NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA
END SEM. THEORY EXAMINATION

Roll No……

Month and year: **Dec.'2020** | Total no. of pages used: 04
Program: **B.Tech (2nd yr)** | Semester: **3rd**
Subject: **Design and Analysis of Algorithms** | Course code: **CSPC-21**
Maximum Marks: **50** | Time allowed: 0**2 Hours**

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NOTE: 1. *The question paper contains four questions.*
2. ***All Questions are compulsory.***
3. *Attempt all parts of a question* ***together at one place****.*
4. *While solving a problem, consider the followings facts:*
   (i) Show all intermediate steps of the algorithm used clearly.
   (ii) If an algorithm uses a data structure(s) then display the contents of DS(s) for all intermediate steps during the execution of the algorithm.
   (iii) Show the entered input(s) & expected output(s).(if required)

Q1. Attempt ***all parts*** of the following: **[2 x 6 = 12]**

(i) Compare the asymptotic complexity of the following functions using *O*-notation.

- $f(n) = 3n^{\sqrt{n}}$
- $g(n) = 2^{\sqrt{n}\log_2 n}$
- $h(n) = n!$

(ii) Build Max-heap on the array A = < 5, 3, 17, 10, 84, 19, 6, 22, 9 >, and after making max-heap, delete the element with key 17.

(iii) Illustrate all the operations of merge sort on the array A= < 3, 41, 52, 26, 38, 57, 9, 49 >

OR

Define divide & conquer approach. Perform quicksort on the following set of numbers:
43, 63, 12, 85, 34, 95, 59, 27, 80

(iv) Use the master method to solve the following recurrences

(a) T(n) = 3T(n/4)+ n lg n

(b) T(n) = 3T(n/2) + n^2

(v) The height of a binary tree is the maximum number of edges in any root to leaf path. Find the maximum number of nodes in a binary tree of height ***h***.

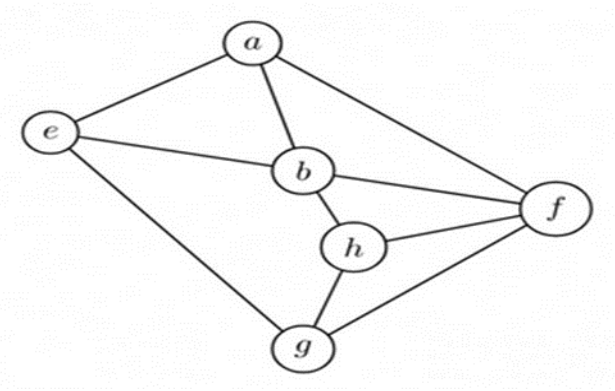
(vi) Calculate the best-case running time of the insertion sort by writing the pseudo code. Further, express this running using O, Θ, and Ω asymptotic notations.

OR

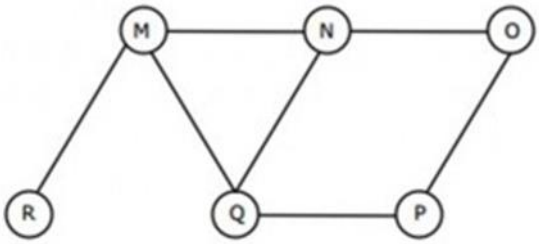
The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and linear probing. What is the resultant hash table?

Q2. Attempt ***all parts*** from the following. **[3 x 5 = 15]**

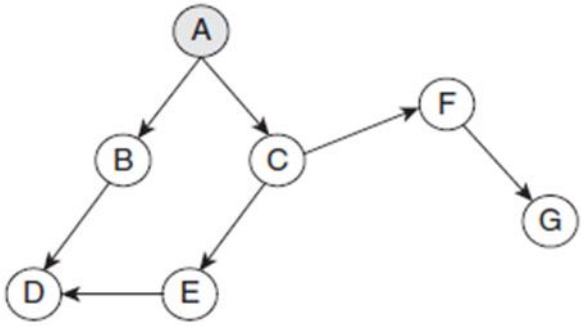
(i) Find **all** possible DFS traversals of the following graph starting at vertex 'a'.



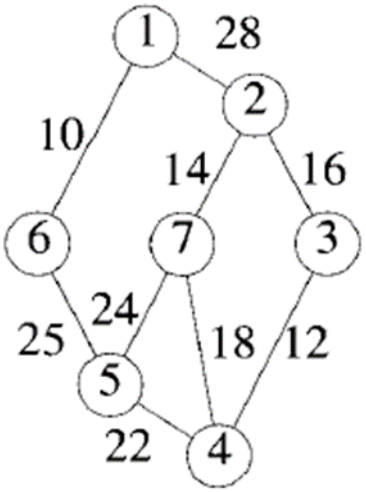
(ii) Execute breadth-first search on the following graph, using vertex Q as the source.



(iii) Find a topological sort of the graph depicted in the below figure.



(iv) & (v) Compute a minimum cost spanning tree for the following graph using (iv) Prim's Algorithm and (v) Kruskal's algorithm.



Q3. Attempt **all parts** from the following. **[5 x 3 = 15]**

(i) Determine all Longest Common Subsequences (LCSs) of < q, p, q, r, r > and < p, q, p, r, q, r, p >

(ii) Find an optimal parenthesization of a matrix chain product $M_1M_2M_3M_4M_5$ whose sequence of dimension is < 2, 25, 3, 16, 1, 1000>.

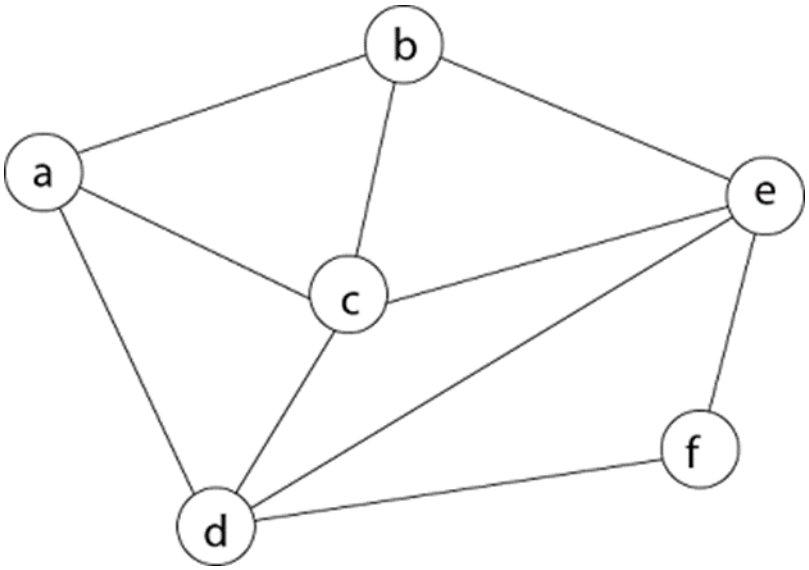
(iii) Construct a B-tree by inserting the keys
K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y
in order into an empty B-tree with minimum degree 2.

Q4. Attempt any ***one part*** from the following. **[1 x 8 = 8]**

(i) Explain Greedy strategy for designing algorithms in generic sense. Further, explain the fractional knapsack problem.
For the given set of items and knapsack capacity = 60 kg, find the optimal solution for the fractional knapsack problem making use of greedy approach.

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

(ii) Define Hamiltonian Circuit Problem. Explain how to find the Hamiltonian cycle by using backtracking in the given graph. Also write the algorithm to find the Hamiltonian cycle by using backtracking.



Best of Luck