# MCA (Revised)
# Term-End Examination
# June, 2021

## MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

*Time : 3 hours* *Maximum Marks : 100*

***Note :*** *Question no.* ***1*** *is* ***compulsory****. Attempt any* ***three*** *questions from the rest.*

**1.** (a) Write recursive binary search algorithm and analyse its run time complexity. *10*

(b) Solve the following Chain-Matrix Multiplication of $M_1$, $M_2$, $M_3$ and $M_4$ using Dynamic programming : *10*

Given :

$\langle M_1, M_2, M_3, M_4 \rangle$ with dimensions $\langle (14 \times 6), (6 \times 90), (90 \times 4), (4 \times 35) \rangle$

(c) Explain Chomsky's classification of grammars. Write Context-Free Grammar (CFG) for the language

$$L = \{a^m\, b^n\, c^n\, d^m \mid m, n \geq 1\}.$$ *10*

(d) Using Karatsuba's method, find the value of the product $1026732 \times 732912$.
Also analyze its Run time complexity in worst case. *10*

**2.** (a) Write Randomized Quicksort algorithm for worst case linear time selection of an element (say $\chi$). Also compare Randomized quicksort algorithm with Quicksort algorithm. *10*

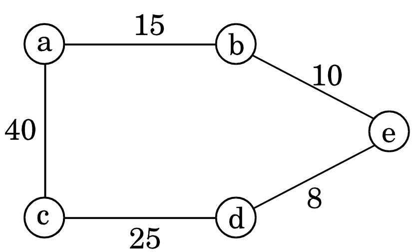
(b) Differentiate between Big-oh (O) and Theta ($\theta$) Asymptotic notation. Show that : *10*

(i) $2x^3 + 3x^2 + 1 = O(x^3)$

(ii) $3x^3 + 2x^2 + 1 \neq \theta(x^2)$

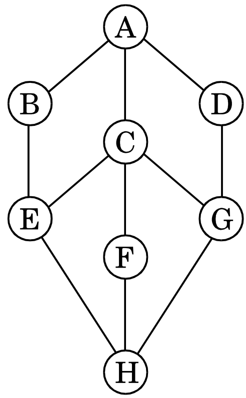
**3.** (a) Write Prim's algorithm and determine its time complexity. *5*

(b) Differentiate between Graph and Spanning tree. Draw all the spanning trees of the following weighted connected graph : *5*




(c) Explain how 0/1 Knapsack problem is solved using dynamic programming. *10*

**4.** (a) Compare time complexity of DFS and BFS algorithm. For the given graph, write DFS and BFS traversal sequence from node A. *10*



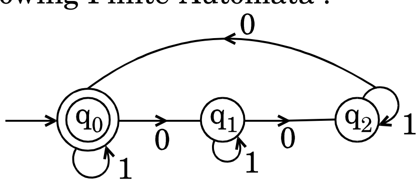

(b) Explain the following : *10*

(i) Halting problem of Turing Machine

(ii) Principle of Optimality in Dynamic Programming

**5.** (a) Prove that if $L_1$ and $L_2$ are context-free languages, then $L_1L_2$ is also a context-free language. *5*

(b) Find the Regular Expression for the following Finite-Automata : *7*



(c) Define Kleene closure with suitable examples. *4*

(d) By using Principle of Mathematical Induction, show that 6 divides $n^3 - n$, where n is a non-negative integer. *4*