

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2020-2021

TIME: 1 Hour 30 Minutes

FULL MARKS: 50

CSE 4809: Algorithm Engineering

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

There are **3 (three)** questions. Answer **all** of them. Figures in the right margin indicate marks.

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1. a) (Write answers with *single sentence only*) 1x5
- Mention the characteristic(s) of algorithms that have a complexity of lgn ?
 - When does insertion sort perform better than merge sort?
 - Write down the general complexity equation of a divide-conquer algorithm.
 - Why does quick sort algorithm just have division (i.e. partition) cost but does not have any merging cost?
 - Mention one application area where $lglgn$ algorithm is taken as a significant improvement over lgn ?
- b) Write down the rationale of master method for its all three cases for determining the complexity of recursive algorithms. 6.66
- c) Suppose in a merge-sort of n data points, the recursive division is stopped when any sub array size becomes k . Then each of the (n/k) sub-arrays is sorted by insertion sort. After the sorting of the (n/k) sub arrays, each of size k , the typical merge-sort procedure is followed. Comment on the complexity of the combined algorithm and justify your answer. 5
2. a) Define NP. Establish the relationships among P, NP and NPC problems. 5
- b) 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. 6.66
- c) What is *reduction*? How is it helpful in deciding a problem to be NPC? 5
3. a) (Write answers with *single sentence only*) 1x5
- What is Catalan number? How is it related to optimal parenthesis problem?
 - Every problem that has an optimal greedy algorithm should also have a dynamic programming solution- why or how?
 - What is optimal substructure equation?
 - Why longest simple path finding problem does not have an optimal substructure property?
 - 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. Briefly describe two ways to improve the time complexity of the algorithm. 6.66
- c) The time complexity of Viterbi algorithm is S^2O , where S is the number of hidden states and O is the number of observations. Validate the time complexity by describing the problem, assumption(s) and the solution briefly. 5