M. TECH. COMPUTER TECHNOLOGY
FIRST YEAR
FIRST SEMESTER EXAM 2024
ADVANCED ALGORITHMS

Time: Three hours   Full Marks : 100

Answer any *five* questions.   5 X 20 = 100

1. Using graphs explain following asymptotic notations: O(big oh), Ω(big omega), θ (theta), o(small oh), ω(small omega). Using master method, find tight asymptotic bounds for following recurrences:

    a. $T(n)=2T(n/2)+n$

    b. $T(n)=7T(n/2)+n^2$

    c. $T(n)=4T(n/2)+n^3$ 10+10=20

2. How does dynamic programming approach differ from divide and conquer approach? Write the greedy algorithm for fractional knapsack problem. 10+10=20

3. What do you mean by NP-Completeness. How do you prove that a problem is NP-Complete. Prove that formula satisfiabiliy is NP-Complete.   10+10=20

4. What is amortized analysis? Explain three methods for amortized analysis.   5+15=20

5. Define Polynomial time approximation scheme (PTAS) and Fully Polynomial time approximation scheme (FPTAS). Give an example of each. Prove that The travelling salesman problem is a polynomial time 2-approximation algorithm.   10+10=20

6. Explain randomized algorithm. What is the expected cost of hiring an assistant in a randomized Hire-Assistant problem?   10+10=20

7. Using potential method show that total amortized cost of performing n increment operations in binary counter is O(n). What is the relationship between decision problems and optimization problems.   10+10=20

8. How do you convert a maximization problem to its standard form? Give an example. Consider the following maximization problem:

    A gold processor has two sources of gold ore: source A and source B. In order to keep his plant running, at least 3 tons of ore must be processed each day. Ore from source A costs 20 dollar per ton to process, while ore from source B costs 10 dollar per ton process. Costs must be kept less

than 80 dollar per day. Moreover, it is required that amount of ore from source B can not exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize amount of gold extracted subject to the above constraints? Formulate a linear programming problem from above. Express the problem in its standard form. Using simplex method provide a solution to the problem.   10+10=20