



***"Investing in Africa's Future"***

**COLLEGE OF ENGINEERING AND APPLIED SCIENCES (CEAS)**

**CSC 1101: THEORY OF COMPUTING**

**END OF FIRST SEMESTER EXAMINATIONS**

**NOVEMBER 2025**

**LECTURER: MR TIMOTHY MAKAMBWA**

**TIME: 3 HOURS**

***INSTRUCTIONS***

You are required to answer questions as instructed in each section

Start each question on a new page in your answer booklet

Answer *all* questions in Section A, any *four* from Section B and any *two* from Section C

## Section A – (Compulsory 20 Marks)

Attempt *all* parts in brief  $2 \times 10 = 20$

### Question One

- a) Define Finite Automata.
- b) Define state, transition, and state-transition diagram with a suitable example.
- c) Explain when is a language accepted by a finite automata.
- d) Explain the terminal and non-terminal symbols of a grammar.
- e) Design a regular expression for the language containing even number of 0's followed by odd number of 1's.
- f) State pumping lemma for context free languages.
- g) Define derivation. Mention the different types of derivation.
- h) Mention the different types of PDA.
- i) Explain the mathematical representation of Turing Machine with a suitable example.
- j) Define halting problem of Turing Machine.

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## Section B

Attempt any *four (4)* of the following  $4 \times 10 = 40$

### Question Two

Construct a Nondeterministic Finite Automata (NFA) to accept strings of a's and b's having substring aba. [10]

### Question Three

Convert the Deterministic Finite Automata (DFA) to Nondeterministic Finite Automata (NFA)



[10]

#### Question Four

Minimize the given DFA using table filling algorithm

\$	a	b
A	B	A
B	A	C
C	D	B
D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

[10]

#### Question Five

Explain the different types of Turing Machine. Design a Turing machine that accepts the language of all strings over the alphabet  $\Sigma = \{a, b\}$  whose second letter is b [10]

#### Question Six

Let  $A = \{1, 2, 3, 4, 5\}$ ,  $B = \{0, 2, 4, 6\}$  and  $C = \{1, 3, 5\}$ . Find the following set.

a)  $(A \cup C) \oplus (A \cap C)$  [3]

b)  $A \oplus (B \cup C)$  [2]

c)  $(A \oplus B) - (A \oplus C)$  [2]

d)  $(A - B) \oplus (A - C)$  [3]

### Section C

Attempt any two (2) questions from the following  $2 \times 20 = 40$

#### Question Seven

Prove the following propositions.

- a) If  $x$  is an even integer then  $x^3$  is also even. [4]
- b) If  $x$  is an odd integer then  $x^3$  is also odd. [4]
- c) If  $x$  and  $y$  are odd integers then  $x + y$  is even. [4]
- d) If  $x$  and  $y$  are odd integers then  $xy$  is also odd. [4]
- e) If  $x$  is an odd integer then  $x^2 - 3x$  is even. [4]

#### Question Eight

Identify each proposition as a tautology, contradiction, or contingency/satisfiable.

- a) a)  $(p \wedge q) \rightarrow p$  [4]
- b) b)  $p \rightarrow (p \vee q)$  [4]
- c) c)  $p \rightarrow (p \rightarrow q)$  [4]
- d) d)  $p \rightarrow (q \rightarrow p)$  [4]
- e) e)  $\neg p \wedge \neg(p \rightarrow q)$  [4]

#### Question Nine

- a) (a) Obtain the left and right derivation for a string  $w=001122$  for the production rules  $S \rightarrow AB, A \rightarrow 01 \mid 0A1, B \rightarrow 2B \mid \epsilon$ . [10]
- b) (b) Prove that regular languages are closed under intersection and union [10]

### **Question Ten**

Construct a Deterministic Finite Automata (DFA) for a regular expression  $(a+b)^*ab$  [20]

**END OF EXAMINATION**