National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	**Discrete Structures**	**Course Code:**	**CS-211**
Program:	**Computer Science**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**4+4+4+4+4**
Paper Date:	**October 2, 2018**	**Weight**	**15**
Section:	**ALL**	**Page(s):**	**2**
Exam Type:	**Sessional - I**		

Student : Name:___________________________ Roll No.______________ Section:______

Instruction/Notes: 1. Solve the exam on this question paper. 2. Students are allowed a **HANDWRITTEN A4 sheet**.

QUESTION 1: Translate the following English sentences into propositional logic using the relevant propositions and predicates:

W: Planet has water	O: Planet has oxygen	N: Planet has nitrogen
F: Planet has food	L: Planet has life	

Operators you are allowed to use: {^, v, ¬, →, ↔}. **No other operators or propositional/predicate symbols are allowed.**

a. Whenever there is oxygen and water on a planet, it has food ______________________________________

b. A planet has neither water nor oxygen but it has nitrogen ______________________________________

c. A planet that has water can have either nitrogen or food but not both ______________________________

d. It is necessary to have oxygen and water to have life on a planet ________________________________

QUESTION 2: Translate the following to predicate calculus. You are allowed to use the quantifiers: {∃, ∀} and the connectives: {^, v, ¬, →, ↔}. **No other operators or propositional/predicate symbols are allowed.**

A(x): x is an astronaut	V(x,y): x visits y	S(x): x is a star
P(x): x is a planet	M(x): x is a mathematician	

a. Every astronaut is also a mathematician ____

b. There are some astronauts who are mathematicians and have visited some planet _____________________

c. There are some mathematicians who have not visited any star ___________________________________

d. All astronauts who have visited a star have also visited all planets ______________________________

QUESTION 3: Translate each expression into proper English statements.
M(x) = x is Maroon, G(x) = x is green, R(x) = x is Russian. ¬ is the not operator

a. $\forall x\,(M(x) \rightarrow \neg G(x))$ ____

b. $\exists x \neg\,((M(x) \land G(x)) \rightarrow R(x))$ ______________________________________

c. $\forall x\,(M(x) \land R(x))$ ____

d. $\forall x (M(x) \rightarrow (G(x) \land R(x)))$ ______________________________________

QUESTION 4: There are 4 students: S,M,N,P. If M enrolls in discrete math then N also enrolls in discrete math. P and S always stay together, so if one enrolls then the other one also enrolls and if one of them does not enroll then the other one also does not enroll. Either S or M but not both enroll in discrete math. N is not enrolled in discrete math.

Translate all the above facts to propositional logic using the set of connectives: {^, v, ¬, →, ↔} and next use the concept of satisfiability and rules of inference to determine who is enrolled in discrete math. Truth table, and informal reasoning will not be accepted and marks will be given only on the quality of your answer.

QUESTION 5: Show that $[\, p \wedge (p \rightarrow q) \,] \rightarrow q$ is a tautology using logical equivalences (and not truth table) .