What is floating point number and what are the two main components of a floating-point number representation? (2)
4. If an 8-bit 2's complement number is $(11101001)_2$, what is its decimal equivalent? (2)
5. Write a short note on components of an ALU and what are the primary functions of the ALU? (2)
6. What is instruction set and how is the instruction set classified? List the different types of instructions. (3)
7. What is a microprocessor? What are the several control signals available on the microprocessor? (2)
8. What does the acronym RICS or CISC stand for and what is its core characteristics? (2)
9. What is memory hierarchy based on the speed as well as use. List its five level hierarchies. (3)
10. What are Laser printers? How does a Laser printer create an image? If you need to print a high-quality graphic with rich color, which type of printer would you choose and why? (1+1+1)
11. (i) Define the term "Visual Display Unit" and list two types of VDU. (2)
(ii) How would you describe a Hard Drive? Write some of the important terms of it? (2)

C. DESCRIPTION TYPE QUESTIONS:

1. Explain the basic electronic components and the key programming language used in the First-Generation computers. (3)
2. What is the Most Significant Bit (MSB) signed-magnitude, 1's complement, and 2's complement represents and how does it determine the number's sign? (3+1)
3. Define hardware control unit. Identify the control signal generated by a hardwired control unit give an instruction Opcode and Status Flags. (2+3)
4. Give that a processor can use pipelining to improve performance. Explain why RISC architectures are often described as being highly pipelined compared to CISC. (4)
5. Describe how a cache Hit and a cache Miss effect CPU performance? (4)
6. Describe the specific type of output needed for operational management, and identify whether a VDU or printer would be the better primary tool for that purpose. (5)
7. Explain in brief about the Personal Computer Architecture? (4)

DATA STRUCTURE AND ALGORITHM

CSE-403

Full Marks : 75 SCTE/NGL/R-2025-I

Pass Marks : 30

Time : 3 Hours

A. Multiple choice questions

(15X1=15)

1. Data must be represented, organized, stored, processed and managed in a way that facilitates _____.
a) Easy access b) Retrieval c) Both (a) and (b) d) Withdrawal
2. An algorithm is
a) A piece of code to be executed
b) A loosely written code to make final code
c) A step by step procedure to solve problem
d) A diagram that explains the process
3. What is a string in the context of data structures?
a) A sequence of characters b) A type of array
c) A collection of integers d) A numerical value
4. The first Index of an Array typically starts from
a) -1 b) 0 c) 1 d) 2
5. Which of the following is a linear data structure
a) Array b) Tree c) AVL tree d) Graph
6. Each node in a linked list must contain at least
a) Three fields b) Two fields
c) Four fields d) Five fields
7. The situation when in a linked list $START=NULL$ is
a) underflow b) overflow c) housefull d) saturated

8. If in a linked list , struct node *current = start->next. What "current" will contain if it is variable of type struct node .
 - a) Address of 2nd Node
 - b) Address Field of 2nd Node
 - c) Data Field of 2nd Node
 - d) Address of 3rd Node
9. The term PUSH and POP is related to.
 - a) Stack
 - b) Queue
 - c) Tree
 - d) Graph
10. Which of the following data structure allows deletion and insertion from only one end
 - a) Queue
 - b) Stacks
 - c) Linked list
 - d) Array
11. A data structure that organizes data similar to a line in the supermarket, where the first one in line is the first one out.
 - a) Queue
 - b) Stacks
 - c) Tree
 - d) Array
12. What is the postfix equivalent of the following infix $A+B/(C-D)$
 - a) $+A/B-CD$
 - b) $ABCD-/+$
 - c) $A+B/CD-$
 - d) $ABCD+/-$
13. A line which connects any two nodes is called.
 - a) Edge
 - b) Depth
 - c) Level
 - d) Height
14. The Depth First Search traversal of a graph will result into.
 - a) Linked List
 - b) Spanning Tree
 - c) Binary tree
 - d) Array
15. An organized logical sequence of records is called
 - a) File
 - b) Organization
 - c) Scrubbing
 - d) Sequencing

B. Answer the following questions

(16X2=32)

1. What is a linear data structure?
2. Briefly explain complexity of an algorithm?
3. What are global variables?
4. List out any four string operations?
5. Find the length of the string "SCTE Nagaland"?

6. What is an array?
7. Define linked list?
8. How is traversing performed in a linked list?
9. What is the purpose of head/start pointer in a linked list?
10. Define STACK in data structure?
11. Define terminal node in tree?
12. Explain in brief the basic concept of a binary search tree?
13. Define weighted graph?
14. Define hash function?
15. Explain in short the concept of Radix sort algorithm?
16. Define sequential access file organization?

