

UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS
FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS

END OF SEMESTER FINAL ASSESMENT

SEMESTER 1, 2022/2023

COURSE	:	BACHELOR OF SCIENCE IN COMPUTER SCIENCE - YEAR 2
PAPER	:	FORMAL METHODS IN COMPUTING
CODE	:	CSC 2106
SEMESTER	:	ONE
DATE	:	15TH DECEMBER 2022
TIME	:	9:30 – 12: 30 PM
DURATION	:	3 HOURS

Instructions

3. Attempt All Questions in Section A and three Questions in Section B
 4. Time Allowed 3 Hours Only
 5. Use of relevant Illustrations/diagrams will earn you a bonus mark (s)
 6. Remember to indicate the question number you have answered.
 7. Write your name, course and registration number on all your answer sheets
 8. All answers should be written on the answer booklet
 9. All university rules apply
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QUESTION ONE:

- a) Formal specification and formal verification are two major components of formal methods. Describe what you understand by these two terms
- b) Give at least two advantages of using formal methods over traditional methods of specifications
- c) Define the following terms as used in Formal methods
 - i. Atom
 - ii. Tautology
 - iii. Axiom
 - iv. Formula

QUESTION TWO:

Decide whether each of the following sentences is **valid, unsatisfiable, or neither**. You may use truth tables or any of the standard sound rules for propositional inference. Show your argument.

- (a) $\text{Smoke} \rightarrow \text{Smoke}$
- (b) $\text{Smoke} \rightarrow \text{Fire}$
- (c) $(\text{Smoke} \rightarrow \text{Fire}) \rightarrow (\neg \text{Smoke} \rightarrow \neg \text{Fire})$
- (d) $\text{Smoke} \vee \text{Fire} \vee \neg \text{Fire}$
- (e) $((\text{Smoke} \wedge \text{Heat}) \rightarrow \text{Fire}) \Leftrightarrow ((\text{Smoke} \rightarrow \text{Fire}) \vee (\text{Heat} \rightarrow \text{Fire}))$
- (f) $(\text{Smoke} \rightarrow \text{Fire}) \rightarrow ((\text{Smoke} \wedge \text{Heat}) \rightarrow \text{Fire})$
- (g) $\text{Big} \vee \text{Dumb} \vee (\text{Big} \rightarrow \text{Dumb})$
- (h) $(\text{Big} \wedge \text{Dumb}) \vee \neg \text{Dumb}$

Question Three:

Prove whether each of the following formulas is a tautology or not

- (a) $P \wedge P$.
- (b) $P \wedge \neg Q$.
- (c) $(P \Rightarrow Q) \Rightarrow P$.
- (d) $P \Rightarrow (Q \Rightarrow P)$.
- (e) $P \Rightarrow (Q \Rightarrow (P \Rightarrow P))$.
- (f) $(P \wedge Q) \Rightarrow P$.
- (g) $P \Rightarrow (P \wedge Q)$.
- (h) $((P \wedge Q) \Rightarrow R) \Leftrightarrow ((P \Rightarrow R) \vee (Q \Rightarrow R))$

Question Four:

Translate the following English sentences into propositional Logic.

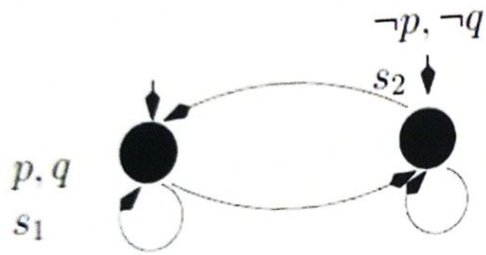
- (a) Every integer strictly less than 3 is not equal to 7.
- (b) Some integer strictly less than 3 is not equal to 7.
- (c) Every even integer less than 9 is not odd.
- (d) Some Hall of residence which belongs to Uganda Martyrs University has solidarity with Box.

QUESTION FIVE

- i) Define the following terms as used in Formal Methods
 - a) State
 - b) State Variable
 - c) Transition
 - d) Domain
- ii) Using the variable ordering " A_1, A_2, A_3, A_4 ", draw the Tree and OBDD corresponding to the following formulas:

$$A_1 \wedge (\neg A_1 \vee \neg A_2) \wedge (A_2 \vee A_3) \wedge (\neg A_3 \vee A_4)$$

QUESTION SIX



Consider the following Kripke Model M:

For each of the following facts, say if it is true or false in CTL.

(a) $M \models A(GFp \rightarrow GFq)$

(b) $M \models A(GFp)$

(c) $M \models A(FG\neg p)$

(d) $M \models A(\neg p U q)$

***THE END ***