

## COMPUTER SCIENCE AND APPLICATIONS

### PAPER—III

**NOTE:** This paper is of two hundred (200) marks containing four (4) sections. Candidates are required to attempt the questions contained in these sections according to the detailed instructions given therein.

### SECTION - I

**Note :** This section contains five (5) questions based on the following paragraph. Each question should be answered in about thirty (30) words and each carries five (5) marks.

(5x5=25 marks)

Design a database for storing the data of all the employees in a business firm and create queries for extracting the following information, on the following lines. Only the relevant information and codes need to be written.

1. Create a table/tables for storing the personal data and also specify the keys.

2. Write SQL queries for getting the list of all employees in the age group of 40 to 50.

3. Create a table/tables to store the pay and service details of the employees and also specify the keys.

4. Write SQL queries for getting the list of employees who have an annual income of more than 4 lakhs considering the salary and other income of the recent-past 12 months.

5. Write SQL queries to generate the names and ages of all employees with one or two children and with one of the child is a female child.

## SECTION - II

**Note :** This section contains fifteen (15) questions each to be answered in about thirty (30) words. Each question carries five (5) marks.

(5×15=75 marks)

6. Design an algorithm to compute  $x^n$ , where  $n$  is a positive integer, using divide and conquer technique.

7. State whether  $L = \{a^n b a^m b a^1 : 1, m, n \geq 1\}$  is regular or not. Justify your claim.

8. Write a function in C/C++ to reverse a linked list without using more than constant amount of extra space.

9. Implement a half subtractor using only NOR gates.

10. Distinguish between memory mapped I/O and I/O mapped I/O.

11. What are the differences between OSI and TCP/IP reference model ?

12. Explain how a semaphore that can hold an arbitrary value be implemented using only binary semaphores and ordinary machine instructions.



13. What is an expert system? How does it differ from a conventional computer program?

14. Describe the waterfall model of a software process.

15. State the relative merits of digital vector generator and analog vector generator.

16. Distinguish between MS - WINDOWS and MS - DOS.

17. Compare Object Oriented DBMS with RDBMS.

18. What is encapsulation? Explain the benefits with an example using private and public keys.

19. Show by an example that virtual functions are hierarchical.

20. Give the postfix notation for  $(9-5)+7$  and  $8-(7+3)$ .

### SECTION - III

**Note :** This section contains five (5) Electives. The candidate has to choose one Elective and has to answer all the five questions from that Elective. Each question carries twelve (12) marks and is to be answered in about two hundred (200) words.

(12x5=60 marks)

#### Elective - I

21. Let  $\Sigma = \{a, b\}$ . Write a regular expression for the following language :  
 $L = \{\text{All strings in } \Sigma^* \text{ with a number of a's divisible by three}\}.$
22. Design a finite automaton that accepts the following language :  
 $L = \{w \in \{a, b\}^* : w \text{ does not contain three consecutive b's}\}$
23. Show that the intersection of two context free languages is not context free.
24. Design a Turing machine C which transforms string  $b\omega b$  to  $b\omega b\omega b$  where  $b$  represents a blank,  $\omega$  shows the position of the head of the tape and  $\omega$  is a string with no blanks. Give the diagrammatic representation of C.
25. Design a push down automaton for the following language :  
 $L = \{a^m b^n : m \neq n\}$

OR

#### Elective - II

21. Using Shannon's result, show that extremely wideband signals can be used to achieve error free communication as long as sufficient SNR exists.
22. State the properties of block codes.

23. Explain how the  $(7, 4)$  Hamming code can be used to correct burst errors.
24. The chirp transforms of a vector  $a = (a_0, a_1, a_2, a_3, \dots, a_{n-1})$  is the vector  $y = (y_0, y_1, y_2, \dots, y_{n-1})$  where  $y_k = \sum_{j=0}^{n-1} a_j z^j$  and  $z$  is any complex number. Show that the DFT is a special case of the chirp transform.
25. Explain how sub-band coding can be used for speech compression.

OR

Elective - III

21. Describe the properties of a solution to the LP problem.
22. State personnel-assignment problem. Why is it called a variation of the transportation problem ?
23. Is the shortest path tree unique ? Justify your answer with a suitable example.
24. Show that every tree is a bipartite graph. Give an example of a bipartite graph which is not a tree.
25. State and explain Kuhn-Tucker conditions.

OR

#### Elective - IV

21. Describe the McCulloch - Pitts model of a neuron.
22. Show that a linear neuron may be approximated by a sigmoidal neuron with small synaptic weights.
23. Describe the following learning rules :
  - a. Error correction learning
  - b. Hebbian learning
24. Explain the following statement :  
"Fuzzy systems are shallow but fully interactive"
25. State and explain fuzzy entropy theorem

OR

#### Elective - V

21. What is meant by portability ? How has it been made easy for porting UNIX to various platforms ?
22. List out any 10 features of UNIX and explain any two of them.
23. Describe the two methods used in UNIX to change the access permissions.
24. Describe the differences between Windows 98 and Windows NT.
25. Using a neat sketch, describe the structure of Windows 2000.

## SECTION - IV

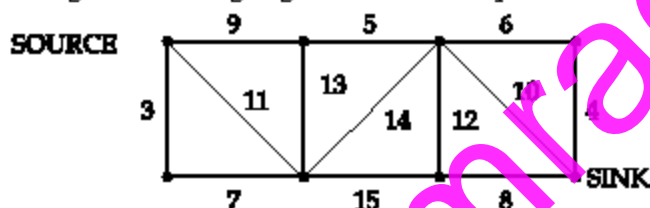
**Note :** This section consists of one question carrying (40) marks to be answered in about one thousand (1000) words on any of the following topics

(40×1=40 marks)

26. (a) Distinguish between a microprocessor and a microcontroller.  
 (b) Using a neat sketch, describe the functional organization of 8085 microprocessor.  
 (c) Write an 8085 assembly language program to determine and print the largest of five given integers.

OR

- (a) The capacities of all the links in a network are made unity and the maximum flow from source to sink determined. What is the physical significance of the number so obtained ?  
 (b) Write an explanatory note on the exponential behaviour of Ford and Fulkerson's algorithm.  
 (c) For the following network, determine the maximum flow from source to sink using the labeling algorithm. The capacities of the links are as indicated :



OR

- (a) State the key advantage of pop-up threads.  
 (b) Describe Coffman's four conditions for deadlock.  
 (c) State the producer-consumer problem and explain how it can be solved.

OR

- (a) Show that any point on the line segment joining two points in  $E_n$  can be expressed as a convex combination of the two points.  
 (b) Consider a diet of two foods  $x$  and  $y$  and, nutrient constraints involving thiamine, phosphorous and iron. The amount of each nutrient in each of the foods (in milligrams per ounce) is given in the following table :

Nutrient	$x$	$y$
Thiamine	0.15 mg/oz	0.10 mg/oz
Phosphorus	0.75 g/oz	1.70 mg/oz
Iron	1.30 g/oz	1.10 mg/oz

The diet should contain at least 1.00 mg of thiamine, 7.50 mg of phosphorous and 10.0 mg of iron. The cost of  $x$  is 2 cents/oz while the cost of  $y$  is 5/3 cents/oz. Write the corresponding linear programming formulation and solve the problem by revised simplex method.