

Birla Industrial & Technological Museum

(A unit of National Council of Science Museums)

19A Gurusaday Road, Kolkata 700019

Trade: Computer

Full Marks: 100

Maximum Time: 180 Mins

(To be filled by the candidate only)		(For Office Purpose Only)
Name of the Candidate (in capital letters)		Marks Obtained
Application No / Letter No:		
Date of Examination:		
..... Signature of Candidate	 Signature of Invigilator	 Signature of Examiner

Instruction to the Candidates

1. Answer all the questions.
2. Put tick mark for the correct answer of the MCQ and write in brief for the descriptive type questions.
3. Use ball point pen only.
4. All rough works to be done on blank spaces provided in the question paper.
5. No double markings on the answers of the MCQ.
6. Use of Calculators/Mobile Phones/Computing device not allowed in the examination hall.
7. If any clarification is required during the examination, please ask the invigilator.

Part -A

Select the correct option for each of the questions: Marks: 15 X 1 = 15

1. Which of the following is a valid C identifier?

- A) 2sum B) _value
- C) -count D) int

2. Which operator is used to access value at the address stored in a pointer?

- A) & B) *
- C) -> D) %

3. What will printf("%d", sizeof(char)); output in C?

- A) 2 B) 1
- C) 4 D) Compiler dependent

4. Which storage class in C makes a variable visible only inside the file it is declared?

- A) auto B) extern
- C) static D) register

5. Which of the following is undefined behavior in C?

- A) Using uninitialized variables B) Using sizeof operator
- C) Using break inside switch D) Declaring global variables

6. Which logic gate's output is 1 only when all inputs are 1?

- A) OR B) NAND
- C) AND D) NOR

7. The Boolean expression $A + A'B$ simplifies to:

- A) $A + B$ B) $A + AB$
- C) $A + A'$ D) $A + B'$

8. What is the output frequency of a full-wave rectifier if input is 50 Hz?

- A) 25 Hz B) 50 Hz

C) 100 Hz D) 200 Hz

9. In a 4-bit ripple counter, the maximum count is:

A) 8 B) 15

C) 16 D) 10

10. Which of the following flip-flops is edge-triggered?

A) RS latch B) D flip-flop

C) SR latch D) None

11. Which data structure uses FIFO principle?

A) Stack B) Queue

C) Linked List D) Tree

12. What is the time complexity of searching in a sorted array using binary search?

A) $O(1)$ B) $O(\log n)$

C) $O(n)$ D) $O(n \log n)$

13. A complete binary tree of height h has how many nodes (maximum)?

A) 2^h B) $2^{(h+1)} - 1$

C) h^2 D) $\log h$

14. Which traversal method of binary tree gives nodes in sorted order if it's a BST?

A) Preorder B) Inorder

C) Postorder D) Level order

15. The best case time complexity for inserting a node in a balanced AVL tree is:

A) $O(1)$ B) $O(\log n)$

C) $O(n)$ D) $O(n \log n)$

16. Which register in CPU holds the address of the next instruction?

A) MAR B) MDR

C) PC D) IR

17. The ALU is part of:

- A) Memory Unit B) Input Unit
- C) Control Unit D) CPU

18. Which addressing mode uses the value of register plus displacement?

- A) Immediate B) Direct
- C) Indexed D) Indirect

19. Cache memory works on the principle of:

- A) Locality of reference B) FIFO
- C) Parallelism D) Virtual memory

20. The number of address lines required for 1K memory is:

- A) 8 B) 10
- C) 16 D) 12

21. Time complexity of linear search is:

- A) $O(1)$ B) $O(n)$
- C) $O(\log n)$ D) $O(n \log n)$

22. Which sorting algorithm is based on the divide and conquer principle?

- A) Bubble sort B) Quick sort
- C) Selection sort D) Insertion sort

23. Dijkstra's algorithm is used to find:

- A) Minimum spanning tree B) Shortest path
- C) Topological sort D) All-pairs shortest path

24. Time complexity of merge sort in worst case:

- A) $O(n)$ B) $O(n \log n)$
- C) $O(\log n)$ D) $O(n^2)$

25. Which problem cannot be solved in polynomial time (currently known)?

- A) MST
- B) Shortest Path
- C) Travelling Salesman
- D) Binary Search

26. Which of the following is not an OS?

- A) Windows
- B) Linux
- C) Oracle
- D) MacOS

27. Which scheduling algorithm may cause starvation?

- A) Round Robin
- B) FCFS
- C) SJF
- D) Priority

28. Thrashing is related to:

- A) Deadlock
- B) Multiprogramming
- C) Paging
- D) Scheduling

29. Which system call creates a new process in Unix?

- A) exec()
- B) fork()
- C) wait()
- D) exit()

30. In Banker's algorithm, the system is in safe state if:

- A) No process is blocked
- B) A safe sequence exists
- C) CPU utilization is maximum
- D) Resources are unlimited

31. SQL command to delete all rows but keep structure:

- A) DROP
- B) TRUNCATE
- C) DELETE
- D) REMOVE

32. Which key uniquely identifies a tuple?

- A) Primary Key
- B) Foreign Key
- C) Candidate Key
- D) Super Key

33. Which normal form removes partial dependency?

- A) 1NF B) 2NF
- C) 3NF D) BCNF

34. ACID property: "Durability" ensures what?

- A) Data remains consistent B) Changes survive failure
- C) Transactions rollback D) Only one transaction runs

