Universiti Malaysia PAHANG

Engineering • Technology • Creativity

FACULTY OF COMPUTER SYSTEMS & SOFTWARE ENGINEERING

FINAL EXAMINATION

COURSE	:	FORMAL METHODS
COURSE CODE	:	BCS2213
LECTURER	:	VITALIY MEZHUYEV
DATE	:	19 JUNE 2014
DURATION	:	3 HOURS
SESSION/SEMESTER	:	SESSION 2013/2014 SEMESTER II
PROGRAMME CODE	:	BCS/ BCN

INSTRUCTIONS TO CANDIDATE:

1. This question paper consists of **FOUR (4)** 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

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

This examination paper consists of **FOUR (4)** printed pages including the front page.

QUESTION 1 [12 Marks]

1. Explain by giving **THREE (3)** reasons how using formal methods allows you to overcome errors at software development.

[4 Marks]

2. You are given the following requirement:

"Users should have easy to use interface to access the payment system"

a) Discuss **TWO (2)** reasons why this requirement is not clear or complete.

[3 Marks]

b) Considering your answer in (a), rewrite the requirement in natural language by avoiding the ambiguity of meaning.

[3 Marks]

3. Find **TWO (2)** unambiguous (but natural sounding) sentences equivalent to the sentence *"The man saw the woman with a telescope"*, the first where the man has the telescope, the second where the woman has the telescope.

[2 Marks]

QUESTION 2 [23 Marks]

1. TLA is good for what kind of systems? State **THREE (3)** types of systems.

[3 Marks]

2. Explain the principles of work of model checking algorithm, implemented in TLC. How does TLC calculates amount of distinct states?

[7 Marks]

3. How do you define behaviour of a system in TLA? Give **ONE (1)** example of specification of behaviour of a system.

[3 Marks]

4. For each following temporal formula give **ONE (1)** example of situation, where the formula can be applied. Use natural language (English).

$\Box P$

[2 Marks]

$\Box[N]_v$

[2 Marks]

$\Diamond F$

[2 Marks]

$\Box\Diamond F$

[2 Marks]

$\Diamond\Box F$

[2 Marks]

QUESTION 3 **[40 Marks]**

Develop TLA specifications of the following situations. You can use TLATEX or ASCII notation. Comment your statements.

1. **Task about a cat, a mouse and a cheese.**
   When rain comes, the cat goes in the room or in the basement. When the cat is in the room, the mouse goes in the hole, and the cheese is put in the fridge. If the cheese is on the table, and the cat is in the basement, then the mouse is in the room. Now comes the rain, and cheese is on the table.

[20 Marks]

2. **Modelling** mechanical **movement**
   Develop TLA specification of linear mechanical movement of material point, bounded in the box with coordinates of borders x=0 and x=5. When a point touches a border it reverses the direction of movement. The movement is discrete – each step of material point is one unit of distance.

[20 Marks]

QUESTION 4 [25 Marks]

Develop model of a simple document control system in Z notation. Comment your statements. People who work together need to share their work, but there are many occasions where misunderstandings and confusion can occur. Errors can be introduced when two people working on the same file of software code and make changes that conflict with each other. We need to involve computer to help prevent such errors: this is the purpose of a document control system.

Here are informal requirements:

- if a user wants to check out a document in order to change the document and the user has the permission to change it, and nobody else is changing the document at the moment, then that user may check the document out;
- as soon as a user has checked out a document for editing, everyone else is disallowed from checking out the document (but people with read permission still can read it);
- when the user is done editing the document, it should be checked in, allowing another user to check it out.

END OF QUESTIONS PAPER