THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF COMPUTER SCIENCE
B.SC (IT) DEGREE PROGRAMME 2024/2025
COU6304: ADVANCED DATA STRUCTURES AND ALGORITHMS
DURATION: **TWO HOURS ONLY (02 HOURS)**

Date:11th June 2025   Time: **01.30pm – 03.30pm**

Answer **Only Four** Questions.

Question 01

a) What is data structure?   (05 Marks)

b) What are the differences between **primitive and non-primitive** data structure?

(05 Marks)

c) What are the types of **Asymptotic Notations**. Briefly explain each   (05 Marks)

d) Consider the function $f(n) = 3n^3 + 20n + 7$. Using your knowledge of algorithm analysis
and asymptotic notations, answer the following:
(i) Define asymptotic notations and explain their significance in algorithm analysis.
(ii) Describe the differences between Big Oh (O), Big Omega (Ω), and Big Theta (θ)
notations with examples.
(iii) Determine the Big Oh notation (upper bound) for the given function $f(n) = 3n^3 + 20n + 7$ and justify your answer.   (10 Marks)

Question 02

a) Explain the basic concept of the **Branch and Bound** algorithm. Describe its key

characteristics.?   (05 Marks)

b) Identify and describe the **three (03) types of Branch and Bound techniques**. (05 Marks)

c) List and explain **at least four (04) applications** of the Branch and Bound technique in
real-world problem-solving scenarios.?   (05 Marks)

d) You are given the following tree representing different states of a problem. Each node is
labeled with a letter and associated with a cost to reach it from the parent node. The goal
is to reach **node G** from the **start node A**.

```
      A
    /  |  \
   B   C   D
  /\       |
 E  F      G
```
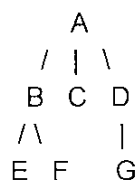
Edge costs:

- A → B = 1
- A → C = 5
- A → D = 2
- B → E = 3
- B → F = 6
- D → G = 1

Use the following search strategies to find a path from A to G:

1. **FIFO (Breadth-First Search)**
2. **LIFO (Depth-First Search)**
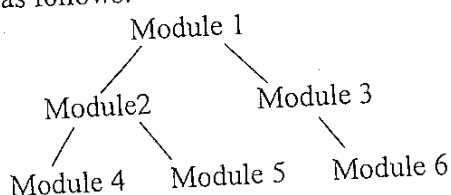3. **Least-Cost Branch and Bound**   (10 Marks)

Question 03

a) Explain the concept of **Dynamic programming** in Data structure and algorithm? (05 Marks)

b) Discuss the differences between the **top-down (memoization) and bottom-up (tabulation)** approaches in dynamic programming.?   (05 Marks)

c) Describe **Prim's and Kruskal's** algorithms for finding a minimum spanning tree. How do their approaches and implementations differ?   (05 Marks)

d) A delivery robot in a warehouse needs to find the shortest path from the entrance (Node A) to the loading bay (Node F). The warehouse is represented as a graph with nodes A, B, C, D, E, and F, and the following paths with their distances:

- A → B (4 units)

- A → C (2 units)

- B → C (5 units)

- B → D (10 units)

- C → E (3 units)

- ₄ E → D (4 units)

- D → F (11 units)

Using **Dijkstra's algorithm**, determine the shortest path from node A to node F and the total distance.   (10 Marks

Question 04

a) Explain the concept of recursion in Data structure and algorithm.? (05 Marks)

b) Compare recursion and iteration by listing **five (05)** major differences between them.?
(05 Marks)

c) Name and briefly describe **five (05)** algorithms that are used in recursion (05 Marks)

d) As an Open University student, you're enrolled in an online course that is structured like a module tree. You start with the **main module (Module 1)**, and it branches into submodules as follows:

```
              Module 1
             /        \
        Module2        Module 3
        /     \             \
  Module 4   Module 5    Module 6
```

To review the content, you can choose one of two strategies:
- **Breadth-First Search (BFS):** You go through modules **level by level** starting with Module 1, then Modules 2 and 3, and so on.
- **Depth-First Search (DFS):** You follow one complete path **deeply before moving to the next** finishing a full module path before switching branches.

If you choose the BFS approach, in what order will you access the modules? (10 Marks)

Question 05

a) Explain the concept of a **priority queue** with a suitable example? (05 Marks)

b) Identify **five (05)** real-world scenarios where priority queues are used and explain their roles briefly? (05Marks)

c) What are the different types of **heaps** in data structures? Describe each briefly. (05 Marks)

d) As an Open University student, you are part of an online quiz competition where participants earn points based on their answers. The quiz system needs to quickly show the **top scorer** and identify the **lowest scorer** efficiently.

- The scores of some participants are:

  [40, 20, 60, 10, 30, 50, 70]

1. **Build a Min Heap** from the scores to easily find the participant with the lowest score.

2. **Build a Max Heap** from the same scores to quickly identify the participant with the highest score. (10 Marks)

Question 06

a) Explain the concept of **complexity classes** in Data structure and algorithm.? (05Marks)

b) Explain the different types of complexity classes and illustrate each with a suitable example

(05Marks)

c) Explain how to prove that a given problem is **NP-complete**. (05Marks)

d) Identify **five (05)** types of problems for which hash tables are not suitable. And explain each

(10 Marks)