35. A correlated subquery is evaluated:

- A) Once per query B) Once per row
- C) Once per table D) Never

36. Which layer in OSI model ensures reliable delivery?

- A) Physical B) Data Link
- C) Transport D) Session

37. Which protocol is connection-oriented?

- A) UDP B) IP
- C) TCP D) ICMP

38. The maximum length of an IPv4 address in binary is:

- A) 16 bits B) 32 bits
- C) 64 bits D) 128 bits

39. Which topology has highest redundancy?

- A) Star B) Mesh
- C) Bus D) Ring

40. In distance vector routing, the count-to-infinity problem is solved by:

- A) Flooding B) Split horizon
- C) Congestion control D) None of the above

41. Which keyword is used to inherit a class in Java?

- A) this
- B) super
- C) extends
- D) implements

42. Which feature of OOP allows multiple forms of a method?

- A) Abstraction
- B) Encapsulation
- C) Polymorphism
- D) Inheritance

43. Which method is called automatically at object creation in Java?

- A) finalize()
- B) init()
- C) constructor
- D) main()

44. Interfaces in Java can contain:

- A) Fields only
- B) Methods only
- C) Both abstract methods and constants
- D) Constructors

45. Which concept prevents multiple inheritance of classes in Java?

- A) Encapsulation
- B) Virtual methods
- C) Diamond problem
- D) JVM restriction

46. The 8086 microprocessor is a:

- A) 8-bit
- B) 16-bit
- C) 32-bit
- D) 64-bit

47. The 8051 microcontroller has how many ports?

- A) 2
- B) 3
- C) 4
- D) 5

48. The maximum memory addressing capability of 8086 is:

- A) 64 KB
- B) 1 MB
- C) 4 GB
- D) 16 MB

49. Which register in 8051 is used for serial communication?

- A) TMOD B) PCON
C) SBUF D) DPTR

50. In 8086, physical address is calculated as:

- A) Segment $\times$ Offset B) Segment + Offset *
C) (Segment $\times$ 10h) + Offset D) None

Part - B

1. A. How can digital technologies be effectively used to design and develop interactive exhibits in museums? Explain with suitable examples.

B. Explain how digital technology can address the accessibility issues in museums for people with disabilities, language barriers, geographical limitations etc.

Marks: 5 + 5 = 10

2. A. Explain the asymptotic notations Big-O (O), Big-Omega (Ω) and Big-Theta (Θ) in details.

B. You are given the network 192.168.10.0/24.

You need to divide this network into subnets to satisfy the following requirements for four departments:

Department	Number of Hosts
A	70
B	35
C	20
D	10

Tasks:

I. Assign the appropriate subnet addresses to each department using VLSM.

II. For each subnet, provide:

- Network Address
- Subnet Mask
- Broadcast Address
- First Host Address
- Last Host Address
- Number of Usable Hosts

III. Show the step-by-step calculation of how you allocated the subnets.

Marks: 5 + 5 = 10

3. A. Describe the different cache mapping techniques with diagram.

B. Six processes arrive at different times as shown below:

Process	Arrival Time (AT)	Burst Time (BT)
P1	0	7
P2	1	4
P3	2	9
P4	3	5
P5	5	2
P6	6	6

Scheduling policy: Round Robin

Time Quantum (q): 3 units

Tasks:

- I. Draw the Gantt chart showing all time slices and preemptions.
- II. For each process, compute Completion Time, Turnaround Time, Waiting Time and Response Time.
- III. Compute average Turnaround Time, average Waiting Time and average Response Time.

Marks: 4 + (2 + 3 + 1) = 10

Part – C

1. Design and implement a program in C++/Java to model a Banking System using Object-Oriented Programming concepts.

Requirements:

- I. Create an abstract base class 'Account' with the following:

Attributes:

- i. accountNumber
- ii. holderName

- iii. balance

Methods:

- i. deposit(double amount)
- ii. withdraw(double amount) //Abstract Method
- iii. displayDetails() // Abstract Method

II. Derive two subclasses:

- i. SavingsAccount with additional attribute interestRate. Withdrawals cannot reduce balance below ₹500.
- ii. CurrentAccount with additional attribute overdraftLimit. Withdrawals allowed up to overdraft.

III. Implement polymorphism so that a single collection of Account references can store both types of accounts.

IV. Demonstrate in main() by:

- i. Creating at least one SavingsAccount and one CurrentAccount.
- ii. Depositing and withdrawing from each account.
- iii. Displaying account details using overridden displayDetails().

Marks: 10

2. Study the table given below:

EmpID	Name	Department	Salary	Age	JoiningYear
101	Alice	HR	45000	29	2018
102	Bob	IT	60000	32	2016
103	Charlie	Finance	52000	41	2014
104	Diana	IT	72000	36	2012
105	Eva	HR	47000	28	2020
106	Frank	Marketing	55000	39	2015
107	Grace	Finance	68000	45	2011
108	Henry	IT	75000	30	2019
109	Irene	Marketing	62000	35	2013
110	John	Finance	50000	29	2017

Write the SQL queries to retrieve the following data:

- I. Retrieve the average salary of each department but only display those departments where the average salary is greater than 55,000.
- II. List the names of employees who earn more than the average salary of their own department.

- III. Display the department with the highest total salary expenditure and show the department name along with the total salary.
- IV. Retrieve the top 3 highest-paid employees across all departments, but also display their department names.
- V. Find the departments that have more than 2 employees older than 30 years, and display the department name along with the count of such employees.

Marks: 5 X 2 = 10