Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

V Semester B. Tech. (Computer Science & Engg.)

Winter – 2011

Course Code: CS503

Course Name: Theory of Computation

ne: 2 hr. 30min. Max. Marks: 60

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Figures to the right indicate full marks.
5) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.

1. **Solve any TWO** 12

(a) Design a finite automaton which accepts number that is divisible by 3.

(b) Construct the corresponding Moore machine for the Mealy machine described by the following transition table:

Present state	Input = 0		Input = 1	
	Next state	Output	Next state	Output
q_0	p_0	n	p_1	n
p_0	p_0	y	p_1	n
p_1	p_0	n	p_1	y

(c) Design finite autoniata which accepts number more than 3a's. Verify the string baaba & baaaba.

2. **Solve any TWO**

(a) Draw an NFA for language L over $\Sigma = \{0, 1\}$ which accepts strings of even length.

(b) Convert given DFA into regular expression:

Present state	Next state		Final state
	Input = 0	Input = 1	
q_1	q_1	q_2	q_1, q_2
q_2	q_3	q_2	
q_3	q_3	q_3	

(c) Explain pumping lemma for regular sets and applications for it.

3. **Solve any TWO**

(a) Eliminate useless symbols , useless productions , unit productions and null productions (if any) from the following grammar : S->a|aA|B|C , A->aB|ϵ ,B->Aa, C-> cCD , D->ddd

(b) Convert the following grammar S->ab|aS|aaS into Greibach normal form.

(c) Let G be the grammar whose productions are S-> aB| bA, A->a|aS|bAA, B->b|bS|aBB, then for the string "aaabbabbba", Find: left most derivation, right most derivation, parse tree of each derivation.

4. (a) Design a Turing machine for 2's compliments.

(b) Design a Turing machine for subtraction F(m,n)={m-n for m>n , 0 for m<n}

5. (a) Find whether the following instance of post correspondence problem is decidable or not. 06

i	List A(w_i)	(x_i) List B
1	1	111
2	10111	10
3	10	0

(b) Prove that: 06

i) The union of two recursive languages is recursive.

ii) The union of two recursive innumerable language recursively innumerable.

MER29

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

V Sem B. Tech

Summer Term 2009

Course Code: CS 503 Course Name: Theory Of Computation

Time: 2 hr.30min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.
6) (Other special instruction, if any)

1. **Solve any two**

(a) Construct finite automata over {a , b} containing all string with aaa's 06

(b) What Moore machine and Mealy machine ? Give difference between them. 06

(c) Construct DFA equivalent to NFA given bellow 06

M = ({p, q, r, s}, {0,1}, δ, p, {s})

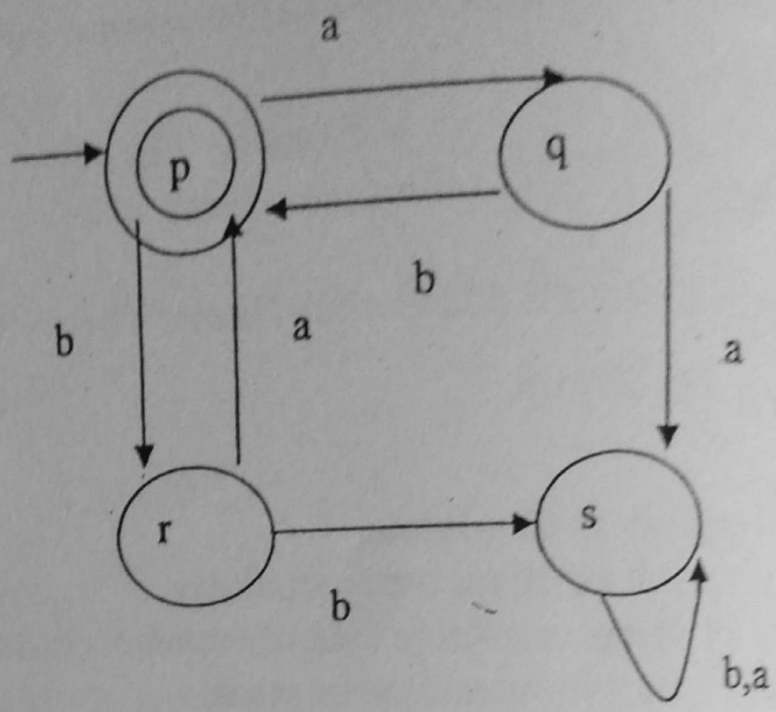
Where δ is given by

	0	1
p	q,s	q
q	r	q,r
r	s	p
s	-	p

Cont.

