MACHAKOS UNIVERSITY

University Examinations for 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE (MATHEMATICS AND STATISTICS)

SMA 394: THEORY OF COMPUTATION

DATE: 18/12/2017 **TIME: 8.30-10.30 AM**

Instructions: Answer Question ONE and any other TWO Questions

QUESTION ONE (30 MARKS)

a) Briefly describe the following terms as used in the theory of computations (10 marks)

i. P problem

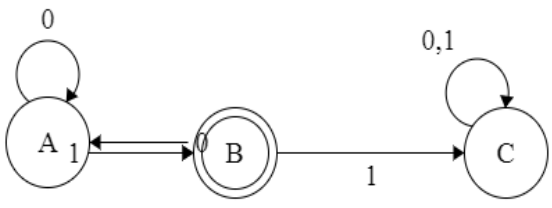
ii. Non-deterministic Finite Automata

iii. Turing Machine

iv. Push Down Automata

v. Deterministic Finite Automata

b) Represent the following deterministic automata using Transition Table. (5 marks)



c) Given the production rules;

S → AB|AaCbB

A → Aa|ʎ

B → bB| ʎ

C → baC|ba

Give the derivation tree for aababbb (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. (5 marks)

e) Models are important ways of studying physical and social phenomena, such as weather systems, spread of epidemics and chemical molecules. What is a model? List four characteristics of a model. (5 marks)

QUESTION TWO (20 MARKS)

a) What do you understand bythe following terms as used in the theory of computation?

i. Regular expression

ii. Context free grammar

iii. Ambiguous grammar (6 marks)

b) What is NP Complete Problem? Give an example of an NP Problem? (4 marks)

c) 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)

QUESTION THREE (20 MARKS)

Let M1 be the DFA given by

M1= (Q_1, Σ, δ_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 δ_1: $Q_1 \times \Sigma \rightarrow Q_1$

Q_1	δ_1(q, a)	δ_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, Σ, δ_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)

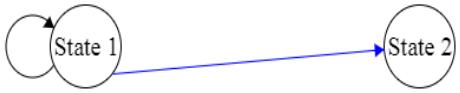
(1, 0, 0, 1, R)

(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)

d) Give THREE practical examples of unsolvable problems related to the halting problems. (3 marks)