

B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Third Semester

INFORMATION TECHNOLOGY

U18ITI3202: Data Structures

COURSE OUTCOMES

- CO1:** Explain various sorting algorithms.
- CO2:** Explain various searching algorithms.
- CO3:** Explain the concepts of List, Stack, and Queue.
- CO4:** Explain the concepts of Trees and Graphs.
- CO5:** Implement the given problem using Linear and Non-Linear Data Structures.
- CO6** Identify and demonstrate the usage of various data structures using simple applications.

Time: Three Hours

Maximum Marks: 100

**Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)**

- 1. Define time complexity and explain its importance in algorithm analysis. CO1 [K₂]
- 2. Differentiate between sequential search and binary search in terms of time complexity. CO2 [K₂]
- 3. Differentiate between stack and queue with respect to their data access patterns. CO3 [K₂]
- 4. Describe the concept of a binary search tree and its property. CO4 [K₂]
- 5. Demonstrate hashing using the division method $h(x) = x \% 7$ for keys [35, 42, 17, 8, 56]. CO5 [K₃]
- 6. Explain how the bubble sort algorithm works with an example array: [5, 34, 88, 4, 27, 50, 45, 90, 66,12]. CO1 [K₃]
- 7. Given a linked list: 10 -> 20 -> 30, write the routine to insert an element 25 after 20. CO3 [K₃]
- 8. Compute the worst-case time complexity of the quick sort algorithm. CO1 [K₂]
- 9. For the following tree traversal sequences, determine the type of traversal: 10, 5, 2, 7, 15, 12, 20. CO4 [K₃]
- 10. Evaluate the result of the postfix expression: 5 3 2 * +. CO6 [K₃]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. Scenario: A hospital needs to develop a patient management system to efficiently handle patient records, appointments, and doctor assignments. The system should be able to manage a dynamic list of patients, support quick search operations, and prioritize emergency cases.

Specific Details:

- Patients are added and removed frequently from the system.
- Each patient record includes ID, Name, Age, Ailment, and Priority Level.
- Emergency cases must be attended to before regular appointments.
- The system should allow searching for patient records by ID.
- Doctors are assigned to patients based on their specialization.

Sample Data Set:

ID	Name	Age	Ailment	Priority Level
P001	John Doe	45	Fracture	High
P002	Jane Smith	30	Flu	Medium
P003	Alice Jones	65	Heart Attack	Critical
P004	Bob Brown	50	Check-up	Low
P005	Lisa Black	28	Allergy	Medium
P006	Tom White	70	Stroke	Critical
P007	Emma Green	35	Pregnancy	High
P008	Mike Davis	60	Diabetes	Medium

- a) Identify a data structure to manage the dynamic list of patients, ensuring efficient insertion and deletion. Justify your choice of data structure. 7 CO5 [K₃]
- b) Implement an algorithm to prioritize emergency patients using an appropriate queue structure. Explain how priority queues can be utilized in this scenario. 7 CO3 [K₃]
- c) Illustrate how hashing can be used to quickly search for patient records by ID. 2 CO2 [K₂]

12. Scenario: A logistics company is deploying autonomous drones for package delivery. The drones need an efficient navigation system to determine the shortest path between locations, considering obstacles and varying distances.

Specific Details:

- The delivery area is represented as a graph with nodes (delivery points) and edges (paths).
- Obstacles are areas that cannot be traversed and need to be accounted for.
- The system must find the shortest and most efficient route for each

delivery.

- Real-time updates may change the availability of certain paths.

- Obstacles:

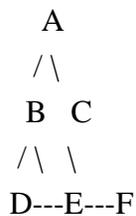
- The path between A-C is blocked.
- Node E is temporarily unavailable.
- The path between B-D has increased distance due to weather (now 6 km).

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|--------|--|---|-----|-------------------|
| a) | Write a code snippet for Dijkstra's algorithm. | 7 | CO4 | [K ₃] |
| b) | Using Dijkstra's algorithm, find the shortest path from node A to node F, considering the obstacles and updated distances. Show all steps of your computation. | 7 | CO5 | [K ₃] |
| c) | Outline the time complexity of Dijkstra's algorithm in this scenario. | 2 | CO1 | [K ₂] |
| 13. a) | Write the routine to perform Quick sort algorithm | 8 | CO1 | [K ₂] |
| b) | Perform binary search on the array [10, 20, 30, 40, 50, 60,70,80,90,100, 110] to find 70. | 8 | CO2 | [K ₃] |
| 14. a) | Outline the operations of a circular queue and how it overcomes the limitations | 7 | CO3 | [K ₂] |

of a linear queue.

- b) Write a routine to implement a circular queue using an array with a maximum size of 5. Include functions for insertion (enqueue) and deletion (dequeue). 7 CO5 [K₃]
- c) Identify a real-world application where a circular queue would be more suitable than a linear queue. 2 CO6 [K₃]
15. a) Explain in detail about height balanced tree and write a routine to perform insertions of data into the tree. 7 CO4 [K₂]
- b) Insert the following sequence of numbers into an empty AVL tree and show the tree after each insertion: 30, 20, 40, 10, 25, 50, 5, 90, 67, 12. Indicate any rotations that occur. 7 CO4 [K₃]
- c) Summarize the importance of balancing a tree. 2 CO4 [K₂]
16. a) Write the routine for Prim's algorithm. 7 CO4 [K₂]
- b) Given the following graph, perform DFS and BFS starting from node A. Provide the order in which nodes are visited. Write the routine for DFS. 7 CO4 [K₃]

Graph Representation:



- c) Write about two real-time applications of DFS and BFS. 2 CO6 [K₃]
