

CHUKA



UNIVERSITY

**UNIVERSITY EXAMINATIONS**

**THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE AWARD OF  
BACHELOR OF SCIENCE COMPUTER SCIENCE / BACHELOR OF SCIENCE  
APPLIED COMPUTER SCIENCE**

**COSC 340: THEORY OF COMPUTATION**

**STREAMS: BSC COMPUTER SCIENCE / BSC APPLIED COMPUTER SCIENCE**

**TIME: 2 HOURS**

**DAY/DATE: FRIDAY 14/12/2018**

**8.30 A.M. – 10.30**

**A.M.**

**INSTRUCTIONS:**

- Answer Question **ONE** and any other **TWO** questions.
- Diagrams should be used whenever they are relevant to support an answer.
- Sketch maps and diagrams may be used whenever they help to illustrate your answer
- Do not write anything on the question paper
- This is a **closed book exam**, No reference materials are allowed in the examination room
- There will be **No** use of mobile phones or any other unauthorized materials
- Write your answers legibly and use your time wisely

**SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION**

**QUESTION ONE [30 MARKS]**

- a) Explain and give an example of each of the following terms used in Theory of Computation:
- i. Alphabet. [2 Marks]
  - ii. String. [2 Marks]
- b) Describe the role of language in the Theory of Computation. [3 Marks]

- c) As physics is to physical systems so Theory of Computation is to Computing and Information Systems. Discuss. [4 Marks]
- d) Let  $M$  be a Turing machine, and let  $w$  be an input string for  $M$ . Define the running time  $t_M(w)$  of  $M$  on input  $w$  according to Theory of Complexity. [4 Marks]
- e) List and explain the four contributions that Alan Turing is famous for in Computer Science. [4 Marks]
- f) Describe the halting problem and give an example of its applications to nowadays computer professionals. [4 Marks]
- g) Explain the importance of NP-Complete problems to computer scientists. [4 Marks]
- h) Highlight in brief each of the branches of the Theory of Computation. [3 Marks]

**SECTION B: ANSWER ANY TWO QUESTIONS FROM THIS SECTION**

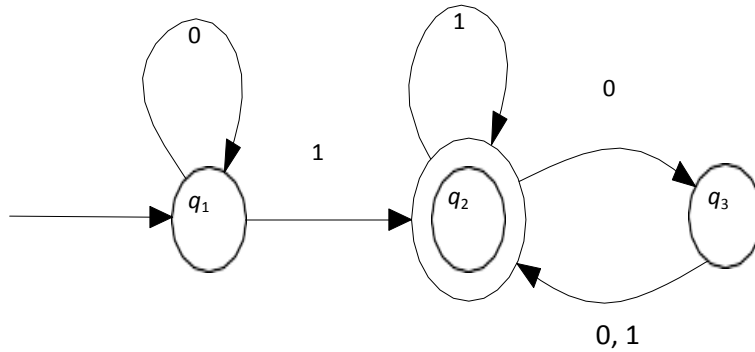
**QUESTION TWO [20 MARKS]**

- a) Let  $L$  be the language  $\{0^n 1^n | n \geq 0\}$ . Explain why language  $L$  is not considered a regular language. [4 Marks]
- b) Let  $A_{DFA} = \{(M, w) : M \text{ is a deterministic finite automaton that accepts the string } w\}$ .  $A_{DFA}$  is decidable. Explain and justify your answer through proof. [6 Marks]
- c) The language  $A_{TM}$  is undecidable. Explain. [4 Marks]
- d) Identify any three modern applications that reference Finite Automata in their designs. [6 Marks]

**QUESTION THREE [20 MARKS]**

- a) Demonstrating using a Turing Machine, differentiate between Turing Recognizable and Turing Decidable Languages. [4 Marks]
- a) An important application of context-free grammars occurs in the specification and compilation of programming languages. Discuss. [6 Marks]

b) Machine M is given below:



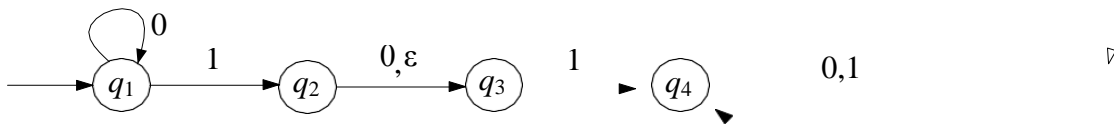
- i. Formally define Machine M. [5 Marks]
- ii. Define the language  $L(M)$  of machine M. [5 Marks]

**QUESTION FOUR [20 MARKS]**

a) Identify the language used by each of the following computation models and explain your answer:

- i. Finite Automaton. [2 Marks]
- ii. Push Down Automata. [2 Marks]
- iii. Context Free Grammar. [2 Marks]
- iv. Turing Machines. [2 Marks]

b) Study the machine given below:



- i. Explain with justification what type of machine this is. [4 Marks]
- ii. Demonstrate the computation of an input 010110 on this machine. [8 Marks]

**QUESTION FIVE [20 MARKS]**

a) Let  $L(A) = \{0, 01\}$  and  $L(B) = \{1, 10\}$ . Find:

- i. Union of  $L(A)$  and  $L(B)$ . [2 Marks]
  - ii. Concatenation of  $L(A)$  and  $L(B)$  . [2 Marks]
- b) Consider the following components of Context Free Grammar:
- $S \rightarrow AB$   
 $A \rightarrow aA$   
 $B \rightarrow bB$
- i. Define the Grammar. [4 Marks]
  - ii. Generate the string  $aaaabb$  from the grammar. [2 Marks]
  - iii. Draw the parse tree to generate the string  $aaaabb$  from the grammar. [2 Marks]
- c) Explain how Hilbert's problems have influenced Computer Science. [4 Marks]
- d) State and explain the Church-Turing thesis highlighting its impact to the Theory of Computation. [4 Marks]
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