Total No. of Printed Pages:03

T.E. (Information Technology) Semester-VI (Revised Course 2016-17)
EXAMINATION AUGUST 2021
Theory of Computation

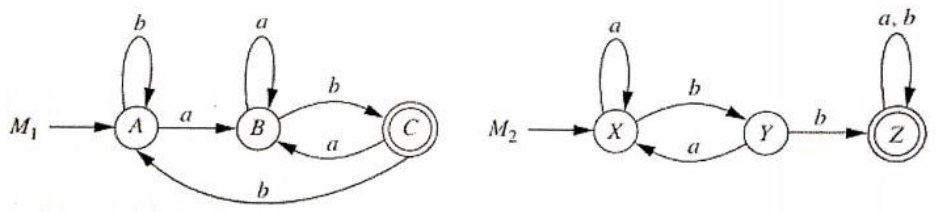
[Duration : Two Hours] **[Total Marks :60]**

Instructions:
1. Answer THREE FULL QUESTIONS with ONE QUESTION FROM EACH PART.
2. Make necessary assumptions if required.

PART A

Q.1 a) Construct a state diagram of DFA recognizing the language where $\sum = \{a, b\}$ [5]
i) L= { $w/length\ of\ w\ is\ at\ least\ 4\ and\ the\ second\ last\ letter\ is\ b$ }
ii) L = {w /w $contains\ odd\ number\ of\ b's\ and\ three\ a's$}

b) Let M1 and M2 given below the finite automata's recognizing languages L1 and L2 respectively [5]



Draw Finite Automata's accepting the following languages:
i) L1∩L2 ii) L1-L2

c) Prove the following grammar is ambiguous [5]
S→a S b / b S b / €
Obtain the unambiguous grammar from the same

d) Convert the following grammar to Chomsky Normal Form [5]
S→PQP
P→aP/€
Q→bQ /b

Q.2 a) Consider the following regular Expression R: $(010+11)^+ (10)^*1$
i) Construct a E-NFA corresponding to R **[2]**
ii) Construct a DFA from E-NFA **[4]**
iii) Obtain a Minimized DFA **[2]**

b) Convert the following grammar to greibache Normal form **[6]**
S →XYb /a

X →aa X /Y
Y →bXb

c) Obtain a CFG corresponding to the following PDA **[6]**
$\delta\ (q_o, 0, z_o) = (q_o,\ XZ_o)$
$\delta\ (q_o, 0, X) = (q_o,\ XX)$
$\delta\ (q_0, 1, X) = (q_1, \mathcal{E})$
$\delta\ (q_1, 1, X) = (q_1, \mathcal{E})$
$\delta\ (q_1, \mathcal{E}, X) = (q_1, \mathcal{E})$
$\delta\ (q_1, \mathcal{E}, Z_o) = (q_1, \mathcal{E})$

Q.3 a) Construct a top down PDA for the following grammar [6]
P→ 0 / 0P /1PP / PP1 / P1P

b) Convert the following NFA to DFA using subset construction method where NFA N = $(\{Q0, Q1, Q2\}, \{0,1\}, \{Q0\}, \{Q3\})$ and transition table is as follows [6]

Current state	Input	Next State
Q0	0,1	Q0
Q0	1	Q1
Q1	0,1	Q2
Q2	0,1	Q3

c) Using Pumping Lemma Theorem prove that the language L=$\{a^n b^n c^n\}$ is not a context free. [6]

d) What is a Unit production? How they eliminated? [2]

PART B

Q.4 a) Construct a Turing Machine that accept the following language L= $\{\times \in \{a, b\}^* \mid \times$ *contains a substring abaa*$\}$ [6]
b) Construct a Turing machine that reverses the input string. Consider the reverse function as Rev:$\{a, b\}^* \rightarrow \{a, b^*\}$ [8]
c) Write a short note on the following
i) Linearly bounded automata [6]
ii) Rice Theorem

Q.5 a) Construct aTuring machine that compute n mod 2; n>=1& replace the input string by the output of the operation on the tape [6]
b) Write a short note the following [8]
i) Rice theorem
ii) Unrestricted grammar
iii) Context sensitive grammar
c) Explain a halting problem in Turing machine [6]

Q.6 a) Design a Turing machine to delete a symbol by changing the tape contents from zay to zy [8]
where y∈ $(\sum \cup \{\Delta\})^*, a \in \sum \cup \{\Delta\}, and\ z \in \sum^*. assume\ that\ \sum = \{a, b\}$

b) Design a Turing machine that computes that following function F$(X) = 3X$ [4]

c) Obtain the unrestricted grammar to generate the following language L= $\{ a^n b^n c^n \mid n \geq 1 \}$ [8]

PART C

Q.7 a) Construct a moore machine that counts the occurrences of the substring qpqpq where [8]
$\sum = \{p, q\}$ $and\ \Delta = \{0,1\}$. Convert the machine to a mealy machine

b) Convert the following grammar into greibiche Normal form [6]
S→ AB
$A \rightarrow BS \mid a$
$B \rightarrow SA \mid b$

c) Construct a Turing machine that recognizes the L=$\{ a^n b^n c^n \mid n \geq 1 \}$. Describe the behavior of the machine for the string " aabbcc" [6]

Q.8 a) Draw an $\varepsilon - NFA$ recognizing the following regular expression (a+b) $(ba)^*(aba)^*$ [4]

b) Construct a PDA corresponding to the given CFG [8]
P→ $PP \mid [P]|(P) \mid$ ^
Describe the behavior of the PDA for the following input string ([]) []

c) Explain with the help of an example how you can combine two Turing machines. [8]