B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
SECOND YEAR SECOND SEMESTER EXAM - 2022

Data Structures And Algorithms   **Time: 3 hours**   **Full Marks: 100**

Answer All Questions.

Q1 (a) Define a stack and mention its two primitive operations.   2+2
(b) Show how a stack can be implemented using linked lists.   5
(c) What is a postfix expression? Use a stack to evaluate the following postfix expression: 2+5
6, 2, 3, +, -, 3, 8, 2, /, +, *, 3, ^, 2, +, \$
Here, '\$' marks end of input and '^' denotes exponentiation. Show your steps.
(d) Briefly explain two different applications of a stack for data processing.   4

OR

(a) Define a queue and mention its two primitive operations.   2+2
(b) Discuss a fixed memory implementation of queue.   5
(c) Define a circular queue. Justify its effectiveness.   2+4
(d) Show how a queue can be used to model traffic control at a turning point. Show using   5
pseudocodes implementation of entry and exit of traffic.

Q2 (a) Define O, Θ, Ω notations.   6
(b) Prove or disprove: $3n^2 + 4n^2 \log n + 5n + 2 = O(n^3 \log n)$ 4
(c) Find the solution to the recurrence relation $T(n) = 2T(\sqrt{n}) + 1$ using the substitution   10
method.

OR

(a) Given: $T(n) = T\left(\frac{3n}{4}\right) + 1$. Find the tight asymptotic bound for $T(n)$.   5
(b) Prove that $If\ f(n) = O(g(n))$ and $g(n) = O(h(n)),\ then\ f(n) = O(h(n))$ 5
(c) Find the solution to the recurrence relation $T(n) = 2T(\sqrt{n}) + 1$ using the substitution   10
method.

Q3 (a) Define a complete binary tree with an example. Mark the leaf and non-leaf nodes in   2+2+3
your example. Show that a complete binary tree of depth d has $(2^d - 1)$ non-leaf nodes.
(b) What do you mean by traversal of a binary tree? Show different types of traversals of a   2+6
complete binary tree of depth 3.
(c) Construct the binary tree with the preorder traversal form: *ABDGCEHIF* and the   5
inorder traversal form: *DGBAHEICF*. Show your steps.

Q4 a) Define balance factor and a height balanced binary search tree.   2+2
b) Show that the binary search tree constructed with nodes as 8, 6, 10, 4, 7, 9, 11, 3, 5, 2 is   3+3
not height-balanced. You should first show the step-by-step construction of the tree taking
the first data as the root.
c) Define order and size of a graph with examples.   2+2
d) Show that the number of edges in a complete bipartite graph of order *2n* is n^2.   3
e) Prove or disprove: The graph K_5 is planar.   3

Q5   (a) Write a recursive procedure for the *Quick Sort* algorithm including a separate code for 6
the partition process.
(b) Apply the algorithm in (a) to sort the dataset 25, 57, 48, 37, 12, 92, 86 in the ascending 5+3
order. Analyze the time-complexity of your solution.
(c) Consider the dataset in (b). How can you find the *key* = *86* in the above dataset? 3+3
Analyze the time-complexity of your solution.

<div align="center">OR</div>

(a) Write a procedure for the *Bubble Sort* algorithm. 6
(b) Apply the algorithm in (a) to sort the dataset 25, 57, 48, 37, 12, 92, 86 in the ascending 5+3
order. Analyze the time-complexity of your solution.
(c) Consider the dataset in (b) after sorting has taken place. How can you find the *key* = *86* 3+3
in the above sorted dataset? Analyze the time-complexity of your solution.