2. **Solve any two**

(a) Construct Regular Expression for given FA.



(b) Construct DFA for Regular expression a*b*c*.

(c) Construct left linear and right linear grammar for 0(01)*

3. **Solve both**

(a) Find Greibàch Normal Form Grammar equivalent to following Context Free Grammar.

$S \rightarrow AA$

$S \rightarrow 0$

$A \rightarrow SS$

$A \rightarrow 1$

(b) Construct push down automata to accept following language.

$L = \{ww^R \mid w \text{ is in } (0+1)^*\}$

4. **Solve any two**

(a) Design Turing Machine to accept language $L = \{a^n b^{2n}\}$ where $n>=1$

(b) Let $M = (\{q1,q2,q3\},\{0,1\},\{0,1,B\},\delta,q1,B,\{q2\})$ 06
Where δ is given by
1) $\delta(q1,1)=(q3,0,R)$
2) $\delta(q3,0)=(q1,1,R)$
3) $\delta(q3,1)=(q2,0,R)$
4) $\delta(q3,B))=(q3,1,L)$
Find <M, 1101> UTM

(c) Explain types of Turing machine. 06

Solve any two

(a) Explain properties of recursive and recursively enumerable language. 06

(b) Explain the following terms 06
I. Valid Item
II. Complete Item
III. LR (0) Grammar

(c) Consider an instance of MPCP find instance of PCP. 06

	List A	List B
i	wi	xi
1	1	111
2	10111	10
3	10	00

Government College of Engineering, Amravati
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V Semester B. Tech. (Computer Sci. & Engg.)

Winter - 2009

Course Code : CS503

Course Name : Theory of Computation

Time : 2 hr.30min. **Max. Marks : 6**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessar
4) Use of logarithmic table, drawing instruments and non programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. Solve Any Two :

(a) Convert following NFA into DFA :

$M=(\{p,q,r\},\{0,1\},\delta, p, \{q, r\})$

Where δ is defined as :

