ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **SUMMER SEMESTER, 2017-2018**

DURATION: 1 Hour 30 Minutes **FULL MARKS: 75**

CSE 4203: Discrete Mathematics

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

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) Describe the worst-case time complexity of the odd-even sort algorithm in terms of the number of comparisons used. Express the complexity in Big-O notation. 10

The algorithm for odd-even sort algorithm is given in Figure 1.

```
procedure oddEvenSort(a1, …, an : real numbers with n ≥ 2)
 isSorted := False
 while isSorted = False do
     isSorted := True
     i := 1
     while i < n do
         if ai > ai+1 then
             interchange ai and ai+1
             isSorted := False

         i:=i+2

     i := 2
     while i < n do
         if ai > ai+1 then
             interchange ai and ai+1
             isSorted := False

         i:=i+2

 return
```

Figure 1: Code listing for Question 1(a).

b) Express the negation of the following propositions using quantifiers, and then express them in English. 15

i. Some drivers do not obey the speed limit.
ii. All Swedish movies are serious.
iii. No one can keep a secret.
iv. There is someone in this class who does not have a good attitude.
v. Every bird can fly.

2. a) Give big-O estimates (with the values of C and n_0) for the following functions: 12

i. $(n^2 + 5)(n - 1)$
ii. $(nlgn + 1)^2 + (lgn + 1)(n^2 + 1)$
iii. $3nlg(n!) + (n^2 + 4)lg\ (n)$

b) Draw Venn Diagrams showing the followings: (Identify all parts of the diagram with proper notations) 8

i. $A \cup B \subset A \cup C, but\ B \cap C = \{\}$

ii. $A \cap B \subset A \cap C, but\ B \cap C = \{\}$

c) Write the following complexities in ascending order : 5

$\theta(n^2), \theta(b^n), \theta(nlogn), \theta(n!)\ and\ \theta(1)$

3 a) Use logical equivalence to show that following propositions are contradiction: 6

i. $\neg(p \vee \neg(p \wedge q))$

ii. $\neg(((p \vee q) \wedge (\neg p \vee r)) \rightarrow (q \vee r))$

b) Use truth table to show that: 6

i. $(p \wedge (p \rightarrow q) \rightarrow \neg q)$ is a contingency.

ii. $((p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r))$ is a tautology.

c) There are two restaurants next to each other. One has a sign says "Good food is not cheap" and other has a sign that says "Cheap food is not good". Are the signs saying the same thing? Justify your answer using predicates, quantification etc. 7

d) Given that $h(x) = 3x$ and $g(t) = -2t - 2 - h(t)$ and $f(n) = -5n^2 + h(n)$, calculate $h(g(8) + f(2))$. 6

4 a) Show that if n is an integer and $n^2 + 5$ is odd, then n is even using 12

i. A proof by contraposition.

ii. A proof by contradiction

b) Given premises : 8

"Students who pass the course either do the homework or attend lecture;"

"Mahid did not attend every lecture;"

"Mahid passed the course."

Using rules of inference prove the conclusion that "Mahid have done the homework".

c) Theorem: If n^2 is positive, then n is positive. 5

Proof: Suppose that n^2 is positive. Because the conditional statement "If n is positive, then n^2 is positive" is true, we can conclude that n is positive.

Is there any problem with the proof of this theorem? Give proper arguments to support your answer.