

## M.E. COMPUTER SCIENCE AND ENGINEERING EXAMINATION, 2025

(1<sup>st</sup> Year 1<sup>st</sup> Semester)

## ADVANCED ALGORITHMS

Time: Three Hours

Full Marks 100

Answer any five questions

1. (a) Describe a PRAM model for parallel computation. What are the disadvantages of a PRAM model?  
 (b) Explain the terminologies – speedup, cost and work.  
 (c) What is spawning?  
 (d) Write a PRAM algorithm to find minimum of  $n$  numbers. Explain with an example. What is the time complexity of the algorithm?

5+6+3+6=20

2. (a) What is the importance of decision problems? What is the relation between decision problems and optimization problems?  
 (b) What are NP problems? Show that graph coloring problem is in NP.  
 (c) What is polynomial reduction? Define NP-completeness.  
 (d) How do we prove that a problem is NP-complete?

4+6+6+4=20

3. (a) What is amortized analysis? What are the three methods for amortized analysis? What are the differences among these methods?  
 (b) Using accounting method, show that the total amortized cost of performing  $n$  increment operations on a binary counter is  $O(n)$ .  
 (c) Write an algorithm for inserting elements in a dynamic table. Using Potential method, show that the amortized cost per 'insert' operation in a dynamic table is constant.

5+5+10=20

4. (a) What are randomized algorithms? Provide a randomized algorithm for hiring problem. What is the expected total fee one needs to pay to the employment agency with a randomized hiring problem?  
 (b) What do you mean by an 'infeasible' linear programming problem? What is an 'unbounded' linear programming problem? Prove the duality theorem in linear programming.

10+10=20

5. (a) What is approximation ratio? What is approximation ratio for a maximization problem? What do you mean by fully polynomial-time approximation scheme

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(FPTAS)?

(b) Write a greedy approximation algorithm for Set Covering problem. Explain its functioning with an example.

(c) Show that the approximation algorithm of the Travelling Salesman problem is a polynomial time 2-approximation algorithm.

6+8+6=20

6. (a) Using Boyer-Moore first heuristic, find how many comparisons are required to locate the pattern “pool” in the following text: “Pupli and Doll go to school by a pool car”. (ignore cases)

(b) List the values in the charjump array for Boyer-Moore algorithm for the pattern “anaconda”.

(c) Draw the KMP flowchart with fail indexes for the pattern “aanbaanshan”

6+4+10=20

7. (a) Write a greedy approximation algorithm for vertex cover problem. Show that that the algorithm is a polynomial time 2-approximation algorithm.

(b) Write a parallel sorting algorithm. What type of abstract machine model is used in the algorithm? Explain its functioning using an array of eight integers.

(c) Discuss the exact algorithm for subset sum problem. Discuss how you can provide an approximate solution for the problem.

7+7+6=20