ELIZADE UNIVERSITY
ILARA-MOKIN
ONDO STATE

FACULTY: BASIC AND APPLIED SCIENCES
DEPARTMENT: MATHEMATICS AND COMPUTER SCIENCE
2nd **SEMESTER EXAMINATION**
2017 / 2018 **ACADEMIC SESSION**

COURSE CODE: CSC 420

COURSE TITLE: Theory of Automata and Computing

COURSE LEADER: Dr. K. Agbele

DURATION: 2 Hours

HOD's SIGNATURE

INSTRUCTION:

Candidates should answer any FOUR (4) Questions.

Students are warned that possession of any unauthorized materials in an examination is a serious assessment offence

Students are permitted to use ONLY a scientific calculator.

1(a) What is an automaton? List and explain the types of Automaton.
(b) Explain the following components of a Finite Machine (i) Input (ii) Return (iii) State (iv) Start State (v) Accepting State (vi) Rejecting State (viii) Dead State (viii) Transition
(c) When is a string accepted by a Non-Finite State Automaton (NFA)?
(d) List five applications of Finite Machine **(15 marks)**

2. (a) Given $\sum = \{a, b\}$, construct a DFA that shall recognize the language $L = \{b^m ab^n : m, n > 0\}$.

(b) Determine a Finite State Automaton (FA), M, accepting L, where $L = \{w \varepsilon \{0,1\}:$ Every 0 in w has a 1 immediately to its right.

(c) Construct a DFA which recognizes the set of all strings on $\Sigma = \{a,b\}$, starting with the prefix 'ab'.

(d) Construct a FA accepting all string over {0,1} having even number of 0's and even number of 1's. **(15 marks)**

3. (a) Design a DFA, *M* which accepts the language $L(M) = \{w \varepsilon \{a,b\}^*:$ w does not contain three consecutive b's}.

Let M = {Q, Σ, δ, q_o, F}
Where:
Q = { q_o, q_1, q_2, q_3},
Σ={a,b},
q_o is the initial state,
F = { q_o, q_1, q_2, } are final states
and δ is defined as follows

Initial state	Symbol	Final state
q_o	a	q_o
q_o	b	q_1
q_1	a	q_0
q_1	b	q_2
q_2	a	q_o
q_2	b	q_3
q_3	a	q_3
q_3	b	q_3

(b) Let M=({q_1,q_2,q_3}, {0,1}, {q_1}, {q_3} is a NDFA where δ is given by

δ (q_1, 0) = {q_2, q_3) δ (q_1, 1) = {q_1)
δ (q_2, 0) = {q_1, q_2) δ (q_2, 1) = {Φ)
δ (q_3, 0) = {q_2) δ (q_3, 1) = {q_1, q_2)

(i) Construct an equivalent DFA and draw the transition diagram
(ii) Check whether the string '011010' is accepted by DFA and NFA

(c) Obtain the state table diagram and state transition diagram (DFA Schematic) of the finite state Automaton M = {Q, S, δ, q_o, F}, where Q = { q_o, q_1, q_2, q_3}, S={a,b}, q_o is the initial state, F is the final state with transition defined by

$\delta(q_o, a) = q_2$ $\delta(q_3, a) = q_1$ $\delta(q_2, b) = q_3$
$\delta(q_1, a) = q_3$ $\delta(q_o, b) = q_1$ $\delta(q_3, b) = q_2$
$\delta(q_2, a) = q_o$ $\delta(q_1, b) = q_0$ **(15 marks)**

4. (a) Consider the alphabet $\sum = \{a, b\}$. Is there any language L on this alphabet for which $(L)^* = L^*$? If yes, give an example of such a language; if no, explain why.

(b) Consider the following two languages on the alphabet $\sum = \{a, b\}$:

$L_1 = \{a^n : n \gg 1\}$; $L_2 = \{b^n : n \gg 1\}$.

Describe the languages below, using either the set notation or precise definition in English.

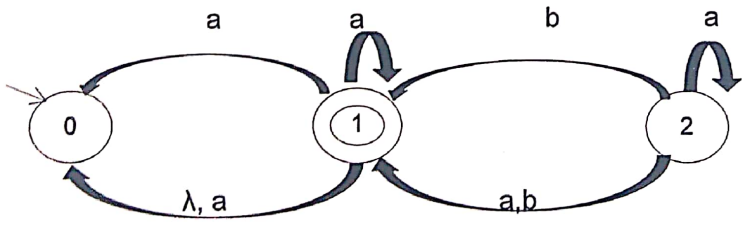
$L_3 = L_1^*$, $L_4 = L_1$, $L_5 = L_1 \, U \, L_2$, $L_6 = L_1 L_2$

$L_7 = (L_1^2)(L_2^2)(L_1^2)$, $L_8 = (L_1 \, U \, L_2)^*$, $L_9 = (L_1 L_2)^*$

(c) For each of the following three languages on $\sum = \{a, b\}$, draw a deterministic finite automaton that accepts it:

(i) All strings that have no b's (note that it includes λ)
(ii) All strings with at least two a's and any number of b's.
(iii) All strings with at most two a's and any number of b's. **(15 marks)**

5. (a) Consider the following sets of integer numbers:
S_1 = {4,5,6},
S_2 = {i: i is even}
S_3 = {i: i is divisible by 3}.
For each set, specify its elements and determine whether it is finite or infinite.
(bi) Draw an example of a graph that has six vertices and six edges. Mark all simple cycles in your graph.
(bii) Draw an example of a tree that has seven vertices, five of which are leaves. How many edges are in your tree.
(c For the alphabet $\sum = \{a, b\}$, draw a deterministic finite accepter that is equivalent to the following accepter:



(15 marks)

(d) Explain the following terms with examples where applicable: (i) Alphabet (ii) Strings (iii) Concatenation (iv) length of a string (v) Empty strings (vi) Positive Closure (vii) Star Closure