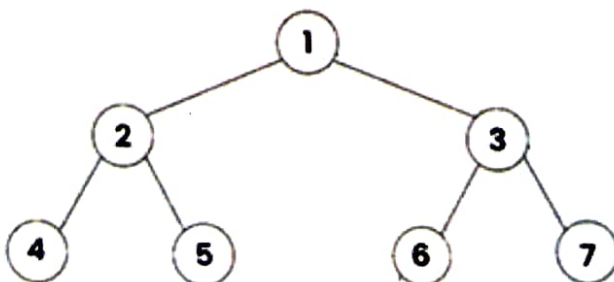
C. Answer the following questions

(7X4=28)

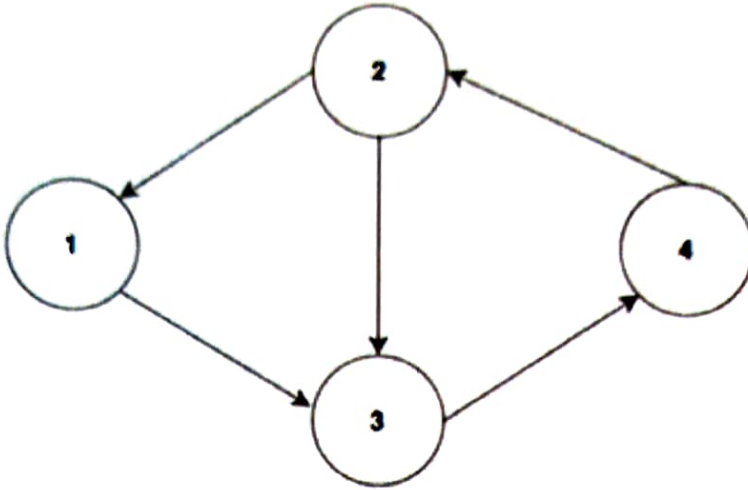
1. How is fixed length structure used for storing strings different from Linked structure?
2. Apply Binary search to find ITEM=67 in the below given array.

12	34	44	56	67	70	87
----	----	----	----	----	----	----

3. Explain pointer arrays with example?
4. Explain dequeues with figure?
5. Perform pre-order and in-order traversal of the given tree?



6. Find the adjacency matrix of the given graph?



7. Sort the given array using merge sort algorithm?

34	16	23	67	43	11	07
----	----	----	----	----	----	----

Object Oriented Programming in C++ CPE409

Full Marks – 75

Pass Marks -30

Time: 3 hours

All figures in the right margin indicate the marks for the corresponding questions.

I. Answer the following Multiple-Choice questions. (15X1=15)

1. What is an object in C++?

- a) Function of a Class b) Instance of a Class
- c) Datatype of a Class c) Syntax of a Class

2. The feature that allows the same operations to be carried out differently depending on the object is _____

- a) Polymorphism b) Inheritance
- c) Encapsulation d) Abstraction

3. Total access specifiers in OOPS for C++ are?

- a) 2 b) 3
- c) 4 d) 1

4. Under which pillar of OOPS do base class and derived class relationships come?

- a) Polymorphism b) Inheritance
- c) Encapsulation d) Abstraction

5. Identify the scope resolution operator.

- a) ; b) !
- c) : d) ::

6. Which of the following can be considered as the members that can be inherited but not accessible in any class?

- a) Public b) Protected
- c) Private d) Both a and c

7. Which of the following feature is also known as run-time binding or late binding?

- a) Dynamic typing b) Dynamic loading
- c) Dynamic binding d) Data hiding

8. Why is reusability a desirable feature?

- a) Reduce Compilation time b) Lowers maintenance cost
- c) Decreases testing time d) None

9. Identify the feature using which, one object can interact with another object.

- a) Message passing b) Message reading
- c) Data binding d) Data transfer

10. Which keyword is used to create a new object?

- a) new
 - b) class
 - c) struct
 - d) this
11. What is the purpose of a destructor?
- a) To create a new object
 - b) To deallocate memory used by an object
 - c) To define the behaviour of an object
 - d) To access the members of an object
12. Which of the following is a benefit of using OOP?
- a) Makes code harder to read and maintain
 - b) Reduces code reusability
 - c) Makes code more modular and easier to maintain
 - d) Reduces the need for abstraction
13. What is the purpose of the 'this' pointer?
- a) To create a new object
 - b) To access the members of the current object
 - c) To define the behaviour of a class
 - d) To call a destructor
14. How many objects can present in a single class?
- a) 1
 - b) 2
 - c) 3
 - d) as many as possible
15. Which of the following is the address operator?
- a) @
 - b) #
 - c) &
 - d) %

II. Answer the following in brief. Any 10.

(10X3=30)

1. List some advantages of C++?
2. What is the difference between a class and an object?
3. What are the four pillars of OOP?
4. What are access specifiers?
5. What are the various types of inheritance?
6. What is meant by exception handling?
7. What is the difference between overriding and overloading.
8. What is do while loop? Give its syntax?
9. What is a friend function?
10. What is user-defined data type and built-in data type?
11. What is an Abstract class?
12. What is the advantage of function overloading?

III. Answer the following question in detail. Any 6. (6X5=30)

1. Explain the following term:
a) Constructor b) Data binding c) Inline Function
d) Objects d) Runtime Polymorphism
2. Write a C++ program to demonstrate the concept of nested if.
3. Explain the different types of inheritance with their syntax.
4. Explain in detail the features/characteristics of Object-Oriented Programming.
5. What is a structure? What is the keyword used to create a structure? Give its syntax.
6. Explain the concept of polymorphism in detail.
7. What are the different types of constructors in C++? Explain each in detail.
8. Write a program in C++ to create a class 'Person' with (Name, Age, Gender) as its attributes.