

Time : 3 hours

Full Marks : 200

**Instructions :**

- (1) Answer **all** questions following the directions.  
 (2) The figures in the margin indicate full marks for the questions.

1. Answer any *two* of the following questions :

10×2=20

- (a) Explain the various sections of an executable—text, bss and data. Where are the local variables stored in an executable?  
 (b) Explain why the following expression grammar causes ambiguity :

$$E \rightarrow E + E | E * E | (E) | id$$

How can the ambiguity be removed?

- (c) Differentiate between preemptive and non-preemptive CPU scheduling. Compute the order of completion of processes for First Come First Serve (FCFS) and Shortest Remaining Time First (SRTF) algorithms for the following processes given below :

Process	Execution Time (ms)	Arrival Time (ms)
A	20	0
B	25	15
C	10	30
D	15	40

2. Answer any *two* of the following questions :

10×2=20

- (a) What is a queue? Explain and write pseudocode for the implementation of queue using array. What is a circular queue?  
 (b) Sort the following elements using bubble sort, demonstrating all the intermediate steps :  
 22, 44, 10, 28, 41, 95, 7, 3, 1, 32, 78  
 (c) Explain the preorder, inorder and postorder traversals of a binary tree with pseudocode and examples.

3. Answer any two of the following questions : 10×2=20

- (a) Implement a JK flip-flop using AND and NOR gates only and explain how it works. How is JK flip-flop different from combinational circuit?
- (b) With the aid of a block diagram, explain the components of 8085/8086 microprocessor. List and explain the usage of registers of the processor.
- (c) Distinguish between RISC and CISC machine architectures with suitable examples.

4. Answer any two of the following questions : 10×2=20

- (a) Explain how parameter passing in functions can be performed using pass by value, pass by reference and pass by pointer mechanisms with suitable examples.
- (b) With suitable examples, explain the usage of default constructor, parameterized constructor, copy constructor and private constructor in object-oriented programming. Explain if it is possible to have a virtual constructor.
- (c) Show that  $p \leftrightarrow q \equiv (p \vee q) \rightarrow (p \wedge q)$  using (i) truth table and (ii) algebra of proposition.

5. Answer any two of the following questions : 10×2=20

- (a) Solve the linear system by using Gauss elimination method :

$$\begin{aligned}x + y + z &= 3 \\x + 2y + 2z &= 5 \\3x + 4y + 4z &= 12\end{aligned}$$

- (b) Using Newton's forward interpolation formula, find the cubic polynomial which takes the following values :

x	0	1	2	3
y	1	2	1	10

- (c) Find the largest eigenvalue and the corresponding eigenvector of the matrix

$$\begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

6. Answer any *two* of the following questions : 10×2=20

- (a) Explain how two cooperating processes can communicate using (i) pipe, (ii) shared memory, (iii) message passing and (iv) signals.
- (b) In order to generate control signals for instruction execution, the control unit of CPU may be designed using (i) hardwired control and (ii) microprogrammed control. Explain and distinguish between these two mechanisms.
- (c) Enumerate the various addressing modes of a 16-bit microprocessor with suitable examples.

7. Answer any *two* of the following questions : 10×2=20

- (a) What are the different methods of accessing record? Describe direct access. Explain the operations required to maintain an indexed file.
- (b) Consider the relation for published books :

BOOK (Book-title, Author, Book-type, Price, Author\_affil, Publisher)

Author-affil refers to the affiliation of author. Suppose the following dependencies exist :

Book-title → Publisher, Book-type

Book-type → Price

Author → Author-affil

What normal form is the relation in? Explain your answer. Apply normalization until you cannot decompose the relation further. State the reason behind each decomposition.

- (c) Explain testing for serializability with respect to concurrency control scheme. How will you determine whether a schedule is serializable or not?

8. Answer any *two* of the following questions : 10×2=20

- (a) What is waterfall model of software development? How does it compare with iterative and incremental development model?
- (b) What is the difference between requirement analysis and requirement specification? Using suitable examples, explain different types of requirement problems that should be identified and resolved during the requirement analysis activity.
- (c) Discuss unit testing and integration testing with suitable examples.