COMS10003: Class Test on Logic

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Instructions

For this class test you are required to answer four questions on logic.

You are expected to work independently.

You may use your logic reference card.

Before you start, familiarise yourself with all the questions.

Clearly state your name and your user name on the answer sheet.

All answers should be clearly structured and fully justified.

Question 1: For each of the statements listed below, determine whether or not it is **logically equivalent to the negation** of the statement:

"If you go home on the weekend, then you should bring your lecture notes and study."

Start by expressing the above statement in the language of propositional logic, clearly stating what meaning you assign to propositional variables.

Proceed by formalising each of the listed statements.

1. If you don't go home on the weekend, then you shouldn't bring your lecture notes and you shouldn't study.
2. If you don't go home on the weekend, then you shouldn't bring your lecture notes or you shouldn't study.
3. If you don't go home on the weekend, then you should bring your lecture notes and study.
4. You don't go home on the weekend, and you shouldn't bring your lecture notes and you shouldn't study.
5. You don't go home on the weekend, and you shouldn't bring your lecture notes or you shouldn't study.
6. You don't go home on the weekend, or you should bring your lecture notes and you should study.
7. You go home on the weekend and you shouldn't bring your lecture notes, or you go home on the weekend and you shouldn't study.
8. You go home on the weekend, and you shouldn't bring your lecture notes and you shouldn't study.
9. You go home on the weekend, and you shouldn't bring your lecture notes or you shouldn't study.

Clearly explain and justify your answer with reference to your formalisation. You may use either symbolic manipulation or truth tables.

[9 marks, one for each statement]

please turn over

Question 2: Demonstrate that $\{\wedge, \neg\}$ is a functionally complete set of connectives. Explain clearly what you need to do and show each step of your work.

Hint: You may make reference to normal forms.

[2 marks]

Question 3: Transform the following proposition into an equivalent proposition in Disjunctive Normal Form:

$$(((\neg p \Rightarrow q) \vee (p \wedge \neg r)) \Leftrightarrow \neg q)$$

Minimise your answer. Is the minimised proposition still in Disjunctive Normal Form? Explain.

[3 marks]

Question 4: Demonstrate that $((p \vee (q \vee r)) \wedge (r \vee \neg p)) \equiv ((q \wedge \neg p) \vee r)$ using:

a) a truth table, and

b) logical equivalences and symbolic manipulation. Justify each step.

[6 marks]