No. of Printed Pages : 7 **MMTE–002**

M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

[M. SC. (MACS)]

Term-End Examination

December, 2025

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 Hours *Maximum Marks : 50*

Note: *(i) Attempt any* ***four*** *questions from question nos.* ***1*** *to* ***6****.*

(ii) Question No. 7 is compulsory.

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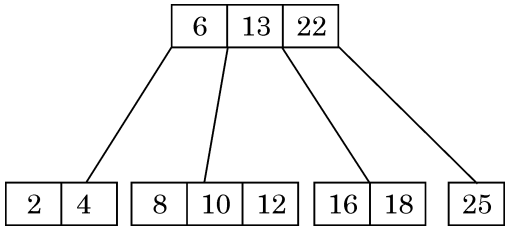
1. (a) Sort the following numbers using the merge sort algorithm, showing all the steps you use in the process : 5

8, 2, 7, 3, 1, 6, 5, 4

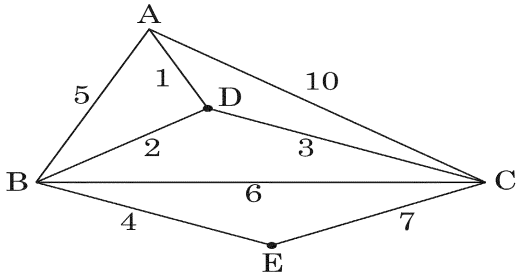
(b) Explain the process of inserting a new element 11 in the following (2, 4) tree : 5



2. (a) Construct a Huffman code for the following data, explaining all the steps : 5

Character	Frequency
a	50
b	20
c	10
d	5
e	30

(b) Find the minimum weight spanning tree of the following graph G using Kruskal's Algorithm : 5



3. (a) Find the longest common subsequence of the sequences X = < 1, 2, 3, 2, 5, 2 > and Y = < 2, 4, 1, 3, 1, 2 > using dynamic programming. 5

(b) Show that subset sum problem is an NP-complete problem. 5

4. (a) Show that there is a polynomial time reduction from independent set problem to set cover problem. 5

(b) Write the algorithm for coin changing problem by using dynamic programming technique and explain each of the steps used in it. Do not write any pseudo-code. 5

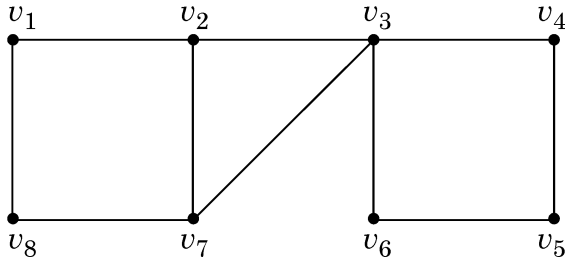
5. (a) A thief enters a house for robbing it. He can carry a maximal weight of 60 kg into his bag. There are 5 items in the house with the following weights and values. What items should the thief take if he can even take the fraction of any item with him ? 5

Item	Weight	Value
1	5	30
2	10	40
3	15	45
4	22	77
5	25	90

(b) Explain with the help of an example that Greedy strategy does not always yield optimal solution for optimisation problems. 5

6. (a) Show that the nth Fibonacci number F_n satisfies the inequality $F_n \geq \left(\sqrt{2}\right)^n$ for all $n \geq 6$. 4

(b) Apply DFS algorithm to find a spanning tree of the following graph. Also find all the fundamental cycles of the spanning tree : 6

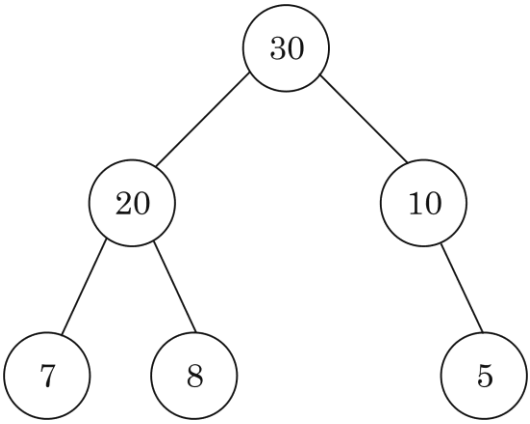


7. Which of the following statements are true and which are false ? Justify your answer with short proof or a counter-example : 5×2=10

   (a) $2^n = O((2.5)^n)$

   (b) Quick sort is always faster than counting sort when applied on any array of numbers.

   (c) The following is an example of max. heap :



(d) Every binary heap is a binary search tree.

(e) Dijkstra's algorithm solves the "all pairs shortest path problem".

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