THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 04
FINAL EXAMINATION: 2009/2010
CSU 2280: DEDUCTIVE REASONING AND PROLOG FOR ARTIFICIAL INTELLIGENCE – PAPER I

DURATION: **TWO AND HALF HOURS** (2 ½ HOURS)

Date: 09th January, 2010 Time: 1.00 pm – 3.30 pm

Answer FOUR Questions ONLY

Q1.

a. Explain the term "Reasoning" in your own words.

b. What are the seven reasoning techniques? Explain using suitable examples.

c. *"One problem can be solved using different reasoning technologies."* Do you agree with this statement? Justify your answer.

d. Write the most suitable reasoning technique for each of the following cases. Give reasons for your answer.
   i. Creating a mobile application to display a particular place in a map.
   ii. Creating a system to diagnose computer hardware problems.
   iii. Solving a set of mathematical equations using relevant approximations.
   iv. An electrician finding a fault with electrical equipments.

Q2.

a. What is meant by the vocabulary of the Propositional Logic? Explain it by using suitable examples.

b. Define the following terms in relation to Propositional Logic.
   i. Syntax
   ii. Semantics

c. Define the terms "Tautology", "Contradiction", "Model assignment" and "Counter Example" by using truth tables.

d. Determine whether each of the following is a Tautology, Contradiction or neither of them by using truth tables.

i. $(P \vee Q) \leftrightarrow (\neg P \vee Q)$

ii. $((P \rightarrow Q) \wedge \neg Q) \rightarrow \neg P$

iii. $(P \rightarrow (Q \vee R)) \leftrightarrow ((P \wedge (\neg Q)) \rightarrow R)$

Q3.

a. Provide an example to show that classical logic cannot match with the real world all the time.

b. The sentence *"All humans have a mother"* has been written in Predicate Logic in the following two different ways.

i. $\forall x\, Human(x) \rightarrow mother(x)$

ii. $\forall x\, Human(x) \wedge mother(x)$

Which interpretation is correct? Justify your answer.

c. Write two real world predicates $P(x, y)$ and $Q(x, y)$ to hold the following property.

$$\forall x\, \exists y\, P(x, y) \equiv \exists y\, \forall x\, Q(x, y)$$

d. Using truth tables show that;

i. $\neg(P \wedge Q) \equiv \neg P \vee \neg Q$

ii. $\neg(P \vee Q) \rightarrow \neg P \wedge \neg Q$

Q4.

a. What are the limitations of Propositional Logic? Explain how those limitations are overcome by Predicate Logic.

b. Explain, in your words the meaning of the following Predicate Logic expressions.

i. $\exists x \, \forall y \, F(x, y)$

ii. $\forall x \, P(x) \wedge \forall y \, F(y)$

iii. $\exists y \, \forall x \, (y + x = x)$

iv. $\forall x \, \exists y \, (x + y = y + x)$

c. Translate the following sentences into Predicate Logic.

i. Everyone is happy and everyone is rich.

ii. It is not the case that all rich people are happy.

iii. If someone is rich, then everyone is happy.

iv. Either everyone is lying or else someone is a thief.

d. Write the following logical expressions in simple English.

i. $\exists x \, Q(x, y) \wedge \forall x \, P(x, y)$

ii. $\forall x \, (P(x) \vee (\exists x \forall z \, Q(x, y, z) \wedge \forall z \, R(z)))$

Q5.

a. Translate the following sentences, using appropriate atomic propositions.

i. If the weather is warm and the sky is clear, then either we go swimming or we go boating. It is not the case that if we do not go swimming then the sky is not clear. Therefore, either the weather is warm or we go boating.

ii. If Saman wins the first prize, then either Ruwan wins the second prize or Kamala is disappointed. Ruwan does not win the second prize. Therefore, if Kamala is disappointed, then Saman does not win the first prize.

b. Consider the following two statements (S1 and S2) and the claim (C1).

S1: If the student is ready for AL examination, then if the student sits the exam in August then the student gets the result in December.

S2: The student does not get the result in December.

C1: Therefore, if the student sits the exam in August then the student is ready for AL examination.

i. Translate the above statements and the claim into Propositional Logic by using the following symbols.

A - The student ready to AL examination

B - The student sits the exam in August

C - The student gets the result in December

ii. Check whether C1 is a valid claim.
(Hint: if C1 is valid then $(S1 \wedge S2) \rightarrow C1$ *becomes a tautology)*

Q6.

a. *"Resolution is a much more powerful way of inferencing than use of inference rules".* Do you agree with this statement? Justify your answer.

b. Briefly explain the following terms.
   i. Skolemisation
   ii. Unification
   iii. Horn Clause

c. What are the steps for converting predicates into CNF?

d. Convert the following predicate logic formula into CNF.

$$\forall x\,(P(x) \rightarrow Q(x) \wedge R(x))$$