PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

Midterm Examination: Semester 2

Date: 6th January, 2014

Subject Numbers: 242-213

Subject Title: Discrete Mathematics

Lecturer: Aj. Andrew Davison

Academic Year: 2013-2014

Time: 9:00 – **11:00 (2 hours)**

Room: Robot

Exam Duration: 2 hours

This paper has 8 questions, in 3 pages.

Authorized Materials:

- Writing instruments (e.g. pens, pencils).
- Books (e.g. dictionaries) and calculators are **not** permitted.

Instructions to Students:

- *Answer questions in English.* Perfect English is **not** required.
- Attempt all questions.
- Write your answers in an answer book.
- Start your answer to each question on a new page
- Clearly number your answers.
- Any unreadable parts will be considered wrong.
- When writing programs, use good layout, and short comments; marks will not be deducted for minor syntax errors.
- The marks for each part of a question are given in brackets (...).

Question 1 (15 minutes; 15 marks)

Show that $(p \rightarrow r) \vee (q \rightarrow r)$ and $(p \wedge q) \rightarrow r$ are logically equivalent.

Question 2 (10 minutes; 10 marks)

Let P(x) be the statement "x can speak English" and let Q(x) be the statement "x knows Java."

Write each of the follwing sentences in terms of P(x), Q(x), quantifiers, and logical connectives. The domain for the quantifiers is all students in CoE.

a) There is a student in CoE who can speak English and who knows Java.

b) There is a student in CoE who can speak English but who doesn't know Java.

c) Every student in CoE either can speak English or knows Java.

d) No student in CoE can speak English or knows Java.

Question 3 (20 minutes; 20 marks)

Let B(x), L(x), MC(x), and F(x) be the statements "x is a baby," "x is logical," "x is able to manage a crocodile," and "x is funny," respectively. The domain consists of all people.

Write each of the following statements using quantifiers, logical connectives, and B(x), L(x), MC(x), and F(x).

a) Babies are illogical. (*Hint*: illogical means "not logical".)

b) Nobody is funny if they can manage a crocodile.

c) Illogical people are funny.

d) Babies cannot manage crocodiles.

e) Does (d) follow from (a), (b), and (c)? If not, is there a correct conclusion?

Question 4 (20 minutes; 20 marks)

For each of the following arguments, show whether it is correct or incorrect, and explain why.

a) All students in this class understand logic. Thor is a student in this class. Therefore, Thor understands logic.

b) Every computer engineering student takes discrete mathematics. Loki is taking discrete mathematics. Therefore, Loki is a computer engineering student.

c) All dragons like fruit. My pet bird is not a dragon. Therefore, my pet bird does not like fruit.

d) Everyone who eats an apple every day is healthy. Odin is not healthy. Therefore, Odin does not eat an apple every day.

Question 5 (20 minutes; 20 marks)

Use rules of inference to show that if $\forall x\ (P(x) \vee Q(x))$, $\forall x\ (\neg Q(x) \vee S(x))$, $\forall x\ (R(x) \rightarrow \neg S(x))$, and $\exists x\ \neg P(x)$ are true, then $\exists x\ \neg R(x)$ is true.

Question 6 (15 minutes; 15 marks)

Show that if n is an integer and n^3+5 is odd, then n is even using:

a) a proof by contraposition.

b) a proof by contradiction.

Question 7 (10 minutes; 10 marks)

Prove that if n is a positive integer, then n is odd **if and only if** $5n + 6$ is odd.

Question 8 (10 minutes; 10 marks)

Prove that if x and y are real numbers, then $\max(x,y) + \min(x,y) = x+y$

Hint: Use proof by cases, with three cases for $x < y$, $x = y$, and $x > y$.

--- End of Examination ---