



**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>BALSAM ABDULJABBAR MUSTAFA</b>
<b>DATE</b>	<b>:</b>	<b>5 JANUARY 2012</b>
<b>DURATION</b>	<b>:</b>	<b>2HOURS 30 MINUTES</b>
<b>SESSION/SEMESTER</b>	<b>:</b>	<b>SESSION 2011/2012 SEMESTER I</b>
<b>PROGRAMME CODE</b>	<b>:</b>	<b>BCS</b>

**INSTRUCTIONS TO CANDIDATE:**

1. This question paper consists of **FIVE (5)** 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.

## SECTION A: Structured Questions

[50 MARKS]

## QUESTION 1

[14 Marks]

(a) Given the statement below

Lecture = {Ahmad  $\mapsto$  SQL, Adam  $\mapsto$  Prolog, Ahmad  $\mapsto$  Prolog,  
Lina  $\mapsto$  Java, Lina  $\mapsto$  SQL}

Answer the following

i. Draw a diagram to show the relation between the sets in the above statement.

[2 Marks]

ii. Find "Dom" Lecture

[1 Mark]

iii. Find "Rng" Lecture

[1 Mark]

iv. Draw Lecture<sup>-1</sup>

[1 Mark]

v. Is the relation in the given statement a "function"? Explain your answer.

[1 Mark]

(b) Let A = {a, b, c} and B = {1, 2, 3}

Answer the following questions

i. Is R = { (a, 1), (b, 2), (2, c) } a relation from A to B?

[1 Mark]

ii. Is Q = { (1, a), (2, b) } a relation from A to B?

[1 Mark]

iii. Is  $P = \{(a, a), (b, c), (b, a)\}$  a relation from  $A$  to  $A$ ?

[1 Mark]

(c) Consider the function  $f(x)$  with:

$$\text{Domain} = \{-2, -1, 0, 1, 2\}$$

$$\text{Range} = \{1, 2, 3, 4, 5\}$$

$$f(x) = 5 - x^2$$

Draw the two-set arrow diagram for  $f(x)$ .

[5 Marks]

## QUESTION 2

[6 Marks]

(a) Differentiate between a 'Sequence' and 'Subsequence'. Give an example of each.

[2 Marks]

(b) Given the sequences

$$A = \langle \text{Mar}, \text{Apr}, \text{May}, \text{Jun}, \text{Jul} \rangle$$

$$B = \langle \text{Oct}, \text{Nov}, \text{Dec} \rangle$$

Find the following

i. Head  $A$

[1 Mark]

ii. First  $A$

[1 Mark]

iii. Tail  $A$

[1 Mark]

iv. Concatenation of A,B

[1 Mark]

**QUESTION 3****[6 Marks]**

(a) Explain why 'Schema' is used in Formal Methods notation. Discuss the state schema and operation schema to show the differences between them.

[5 Marks]

(b) Give an example to illustrate the structure of state schema in Z notation.

[1 Mark]

**QUESTION 4****[10 Marks]**

(a) Create a truth table to determine if statements (i) and (ii) are logically equivalent. Justify your answer.

i. " If Helmi likes basketball, then he likes swimming and football"

[4 Marks]

ii. " If Helmi dislikes football or he dislikes swimming, then he dislikes basketball"

[4 Marks]

(b) Let  $P(x)$  be " $x^2 \leq 16$ ". Domain consists of positive integers from 4 to 7.

Is  $\exists x P(x)$  True? Justify your answer.

[2 Marks]

**QUESTIONS****[14 Marks]**

This case study concerns with modeling a university committee application. Faculty members may sit on university committee dealing with budget, academic affairs, research, and other issues.

The basic types in this application are:

- 1- [Faculty] the set of all uniquely faculty members
- 2- [committee] the set of all uniquely identifiable committees

The relation “member-of” specifies which faculty members sit on these committees.

Using schemas, prepare a Z document that includes:

- |  |           |
|--|-----------|
| (a) Types used   | [1 Mark]  |
| (b) Global declaration   | [1 Mark]  |
| (c) Initial state  | [1 Mark]  |
| (d) Operations such as adding another faculty member to a given committee  | [2 Marks] |
| (e) Deleting certain faculty member from a designated committee  | [3 Marks] |
| (f) Creating a new committee   | [3 Marks] |
| (g) Inquires such as listing all committees that a particular faculty member sits on and listing all faculty members who sit on a specific committee and error handling. | [3 Marks] |

**END OF QUESTIONS PAPER**