# ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

## Department of Computer Science and Engineering (CSE)

**MID SEMESTER EXAMINATION** **SUMMER SEMESTER, 2021-2022**

**DURATION: 1 HOUR 30 MINUTES** **FULL MARKS: 50**

## CSE 4809: Algorithm Engineering

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

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1. a) Answer the following questions with single sentence only: 1 × 3 (CO2) (PO1)
   - i. Write names of two applications that use memory based balanced tree.
   - ii. Why are memory-based balanced trees not suitable for disc based search and indexing?
   - iii. Mention one application area where $\log_2 \log_2(n)$ algorithm is taken as a significant improvement over $\log_2(n)$.

   b) Given a regular recursion: $T(n) = aT(n/b) + f(n)$ 7.67 (CO1) (PO1)
   If $f(n) = O(n^{\log_b a - \epsilon})$, prove that $T(n) = \theta(n^{\log_b a})$.

   c) With three example instances, show the key insertion mechanism of B+ Tree. Assume t = 3. 6 (CO2) (PO1)

2. a) What is quasi polynomial time algorithm? Outline the solution for 0-1 Knapsack problem and justify its complexity as quasi polynomial. Mention at least one more algorithm that is also quasi polynomial. 5 (CO1) (PO1)

   b) How is GPU parallelism used to speed up the training in Deep Learning setup? 6.67 (CO2) (PO1)

   c) Briefly describe one divide and conquer algorithm that is used in recent research related to you. 5 (CO4) (PO1)

3. a) Answer the following questions with single sentence only 1 × 4 (CO2) (PO1)
   - i. How is Catalan number related to matrix chain multiplication?
   - ii. "Every problem that has an optimal greedy algorithm should also have a dynamic programming solution"- why?
   - iii. Why does the longest simple path finding problem not have an optimal substructure property?
   - iv. Can dynamic programming solve multi-objective optimization problem? Justify your answer.

   b) Write down the optimal substructure equation for DTW after briefly describing the optimization problem the algorithm attempts to solve. Comment on the complexity of the DTW algorithm. 5.66 (CO2) (PO1)

c) Given a grid of $(m \times n)$ dimension containing cells filled with reward (positive or negative), the reward of an area will be the sum of rewards of all the cells withing the area. 7 (CO2) (PO1)

If a problem is defined as to find the maximum possible reward from a minimum square:

i. Can you use Dynamic Programming algorithm for the problem defined above? If so, what will be optimal substructure for the problem?

ii. If Dynamic Programming cannot be used in this context or the benefit of using the algorithm is hindered for some reason, point out why?