# MACHAKOS UNIVERSITY

**University Examinations for 2018/2019**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY**

**SECOND YEAR FIRST SEMESTER EXAMINATION FOR**

**BACHELOR OF SCIENCE (COMPUTER SCIENCE)**

**SCO 211: AUTOMATA THEORY**

**DATE: 8/5/2019** **TIME: 2.00-4.00 PM**

**INSTRUCTIONS**

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

**QUESTION ONE (30 MARKS)**

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

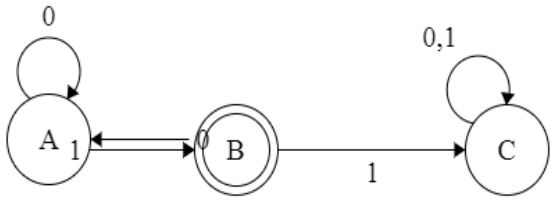
i. Non-deterministic Finite Automata

ii. Turing Machine

iii. Push Down Automata

iv. Deterministic Finite Automata

b) Represent the following non-deterministic automata using Transition Table. (3 marks)




c) Given the production rules;

S → bA/aB

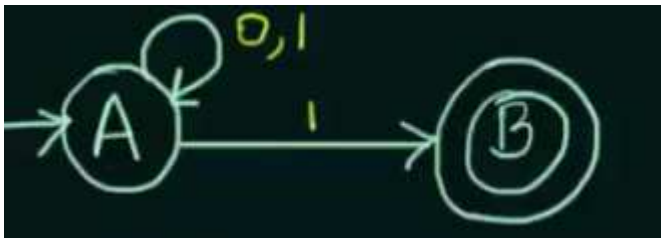
A → aS|aAA|a

B → bS|aBB|b

Find the leftmost derivation for w=aaabbabbba (5 marks)

d) Differentiate between an empty string (ε) and the empty set (∅) and explain why an empty string is considered an element in every set. (4 marks)

e) The Non-deterministic finite automata below accepts all strings that ends in 1,




Draw the Deterministic finite Automata equivalence. (4 marks)

f) Consider a non-deterministic PDA M= ({q0}, { a, b}, { a, b., Z}, δ, q0, Z, ∅), for the language L={ $a^n b^n$: n ≥1) where δ is defined as follows: δ(q0, ε , Z)= {(q0, ab), (q0,aZb)}(Two possible moves for input ε on the tape and Z on the stack), δ(q0, a, a)= { (q0, ε)} and δ(q0, b, b) = (q0, ε). Check whether string w= aabb is accepted or not. Clearly show your work. (6 marks)

**QUESTION TWO (20 MARKS)**

a) What do you understand from the following terms as used in Automata Theory?

i. Regular expression

ii. Context free grammar

iii. Ambiguous grammar

b) 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)

c) Explain the Chomsky's four types of grammars, giving for each the class of language it generates. (4 marks)

**QUESTION THREE (20 MARKS)**

Let M1 be the DFA given by

M1= ($Q_1$, Σ, $\delta_1$, $q_0$, $F_1$)

$Q_1$= {$q_0$, $q_1$, $q_2$, $q_3$}

Σ= {a, b}

$F_1 = \{q_3\}$

The transition function $\delta_1$: $Q_1 \times \Sigma \rightarrow Q_1$

| $Q_1$ | $\delta_1(q, a)$ | $\delta_1(q, b)$ |
|---|---|---|
| $q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_2$ | $q_3$ | $q_0$ |
| $q_3$ | $q_2$ | $q_1$ |

Describe what these represent in the machine

$Q_1$, $\Sigma$, $\delta_1$, $q_0$, $F_1$ (5 marks)

a) Draw a state diagram to show how the machine responds to the following input

i. abbab (5 marks)

ii. baabba (6 marks)

b) Give two everyday applications of a machine such as this. (2 marks)

c) Give two operations of a regular language giving examples. (2 marks)

**QUESTION FOUR (20 MARKS)**

Below is an NFA Machine M1

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

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

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

c) Using well labeled diagrams, differentiate between Deterministic and non-deterministic finite automata. (5 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)

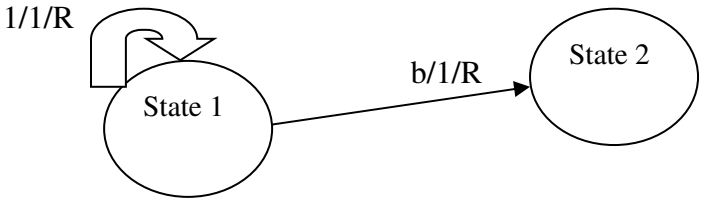
(1, 0, 0, 1, R)

(2, 1, 1, 1, R)

(1, b, 1, 3, R)

(2, b, 0, 3, R)

c) 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)