Nirma University

Institute of Technology

Semester End Examination (IR), December - 2017

B. Tech. in Computer Engineering / Information Technology, Semester-V

CE501 Theory of Computation

Roll / Exam No.		Supervisor's initial with date	

Time: 3 Hours | Max. Marks : 100

Instructions:
1. Attempt all questions.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume suitable data wherever necessary and mention the same.
5. Steps / Process should be mentioned clearly for each question.

Q-1. Do as directed. **[16]**

(A) In each case below, find a string of minimum length in {a, b}* not in the Language corresponding to the given regular expression. [4]

a. b* (ab) *a*
b. (a*+b*)(a*+b*)(a*+b*)
c. a*(baa*)*b*
d. b*(a+ba) *b*

(B) Find the regular expression and finite automaton for following languages. Σ={a,b} [4]

1. The language of all strings containing exactly two b's.
2. The language of all strings containing at least two a's.
3. The language of all strings that do not end with ab
4. The language of all strings that begin or end with aa or bb

(C) Explain in brief any 4 applications of Finite State Machine. [4]

(D) Consider the following finite state machine transition table. Now if the language accepted by the given DFA is (a+b(b+aa)*ab)* then which is the final state of the machine ? (q_0:initial state) [4]

State	δ(q,a)	δ (q,b)
q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_1	q_0

Q-2. Answer the following. **[18]**

(A) A finite state machine with the following state table has a single input 'X' and a single output 'Z'. If the initial state is unknown, then which is the shortest input sequence to reach the final state 'C' ? [6]

Present State	Next state Z	
	X=1	X=0
A	D,0	B,0
B	B,1	C,1
C	B,0	D,1
D	B,1	C,0

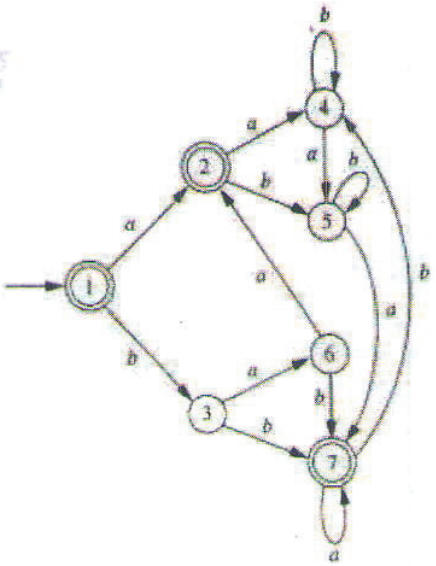
(B) For the Moore Machine given in the following table. Find the equivalent Mealy Machine, Start state in q_0. [6]

Current state	Input Symbol		Output
	a	b	
q_0	q_1	q_2	1
q_1	q_3	q_4	1
q_2	q_4	q_0	0
q_3	q_1	q_2	0
q_4	q_3	q_0	1

OR

(B) Prove that for every n >= 0, $n(n^2 + 5)$ is divisible by 6 using PMI. [6]

(C) Minimize the following FA. [6]

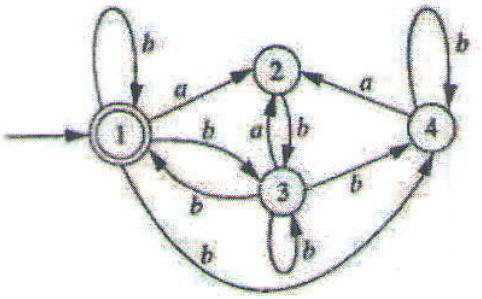


OR

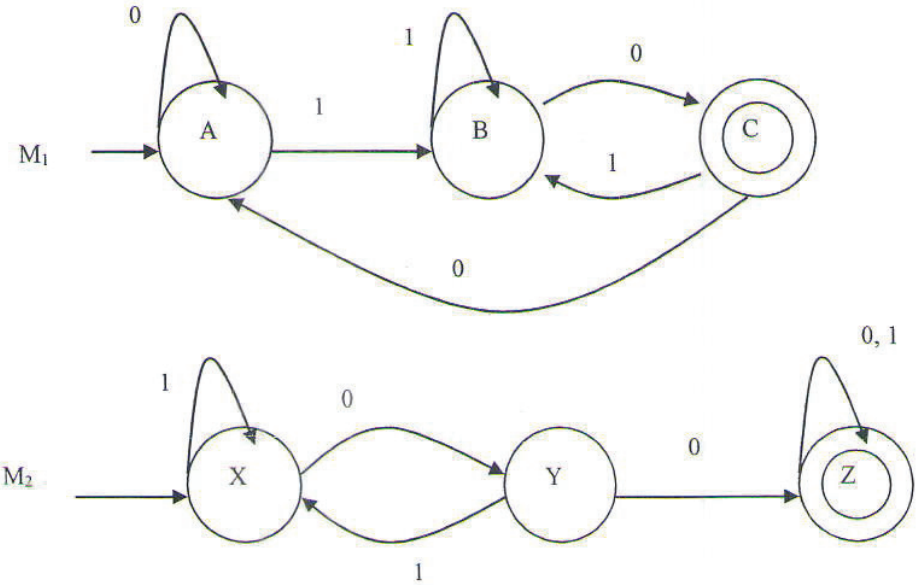
(C) Prove that the language $L = \{a^n \mid n \text{ is a prime number}\}$ is a regular or not using Pumping lemma. [6]

Q-3. Answer the following. **[16]**

(A) Convert the following NFA to equivalent DFA. [8]



(B) Let M_1 and M_2 be two finite automata accepting the language L_1 and L_2 respectively as shown in following figure. Construct the finite automata to accept the language $L = L_2 - L_1$. [8]



Q-4. Do as directed. **[16]**

(A) What do you mean by an ambiguous grammar, prove that the following grammar is an ambiguous : [4]

$E \rightarrow a \mid E+E \mid E-E \mid E^*E \mid E/E$

(B) Write CFG for the following: [4]

1. $\{a^i b^j c^k \mid i = j + k\}$
2. $\{a^i b^j c^k \mid j = i \text{ or } j = k\}$

(C) Construct CFG for the following RE: (0 + 1)* (01)* [4]

(D) What is the difference between deterministic PDA and non-deterministic PDA, explain it with suitable example. [4]

Q-5. Answer the following. **[18]**

(A) Design a PDA for more number of a's as compare to b's. [6]

(B) Convert the following into GNF : [6]

$S \rightarrow XY$
$X \rightarrow YSY$
$X \rightarrow YY \mid 1$
$Y \rightarrow 0X1 \mid 1$

OR

(B) Design a PDA for the following CFG: [6]

$S \rightarrow b \mid bS \mid aSS \mid SSa \mid SaS$

(C) Design a TM over $\Sigma = \{a,b\}$ to accept the language $L = \{a^n b^n \mid n \geq 1\}$ [6]

OR

(C) Write a note on Universal Turing Machine. [6]

Q-6. Answer the following. **[16]**

(A) Design CFG for the following PDA. [8]

$\delta(q_0, a, Z_0) \vdash (q_0, aZ_0)$
$\delta(q_0, a, a) \vdash (q_0, aa)$
$\delta(q_0, c, a) \vdash (q_1, a)$
$\delta(q_1, a, a) \vdash (q_2, \epsilon)$
$\delta(q_2, a, a) \vdash (q_2, \epsilon)$
$\delta(q_2, \epsilon, Z_0) \vdash (q_2, \epsilon)$

(B) Design a Turing Machine for Reversing a String. [8]