

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, **MAY** 2019

B. Tech/ M. Tech (as applicable) in Computer Science & Engineering, Semester VI

Roll No.....

COURSE CODE: CSE602

Time: 2 hours

Max. Marks: 30

COURSE TITLE: Design & Analysis of Algorithm

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1 A *Hamiltonian path* on a directed graph $G=(V,E)$ is a path that visits each vertex in V exactly once. Give a polynomial-time algorithm to determine whether a directed graph G contains *either* a cycle or a Hamiltonian path (or both). 05

Q.2 A knapsack capacity is 100. The weights and values of five objects are as follows:- 05

Weight	W_i	10	20	30	40	50
Value	P_i	20	30	66	20	60

Solve the knapsack problem and find the maximum profit that can be obtained.

Q.3A Solve the following Travelling Salesman Problem using the branch and bound technique:- 05

	A	B	C
A	∞	2	3
B	5	∞	3
C	2	4	∞

Q.4 You are given a sequence of n songs where the i th song is i minutes long. You want to place all of the songs on an ordered series of CDs (e.g. CD 1, CD 2, CD 3, ... ; CD k) where each CD can hold m minutes. Furthermore, 05

- (1) The songs must be recorded in the given order, song 1, song 2, ..., song n .
- (2) All songs must be included.
- (3) No song may be split across CDs.

Your goal is to determine how to place them on the CDs as to minimize the number of CDs needed. Give the most efficient algorithm an optimal solution for this problem and analyze the time complexity of the algorithm.

Q.5A Your Mother is cooking from her garden, which is arranged in grid with n rows and m columns. Each cell (i, j) ($1 \leq i \leq n$, $1 \leq j \leq m$) has an ingredient growing in it, with *tastiness* given by a positive value $T_{i,j}$. Your Mother doesn't like cooking "by the book". To prepare dinner, she will stand at a cell (i, j) and pick one ingredient from each quadrant relative to that cell. The tastiness of her dish is the product of the tastiness of the four ingredients she chooses. Help Your Mother find an $O(nm)$ dynamic programming algorithm to maximize the tastiness of her dish. 10

Here the four *quadrants* relative to a cell (i, j) are defined as follows:

top-left = {all cells $(a, b) \mid a < i, b < j$ },

bottom-left = {all cells $(a, b) \mid a > i, b < j$ },

top-right = {all cells $(a, b) \mid a < i, b > j$ },

bottom-right = {all cells $(a, b) \mid a > i, b > j$ }.

Because Your Mother needs all four quadrants to be non-empty, she can only stand on cells (i, j) where $1 < i < n$ and $1 < j < m$.

Define $TL_{i,j}$ to be maximum tastiness value in the top-left quadrant of cell (i, j) : $TL_{i,j} = \max\{T_{a,b} \mid 1 \leq a \leq i, 1 \leq b \leq j\}$. Find a dynamic programming algorithm to compute $TL_{i,j}$, for all $1 < i < n$ and $1 < j < m$, in $O(nm)$ time.

OR

Q.5B Finding the median of a sorted array is easy: return the middle element. But what if you are given two sorted arrays A and B , of size m and n respectively, and you want to find the median of all the numbers in A and B ? You may assume that A and B are disjoint. 10

- Give a naive algorithm running in $\Theta(m + n)$ time.
- If $m = n$, give an algorithm that runs in $\Theta(\lg n)$ time.