

ENGR123 Test One
50 minutes. 5 questions.
40 marks total
19 August 2015

Name:

ID Number:

Please use the spaces provided in this test booklet to give your answers. Attempt all questions. Blank pages for rough work are provided toward the end. A formula sheet is on the last page.

1. Complete the following truth table

[10 marks]

P	Q	R	$\neg(P \wedge Q) \vee (R \rightarrow P)$	$P \rightarrow (R \rightarrow P \vee Q)$
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

2. Let $F(p)$ = “printer p is broken”; $B(p)$ = “printer p is busy”;
 $Q(j)$ = “job j is queued” and $L(j)$ = “job j is lost”.

[8 marks]

Consider the statements:

- $\exists p (F(p) \wedge B(p)) \rightarrow \exists j L(j)$
- $\forall p B(p) \rightarrow \exists j Q(j)$

- (a) Translate the statements into English.
(b) Negate the statements (symbolically, i.e. not in English).

3. (a) What is a valid argument? [2 marks]
- (b) Rewrite the following arguments using predicates and *explain* which are valid. [6 marks]
- i. All convertible cars are fun to drive. Isaac's car is not a convertible. Therefore, Isaac's car is not fun to drive.
 - ii. Everyone who eats granola for breakfast is healthy. Lucy is not healthy. Therefore, Lucy does not eat granola for breakfast.

4. Let F be the set of Facebook users. For each of the following relations, check:

(i) reflexivity (ii) symmetry (iii) transitivity and (iv) anti-symmetry.

[8 marks]

(a) $R \subset F \times F$ is the relation aRb iff there is a photo that both a and b have liked.

(b) $S \subset F \times F$ is the relation aSb iff a has as many or more friends than b .

5. A chain letter works as follows. Stage one: an initial person sends the letter to 2 friends. Stage 2: each of whom sends it to 2 new friends. Stage 3++: and so on.

(a) Give a formula for the *total* number of letters that have been mailed *by the n^{th} stage* of the chain. **[2 marks]**

(b) Prove your formula is correct using induction. **[4 marks]**

Use this page for rough working if needed.

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