CE8-R3: LOGIC AND FUNCTIONAL PROGRAMMING

NOTE:

> 1. Answer question 1 and any FOUR questions from 2 to 7.
> 2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours **Total Marks: 100**

1.
a) Explain the differences between declarative and imperative computing paradigms.
b) Simplify $(\sim(P \wedge Q) \rightarrow R) \wedge P \wedge Q$.
c) What do you mean by Herbrand expansion? Describe Herbrand universe.
d) Define the query computation cycle in Prolog.
e) What are the advantages of Functional Programming?
f) Compare tuple and record data type in case of SML.
g) Evaluate $(\lambda x.(\lambda y.x + y))\ 3\ 5$ (showing all the steps).

(7×4)

2.
a) Translate the following sentences into propositional logic.
   i)   If it is not raining and I have time then I will go to a movie.
   ii)   It is raining and I will not go to movie.
   iii) I will go to movie only if it is not raining.
b) Given $C \vee D$; $\sim H \rightarrow (A \wedge \sim B)$; $(C \vee D) \rightarrow \sim H$; $(A \wedge \sim B) \rightarrow (R \vee S)$; infer $(R \vee S)$.
c) Test the validity of the following argument:
   If milk is black then every crow is white. If every crow is white then it has four legs. If every crow has four legs then every buffalo is white and brisk. The milk is black. Therefore, buffalo is white.

(6+6+6)

3.
a) Write an algorithm in order to convert a formula into prenex normal form. Illustrate with an example.
b) Find a prenex form for the formula.
   $$\exists x(Px \rightarrow \sim\exists y(Py \rightarrow (Qx \rightarrow Qy)) \wedge \forall x(Px \leftrightarrow \forall yQz))$$
c) Use resolution to show that the following argument is valid:
   No student reads a boring book seriously. This book is read seriously by al least one student (you). Therefore, the book is not boring.

(6+6+6)

4.
a) Write a Prolog program for reversing lists.
b) Write a Prolog program to check whether a given list is a palindrome. The program should behave in the following way.

Query:	Result:
palindrome([a,b,c])	no
palindrome([])	yes
palindrome([a,b,a])	yes
palindrome([a,b,b,a])	yes

c) What do you mean by an incomplete data structure? Write a code segment for binary search tree to illustrate incomplete data structure.

(6+6+6)

5.

a) Why do we need exception handler? Explain with an example. What are the primary benefits of exception handling?

b) Implement stack data structure in SML.

c) Define the following functions in SML:
   i) The function dropSpace returns a list with leading spaces removed
   ii) The function takeSpace returns just the leading spaces.

(6+6+6)

6.

a) Compare curry, uncurry and compose.

b) Define free and bound variables with examples.

c) For any lambda term s, the set FV(s) is finite. Explain.

(6+6+6)

7.

a) Prove the following:
   i) The rev (list reverse) function and the @ (append) operator obey an inter-change law since the following holds for all lists L1 and L2;   rev (L1 @ L2) = rev L2 @ rev L1.
   ii) The rev function is an involution, i.e. it always undoes its own work, since rev (rev L) = L.

b) Explain the differences between lazy and eager evaluation.

c) What do you mean by infinite data structure? Explain with a suitable example.

((4+4)+4+6)