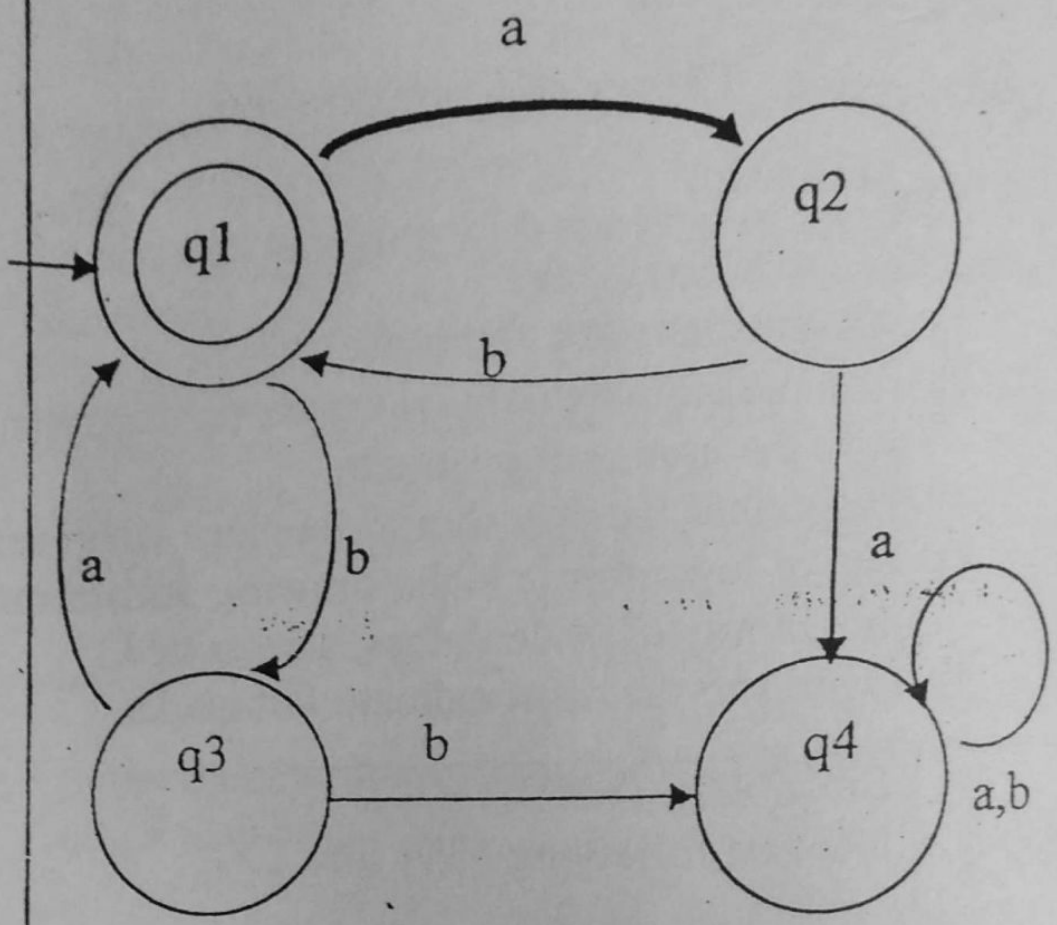
	0	1
p	p,q	q,r
q	p,q,r	r
r	p	r

(b) Construct a DFA accepting all strings w over $\{0,1\}$ such that the number of 1's in w is 3 mod 4.

(c) Construct Moore machine for inputs from $(0+1)^*$, if the input ends in 101, output A; if the input ends in 110, output B; otherwise output C.

Solve any TWO :

2 (a) Construct a regular expression to describe the language accepted by following DFA :



(b) Construct a Finite automata equivalent to following regular expression

(01+(10+01)*+10)*

(c) Prove that $L=\{0^n1^n \mid n \geq 1\}$ is not regular by using Pumping Lemma for regular sets

(a)	Let G be the CFG generating well-formed formulas with predicates p and q. $S \rightarrow \sim S \mid [\, S \supset S \,] \mid p \mid q$ where p,q, ~, [,], and $\supset$ are the terminals. Find the Chomsky Normal Form Grammar generating L(G).	04
	OR	
	Construct right-linear and left-linear grammars for the regular expression **(00(101)*00)+11**	
(b)	Construct a PDA to accept the language $N(M)=\{wcw^R \mid w \in \{a, b\}^*\}$	08
	Solve Any One	12
(a)	Design a Turing machine to recognize the language $L = \{ww^R \mid w \text{ is in } (0+1)^*\}$	
(b)	Design a Turing machine for proper subtraction i.e. $f(m,n) = \{m-n$ if $m \geq n$ $\{0$ otherwise	
	Solve Any Two :	
(a)	Explain : (i) Chomsky hierarchy of languages (ii) Decidable and undecidable problems	12
(b)	Show that complement of recursive language is recursive.	
(c)	Consider an instance of PCP. Let $\Sigma = \{a,b\}$, and let A and B be the lists given below : A= (b, bab^3, ba) and B=(b^3, ba, a) Show that the PCP is decidable. Also find its solution.	

nt College of Engineering, Amravati

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V Semester B. Tech.

Winter 2008

IT505

: Theory of Computation

nin. **Max. Marks : 60**

Candidate

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ıe suitable data wherever necessary and clearly

ıe assumptions made.

ms/sketches should be given wherever necessary.

logarithmic table, drawing instruments and non-

nmable calculators is permitted.

; to the right indicate full marks.

ain Finite State Machines as language 06

ɔtors.

gn DFA for following language over $\Sigma=\{0,1\}$ 06

x | 00 is not the substring of x}

ssible, try to minimize it.

that $L=\{a^p \mid p \text{ is a prime}\}$ is not a regular 06

age.

