

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

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

COSC 340: THEORY OF COMPUTATION

STREAMS: BSC. COMP SCI / BSC. APPLIED COMP.SCI

TIME: 2 HOURS

DAY/DATE: TUESDAY 02/02/2021

11.30 A.M. – 1.30 P.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

QUESTION ONE [30 MARKS]

- a) Explain the purpose of the Theory of Computation [2 Marks]
- b) Briefly describe each of the three areas of the theory of computation and explain the benefits of each to the field of computing [6 Marks]
- c) Using your knowledge from theory of computation explain what an algorithm is [2 Marks]
- d) Draw and define an example Deterministic Finite Automaton [6 Marks]
- e) Explain any three areas where Push Down Automaton are used [6 Marks]

- f) Giving examples define the three regular expressions on languages [6 Marks]
- g) Identify any two differences between the input alphabet and the tape alphabet of a deterministic Turing Machine [2 Marks]

SECTION B

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO [20 MARKS]

- a) Consider the following substitution rules of a Context Free Grammar
- $S \rightarrow AB$
 $A \rightarrow a$
 $A \rightarrow aA$
 $B \rightarrow b$
 $B \rightarrow bB$

Use the above to identify:

- i. Terminal [2 Marks]
 ii. Start variable [1 Mark]
 iii. Variables [2 Marks]
- b) Use the rules of the grammar in a) above to derive any three strings of the format $\{a, b\}^*$ [3 Marks]
- c) Generate a parse tree to derive each of the strings in b) above [3 Marks]
- d) Let n be a positive integer. If n^2 is even, then n is even.
- i. Prove the theorem using proof by contradiction [5 Marks]
 ii. Prove the theorem using proof by induction [4 Marks]

QUESTION THREE [20 MARKS]

- a) You are given the following language
 $L = \{0^n 1^n \mid n \geq 0\}$
- i. Describe this language [2 Marks]
 ii. Give examples of any two strings of this language [2 Marks]
 iii. Explain if the language is regular or irregular. Justify your answer [2 Marks]
- b) Discuss the **Entscheidungsproblem** explaining its contribution to the of theory of computation [5 Marks]

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- c) Using appropriate diagrams differentiate between Deterministic Finite Automaton and Non Deterministic Finite Automaton [5 Marks]
- d) Making reference to Computer storage highlight the different computational models [4 Marks]

QUESTION FOUR [20 MARKS]

- a) Discuss the pigeon hole principle in theory of computation [5 Marks]
- b) Assume we have two regular languages $L(A) = \{0, 1\}$ and $L(B) = \{010, 001, 110\}$. Show the results of the regular operations below on the two languages:
- i. Conjunction of Language $L(A)$ and Language $L(B)$ [3 Marks]
 - ii. Star of Language $L(B)$ [3 Marks]
 - iii. Union of Language $L(A)$ to $L(B)$ [3 Marks]
- c) Describe any three types of Turing Machines [6 Marks]

QUESTION FIVE [20 MARKS]

- a) A toll gate to a park opens after a person inserts coin denomination of Ksh. 20 or more. Assuming that a certain visitor inserts three coin denominations in a sequence of Ksh. 5, Ksh. 5 and Ksh. 10 and assuming that no change is given back:
- i. Draw the diagram of the DFA machine [5 Marks]
 - ii. Formally define the machine [5 Marks]
- b) Making reference to the concept of algorithms and running time of algorithms, discuss the Theory of Complexity, a branch of Theory of Computation [6 Marks]
- c) Let Σ be an alphabet and let $A \in \Sigma^*$ be a language over the alphabet. Language A is decidable. Explain why Language A is said to be decidable [4 Marks]
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