



**Universiti  
Malaysia  
PAHANG**

Engineering • Technology • Creativity

**FACULTY OF COMPUTER SYSTEMS & SOFTWARE ENGINEERING  
FINAL EXAMINATION**

<b>COURSE</b>	<b>:</b>	<b>FORMAL METHODS</b>
<b>COURSE CODE</b>	<b>:</b>	<b>BCS2213</b>
<b>LECTURER</b>	<b>:</b>	<b>PROF.DR.PRABAT K.MAHANTI</b>
<b>DATE</b>	<b>:</b>	<b>7 JANUARY 2013</b>
<b>DURATION</b>	<b>:</b>	<b>3 HOURS</b>
<b>SESSION/SEMESTER</b>	<b>:</b>	<b>SESSION 2012/2013 SEMESTER I</b>
<b>PROGRAMME CODE</b>	<b>:</b>	<b>BCS</b>

**INSTRUCTIONS TO CANDIDATE:**

1. This question paper consists of **SIX (6)** questions. Answer **ALL** questions.
2. Write your answers in the answer booklet provided.
3. Answer **EACH** question on a new page.
4. All calculations and assumptions must be clearly shown.

**EXAMINATION REQUIREMENTS:**

NONE

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**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO**

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This examination paper consists of **FIVE (5)** printed pages including the front page.

**QUESTION 1****[5 Marks]**

- (a) Let  $A = \{0, 1, 2, 3\}$  be a set. Write each of the following statements without using quantifiers, instead using only the  $\wedge$ ,  $\vee$  and  $\neg$  operations.

(a)  $\exists x \in A, P(x)$  (b)  $\forall x \in A, P(x)$  (c)  $\exists x \in A, \neg P(x)$  (d)  $\forall x \in A, \neg P(x)$

(e)  $\neg \exists x \in A, P(x)$  (f)  $\neg \forall x \in A, P(x)$

**[3 Marks]**

- (b) Show that the following argument is valid using required truth table:

Premise #1: If Mark is a freshman, then he is taking C-programming.

Premise #2: Mark is a freshman.

Conclusion: So, Mark is taking C-programming.

**[2 Marks]****QUESTION 2****[5 Marks]**

- (a) State what is a tautological proposition?

**[1 Mark]**

- (b) Write predicates and a full truth table, explain whether 'She loves me, She loves me not' is a tautology or not.

**[3 Marks]**

- (c) Write a sentence in English for the following statement about the natural numbers:

$$\exists x, \exists y, \exists z, x^2 + y^2 = z^2$$

**[1 Mark]**

**QUESTION 3****[7 Marks]**

- (a) Suppose that  $S$  and  $T$  are types, write in words what  $S \leftrightarrow T$  is called. Also write in symbols what  $S \leftrightarrow T$  is in short form.

**[2 Marks]**

- (c) Assume a type  $\text{BOOL} ::= \text{true} \mid \text{false}$ , and an abstract type  $T$ .

Write a schema **If-Then-Else** that inputs a variable  $\text{Cond?} : \text{BOOL}$  and values  $\text{in1?} : T$  and  $\text{in2?} : T$  and outputs  $\text{out!} : T$ . If  $\text{Cond?} = \text{true}$  then **If-Then-Else** outputs  $\text{in1?}$  Otherwise, **If-Then-Else** outputs  $\text{in2?}$

**[5 Marks]****QUESTION 4****[7 Marks]**

- (a) Model the state of the Zenith Hotel as a schema *HOTELState* with a relation *occupying*:  $\text{PERSON} \leftrightarrow \text{ROOM}$ . Include some elementary consistency checks, including ‘a person cannot occupy more than one room’ and ‘every room can accommodate at most two people’ and any other check you may consider reasonable and appropriate.

**[5 Marks]**

- (b) Write an initial state Schema in which the Zenith Hotel is empty (has no occupants).

**[2 Marks]****QUESTION 5****[6 Marks]**

- (a) Write for Zenith Hotel Schemas *OccupiedRooms* and *Guests* with outputs *occupiedRooms!* and *guests!*. You may use  $\Delta$  and  $\exists$  without comment.

**[6 Marks]**

**QUESTION 6****[10 Marks]**

- (a) Write for Zenith Hotel a schema *FireAlarm*, with input *fire?* of type  $\text{BOOL} ::= \text{literal} \mid \text{figurative}$ . If *fire?* = literal then it empties the hotel. If *fire?* = *figurative* then it fills all the vacant rooms with couples. You may use  $\Delta$  and  $\Xi$  without comment.

**[5 Marks]**

- (b) Express the following statement into formal system specifications:

“Every mail message larger than one megabyte will be compressed.”

“If a user is active, at least one network link will be available.”

**[5 Marks]****END OF QUESTION PAPER**