2. (a) Using appropriate steps convert the following CF to its Chomsky Normal Form,

$S \rightarrow ASB \mid \wedge$
$A \rightarrow aAS \mid a$
$B \rightarrow SbS \mid A \mid bb$

(b) Construct a PDA for language,

$L=\{ a^n b^n \mid n>=1 \}$

Explain its working with the help of transition function.

(c) Consider G, whose productions are,
$S \rightarrow aAS \mid a$, $A \rightarrow SbA \mid SS \mid ba$
Using Derivation tree show that, $S \rightarrow a^2b^2a^2$

3. (a) Design TM for successor function.

(b) Show that Post-correspondence problem is undecidable.

(c) Suggest different variations in TM. Comment on the power of the TM.

4. (a) Describe Universal Turing Machines.

(b) For given Moore machine show that there exists equivalent Mealy machine.

(c) Discuss recursive functions and its applications.

5. (a) Write short notes on -
LR(k) grammar.

(b) Linear Bounded Automata

(c) Enumerable languages.

Government College
(An Autonomous Institute of Government of Maharashtra)

Fifth Semester B. Tech. (CS/IT)

Winter 2015

Course Code: CSU502

Course Name: Theory of Computation

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1.		**Solve any two**	
	a)	Construct a DFA to accept a string containing at least two 0's and at most one 1	**06**
	b)	Find minimum state finite automata equivalent to following finite automata	**06**
	c)	Design a mealy machine accepting the language consisting a string from $\sum = \{0, 1\}$ ending with two consecutive 0's or 1's.	**06**
2		**Solve any two**	
	a)	Draw a FA that accepts strings ending in 1 but not	**06**

Contd.. 1

containing substring 00.over alphabet {0, 1} and write a regular expression for the same

b) Explain Pumping lemma for regular set 06

c) Construct finite automata for regular expression 01[((10)* + 111)* +0]*1 06

3 **Solve any two**

a) Convert to Greibach Normal Form the grammar G=({A1,A2, A3},{a,b},P,A1) where P consists of the following. 06

A1 ->A2 A3
A2 ->A3 A1 /b
A3 ->A1 A2 /a

b) Construct PDA to accept language L = $\{ww^R | w$ is in (0+1)*$\}$ 06

c) Let G be a grammar g=({S,A,B},{0,1},P,S} where P consists of 06

S ->0B/1A
A->0/0S/1AA
B->1/1S/0BB for the string 00110101 find its leftmost derivation and derivation tree

4 Design a Turing Machine to compute f(m*n)=m*n, where m,n>=0 and simulate their action on the input 001000 12

5 a) Does PCP with two lists x= (01, 110010, 1, 11) and y= (0, 0, 1111, 01) have a solution? 06

b) Obtain the binary code for the TM **06**

M=({q1,q2,q3,q4},{0,1},{0,1,B}, δ ,q1,B,{q4})

With the moves

δ (q1,0)=(q3,1,L)

δ (q1,1)=(q4,0,R)

δ (q2,0)=(q2,0,L)

δ (q2,1)=(q3,1,L)

δ (q3,0)=(q3,B,L)

δ (q3,1)=(q3,1,R)

δ (q3,B)=(q3,B,R)

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

V Semester B. Tech. (Computer Sci. & Engg.)

Winter - 2009

Course Code : CS503

Course Name : Theory of Computation

Time : 2 hr.30min. Max. Marks : 60

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1.	(a)	Solve Any Two : Convert following NFA into DFA : $M=(\{p,q,r\},\{0,1\},\delta, p, \{q, r\})$ Where δ is defined as :	12

