GU TECH, AL GHAZALI UNIVERSITY

FALL-2024 CS-Department
Assignment 2

Issue Date: 19-12-2024 **Due date: 29-12-2024** **Total Marks 50**

Course Code: CS101	**Course Name: Discrete Structures**

Instructions:

You must submit the **scanned copy** of your own handwritten assignment on google classroom within the due date, strong action would be taken on plagiarism cases from straight **ZERO** in assignment to **Grade F** in course.

1. Suppose the following two propositions are both False. **[10 points]**

Consider the propositional function M(x, y) =”x has sent an email to y”, and T(x, y) =”x has called y”. The predicate variables x, y take values in the UoD D={students in class }. Express the following statements using symbolic logic:

(a) There are atleast two students in class such that one student has sent other an email and the second student has called the first student.

(b) There are some students in class who have emailed everyone.

2. Determine the truth value of each of these statements if the UoD for each variable consists of all real numbers. **[10 points]**

(a) $\exists x \forall y (y \neq 0 xy = 1)$

(b) $\forall x \exists y (x + y = 1)$

(c) $\exists x \exists y (x + 2y = 2 \wedge 2x + 4y = 5)$

(d) $\forall x \forall y \forall z ((x = y)(x + z = y + z))$

3. Let W(x, y) mean that student x has visited website y, where the UoD for x consists of all students in your school and the UoD for y consists of all websites. Express each of these statements by a simple English sentence. **[10 points]**

(a) $\exists y (W(John, y) \wedge W(Cindy, y))$

(b) $\exists y \forall z (y \neq David) \wedge (W(David, z) W(y, z))$

(c) $\exists x \exists y \forall z ((x \neq y) \wedge (W(x, z) \iff W(y, z)))$

4. Suppose a software system has 9 components {A, B, C, D, E, F, G, H, I}. Each component has either exactly one of the two types of bugs (Bug 1 and Bug 2) or has no bug (is clean). We want to identify which components have Bug 1 or Bug 2 or is clean. Findings are summarized as follows. **[10 points]**

(a) Let P(x) be the predicate that component x has Bug 1, let Q(x) be the predicate that component x has Bug 2 and let R(x) be the predicate that component x is clean. Translate each of the below findings in terms of the predicates P(x), Q(x) and R(x).

i. E and H do not have the same bug.

ii. If G has Bug 1 then all components have Bug 1.

iii. If E has Bug 1 then H has Bug 1 too.

iv. if C has Bug 1 then D and F do not have Bug 1.

v. if either E or H has Bug 1 then I does not have Bug 2.

vi. At least 4 components have Bug 1.

vii. If A has either bug then all components have Bug 2.

viii. A and F are not in the same category.

ix. B has Bug 2.

x. At least one of C and G have the same bug as B.

xi. Exactly 2 components have Bug 2.

xii. If I has bug 2 then at least one D, F and A have Bug 2 too.

xiii. If E or G have bug 2 then all components have either Bug 1 or Bug 2.

(b) Determine, using the above findings, which components have Bug 1, which ones have Bug 2 and which are clean.

Hint: First determine which components have Bug 1 then determine which ones have Bug 2 and then list the clean ones.

5. Let P,Q and R be the following propositions: **[10 points]**

- P: You get sick.
- Q: You miss the exam.
- R: You pass the course.

Write the following compound propositions as English sentences.

(a) PQ

(b) $R \iff \neg Q$

(c) $Q\neg R$

(d) $P \vee Q \vee R$

(e) $(P\neg R) \vee (Q\neg R)$

(f) $(P \wedge Q) \vee (\neg Q \wedge R)$