



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND/THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

BACHELOR OF SCIENCE (MATHEMATICS)

SCO211/SMA394: AUTOMATA THEORY/THEORY OF COMPUTATION

DATE: 17/12/2021

TIME: 11.00-1.00 PM

INSTRUCTIONS: Answer Question ONE and other TWO Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Describe the THREE main branches of Theory of Computation. (3 marks)
- b) Differentiate between NFA and DFA. (4 marks)
- c) Describe the applications of pumping lemma. (3 marks)
- d) Obtain a DFA to accept strings of a's and b's starting with the string ab. (6 marks)
- e) Convert the below automation to DFA. (6 marks)

δ	0	1
$\square$	{p,r}	{q}
p	{r,s}	{p}
q	{p,s}	{r}
*	{q,r}	I

- f) Obtain a grammar to generate the following language $L = \{ WWR \text{ Where } W \{a, b\}^* \}$. (4 marks)
- g) Prove that $L = \{ w | w \text{ is a palindrome on } \{a,b\}^* \}$ is not regular. i.e., $L = \{ aabaa, aba, abbbba, \dots \}$ (4 marks)

QUESTION TWO (20 MARKS)

- a) Define Turing Machine. (4 marks)
- b) Describe FOUR applications of Finite Automata. (4 marks)
- c) Obtain grammar to generate string consisting of any number of a's and b's with at least one b. (4 marks)
- d) Construct PDA: For the language. (4 marks)

$$L = \{wcw^R \mid w \in \{a, b\}^*, c \in \Sigma\}$$

- e) Eliminate non-reachable symbols from $G = (\{S, A\}, \{a\}, \{S \rightarrow a, A \rightarrow a\}, S)$. (4 marks)

QUESTION THREE (20 MARKS)

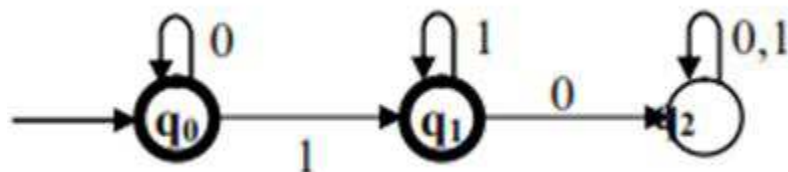
- a) Describe deductive proof. (2 marks)
- b) Discuss THREE uses of Context free Grammars. (6 marks)
- c) Construct a state transition diagram for a DFA that recognizes the following language over the alphabet $\Sigma = \{a, b\}$: (6 marks)

$$L_1 = \{w \mid w \neq ba, \text{ and } w \text{ does not contain } bab\}$$

- d) Design a TM to recognize a string of the form $a^n b^{2n}$ (6 marks)

QUESTION FOUR (20 MARKS)

- a) Give FOUR applications of automata theory. (4 marks)
- b) Construct a state transition diagram for 5-state NFA that recognizes the language given by the regular expression $a(cb)^* \cup c(ba)^*$. (6 marks)
- c) Discuss the language accepted by the following FA. (6 marks)



- d) Explain CGF with an example. (4 marks)

QUESTION FIVE (20 MARKS)

- a) Obtain DFAs to accept strings of a's and b's having exactly one a. (5 marks)
- b) Explain the ground rules of finite automata. (5 marks)
- c) Let R be a regular expression. Then there exists a finite automaton $M = (Q, \Sigma, G, q_0, A)$ which accepts $L(R)$. (6 marks)
- d) Prove pumping lemma. (4 marks)