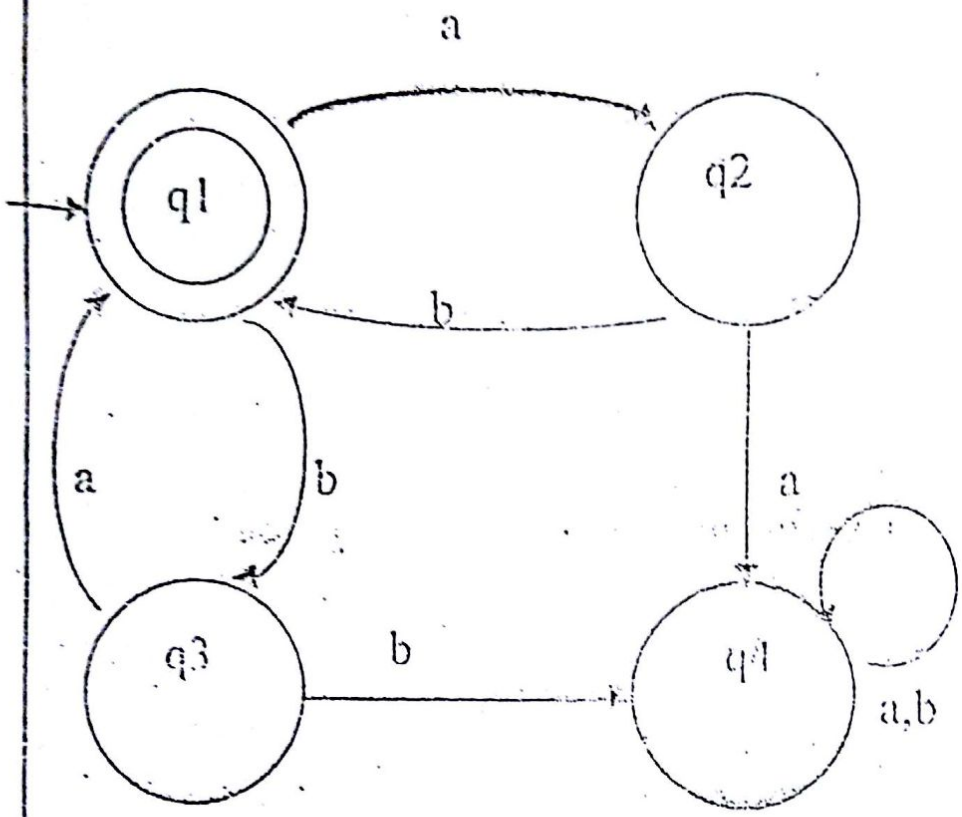
	0	1
p	p,q	q,r
q	p,q,r	r
r	p	r

	(b)	Construct a DFA accepting all strings w over {0,1} such that the number of 1's in w is 3 mod 4.	

(c) Construct Moore machine for inputs from $(0+1)^*$, if the input ends in 101, output A; if the input ends in 110, output B; otherwise output C.

Solve any TWO :

(a) Construct a regular expression to describe the language accepted by following DFA :



(b) Construct a Finite automata equivalent to following regular expression
$(01+(10+01)^*+10)^*$

(c) Prove that $L=\{0^n1^n \mid n \geq 1\}$ is not regular by using Pumping Lemma for regular sets

3	(a)	Let G be the CFG generating well-formed formula with predicates p and q. $S \rightarrow \sim S \mid [\, S \supset S \,] \mid p \mid q$ where p,q, ~, [,], and $\supset$ are the terminals. Find the Chomsky Normal Form Grammar generating L(G). OR Construct right-linear and left-linear grammars for the regular expression (00(101)*00)+11	
	(b)	Construct a PDA to accept the language $N(M) = \{wcw^R \mid w \in \{a, b\}^*\}$	08
4		Solve Any One	12
	(a)	Design a Turing machine to recognize the language $L = \{ww^R \mid w \text{ is in } (0+1)^*\}$	
	(b)	Design a Turing machine for proper subtraction i.e. $f(m,n) = \{m-n$ if $m \geq n$ $\{0$ otherwise	
5		Solve Any Two :	
	(a)	Explain : (I) Chomsky hierarchy of languages (II) Decidable and undecidable problems	12
	(b)	Show that complement of recursive language is recursive.	
	(c)	Consider an instance of PCP. Let $\Sigma = \{a,b\}$, and let A and B be the lists given below : $A = (b, bab^3, ba)$ and $B = (b^3, ba, a)$ Show that the PCP is decidable. Also find its solution.	

