MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 211: AUTOMATA THEORY

DATE: 26/9/2019 **TIME: 11.00-1.00 PM**

INSTRUCTIONS

Answer **question ONE and any other TWO questions.**

QUESTION ONE (30 MARKS)

(a) Briefly describe the following terms as used in the Automata Theory (8 marks)

i. Non-deterministic Finite Automata

ii. Turing Machine

iii. Push Down Automata

iv. Deterministic Finite Automata

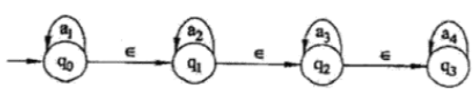
(b) Give the three major ways that reduction in Context Free Grammar can be done. (3 Marks)

(c) Give the length of the following strings over the alphabet Σ={a,b,…z}:

(i) fool

(ii) automata (4 Marks)

(d) Given the following NFA, give the ϵ closure for the four states qo, q1,q2 and q3. (4 marks)



(e) Use Chomsky hierarchy to show a containment hierarchy of classes of formal languages. (4 Marks)

(f) Give two properties of regular sets (2 Marks)

PART B: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Parsing determines whether w ∈ L (G). Parsing constructs a derivative tree (Parse tree) for w implicitly or explicitly. Discuss FIVE applications of parse trees. (10 Marks)

b) Construct a DFA to accept the language generated by the following grammar.

$$S \rightarrow aA \mid \in$$
$$A \rightarrow aA \mid bB \mid \in$$
$$B \rightarrow bB \mid \in$$

(10 Marks)

QUESTION THREE (20 MARKS)

Below is an NFA Machine M1

	$\delta_1(q, \Lambda)$	$\delta_1(q, a)$	$\delta_1(q, b)$
q_0	∅	$\{q_0, q_1\}$	q_3
q_1	∅	∅	q_2
q_2	q_0	∅	q_2
q_3	∅	q_4	∅
q_4	∅	∅	$q_3, q_4\}$

a) Draw the state diagram for M1 (8 Marks)

b) What is L (M1)? (7 Marks)

c) Differentiate between Deterministic and non-deterministic finite automata. (You can use well labeled diagrams to illustrate your answers). (5 Marks)

QUESTION FOUR (20 MARKS)

Non- Deterministic Finite Automata, unlike their counterpart the deterministic finite automata, accepts an empty string as the input alphabet. However, two NFA, one with empty string input and one without are said to be the same. Given the following formulae

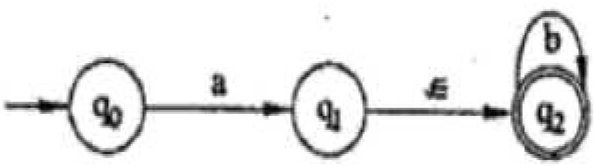
(i) $\hat{\delta}(q, x) = \in -\text{closure}\,(\delta(\hat{\delta}(q, \in), x))$

(ii) $\hat{\delta}(q, \in) = \in -\text{closure}(q)$

And the condition that

$$F_1 = \begin{cases} F \cup \{q_0\} & \text{if } \in -closure(q_0) \text{ contains a state of } F \\ F & \text{otherwise} \end{cases}$$

Clearly show that NFA with empty string transitions can be equivalent to NFA without empty string transition given the same set of states for the following NFA. (20 Marks)



QUESTION FIVE (20 MARKS)

a) A good model for the "computing agent "entity must capture the fundamental properties of a computing agent. A Turing machine has the required features for a computing agent. Using a diagram if necessary, explain the FIVE operations of a Turing machine. (5 Marks)

b) An odd parity bit scheme has the following characteristics;

An extra bit attached to the end of a string of bits

Set up so that the number of 1s in the whole string, including the parity bit is odd.

If the string has an odd number of 1s, parity bit is set to 0

If the string has an even number of 1s, parity bit is set to 1.

Draw a state diagram to represent this Parity Bit Machine using the following Turing Machine program (8 Marks)

(1, 1, 1, 2, R)

(1, 0, 0, 1, R)

(2, 1, 1, 1, R)

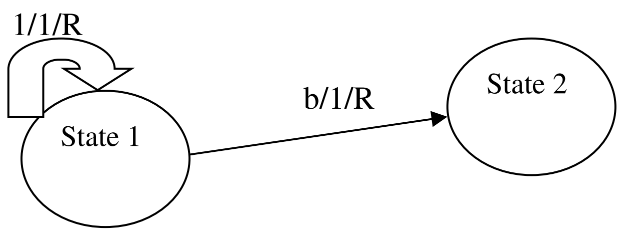
(1, b, 1, 3, R)

(2, b, 0, 3, R)

c) Answer question **ONE** and any other **TWO** questions

d) Marks are awarded for clear and concise answers

e) i) Write a Turing Machine program for the following State diagram (2 Marks)



ii) Give an alternative solution to the one given in c (i) above. (2 Marks)