*Total No. of Pages: 02*

*Student Name* .....

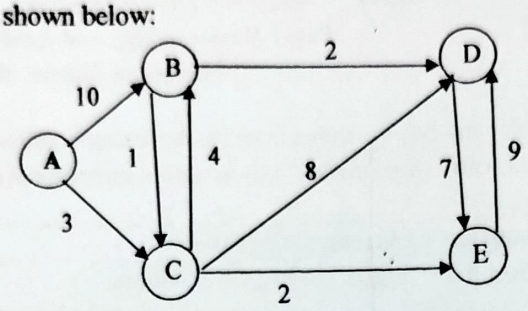
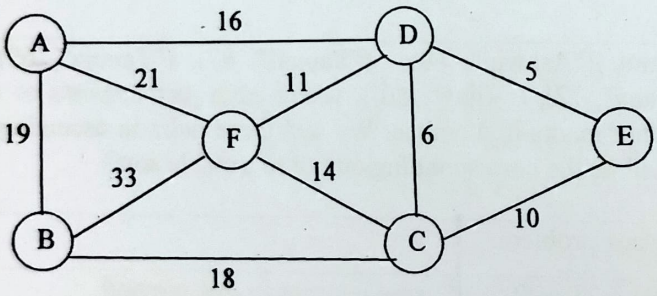
*Enrollment No.* .....

# Mid-Term Examination – November 2023

**Programme: B. Tech (AI & DS, AI & ML, IIOT)** **Semester: Fifth (September, 23 – January, 24)**
**Paper Code: AIDS-303/AIML-303** **Paper Name: Design and Analysis of Algorithm**
**Time: 1½ Hours** **Maximum Marks: 30**

**Note:** Q. No. 1 is compulsory. Attempt any two questions from the remaining questions. Some questions have internal choice also. All questions carry equal marks. Only scientific calculator is allowed.

| | **Question 1 (Attempt any Five)** | **Marks** |
|---|---|---|
| 1(a) | Find the order of the function f(n) = log(n!) in big Oh notation. | [2] |
| 1(b) | In Strassens' matrix multiplication, what is the formula to calculate the element present in the second row, first column of the product matrix? | [2] |
| 1(c) | Find the time complexity for algorithm to find the number of bits in binary representation of a decimal number n. (Example decimal number 9 is represented in binary by 1001 i.e. 4 bits) | [2] |
| 1(d) | A machine needs a minimum of 200 seconds to sort 1024 elements by Quick Sort. Approximately what will be the minimum time required to sort 512 elements? | [2] |
| 1(e) | We have a list of pairs [("Ashwin", 69), ("Sumati", 87), ("Tanuja", 69), ("Brinda", 87), ("Shabana", 72), ("Vijay", 60)], where each pair consists of a student's name and his/her marks in a course. We sort these pairs in ascending order of marks. What will be the corresponding output to a stable sort? | [2] |
| 1(f) | Explain fractional knapsack problem. | [2] |
| 1(g) | Solve the recurrence $T(n) = 2T(n/2) + n^2$ using recurrence tree method. | [2] |
| | **Questions 2** | |
| 2(a) | (i) Solve the following recurrence relation using Master's theorem $T(n) = 2T(n/4) + n^{0.51}$ | [5] |
| | (ii) Calculate the time complexity for Towers of Hanoi. It consists of three pegs A, B and C. Move n disks from A to B, Never put a larger disk above a smaller one and C is transit peg. | [5] |
| | **OR** | |

| | | |
|---|---|---|
| 2(b) | (i) Let $r_n$ be the number of n-bit strings that do NOT contain two consecutive 1's. Find the recurrence relation for $r_n$? | [5] |
| | (ii) Compute the time complexity of insertion sort and perform the insertion sort to sort the following numbers [27, 19, 33, 15, 4] | [5] |
| | **Question 3** | |
| 3(a) | (i) Illustrate Djiskstra's Algorithm for finding the shortest path from A in the graph shown below:<br>  <br> | [5] |
| | (ii) What is the optimal Huffman code for the following set of frequencies:<br>a: 0.25, b: 0.1, c: 0.2, d: 0.15, e: 0.26, f: 0.04 | [5] |
| | **OR** | |
| 3(b) | (i) Construct a minimum spanning tree using Prim's algorithm for the graph shown below:<br>  <br> | [5] |
| | (ii) Perform the heap sort to sort the following numbers.<br>4, 10, 3, 5, 1 | [5] |

End