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Fifth Semester B. Tech. (CS/IT)

Winter 2015

Course Code: CSU502

Course Name: Theory of Computation

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1.		**Solve any two**	
	a)	Construct a DFA to accept a string containing at least two 0's and at most one 1	**06**
	b)	Find minimum state finite automata equivalent to following finite automata	**06**
	c)	Design a mealy machine accepting the language consisting a string from $\sum = \{0, 1\}$ ending with two consecutive 0's or 1's.	**06**
2		**Solve any two**	
	a)	Draw a FA that accepts strings ending in 1 but not	**06**

Contd..

containing substring 00.over alphabet {0, 1} and write a regular expression for the same

b) Explain Pumping lemma for regular set **06**

c) Construct finite automata for regular expression 01[((10)* + 111)* +0]*1 **06**

3 **Solve any two**

a) Convert to Greibach Normal Form the grammar G=({A1,A2, A3},{a,b},P,A1) where P consists of the following. **06**

A1 ->A2 A3
A2 ->A3 A1 /b
A3 ->A1 A2 /a

b) Construct PDA to accept language L = $\{ww^R | w$ is in (0+1)*$\}$ **06**

c) Let G be a grammar g=({S,A,B},{0,1},P,S} where P consists of **06**

S ->0B/1A
A->0/0S/1AA
B->1/1S/0BB for the string 00110101 find its leftmost derivation and derivation tree

4 Design a Turing Machine to compute f(m*n)=m*n, where m,n>=0 and simulate their action on the input 001000 **12**

5 a) Does PCP with two lists x= (01, 110010, 1, 11) and y= (0, 0, 1111, 01) have a solution? **06**

b) Obtain the binary code for the TM **06**

M=({q1,q2,q3,q4},{0,1},{0,1,B}, δ ,q1,B,{q4})

With the moves

δ (q1,0)=(q3,1,L)

δ (q1,1)=(q4,0,R)

δ (q2,0)=(q2,0,L)

δ (q2,1)=(q3,1,L)

δ (q3,0)=(q3,B,L)

δ (q3,1)=(q3,1,R)

δ (q3,B)=(q3,B,R)

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Fifth Semester B. Tech. (CS/IT)

Winter – 2017

Course Code: CSU 502

Course Name: Theory of Computation

Time: 2 hr.30min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. **Solve any two**

(a) construct finite automata which accept decimal number divisible by 3 **06**

(b) Construct finite automata that accepts the set of all strings of zeros and ones that contains even numbers of zeros and even numbers of ones **06**

(c) Construct DFA equivalent to NFA given bellow **06**

$M = (\{p, q, r, s\}, \{0,1\}, \delta, p, \{s\})$ Where δ is given by

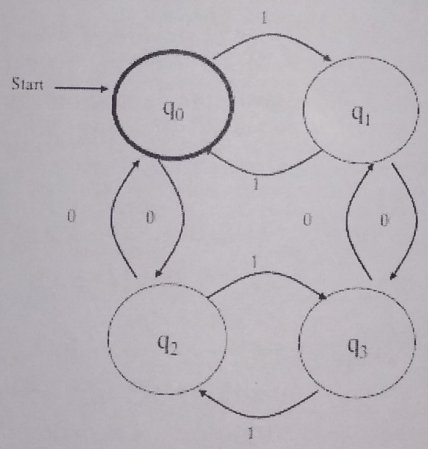
Cont.

	0	1
p	q,s	q
q	r	q,r
r	s	p
s	-	p

2. Solve any two

(a) Construct NFA with ϵ moves for Regular expression $(0(00)^*1+01^*0)^*$ **06**

(b) Construct regular expression for deterministic finite automata given bellow M= $(\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_0\})$ **06**



(c) Construct left linear and right linear grammar for $(0+1)^*00(0+1)^*$ **06**

3. Solve any two

(a) Consider grammar G = ({S, A, B}, {0,1}, P, S) where p consist of **06**

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

For the string aaabbabbba find leftmost and rightmost derivation and parse tree

(b) Find Greibach Normal Form grammar equivalent to following context free grammar **06**

$G = (\{A1, A2, A3\}, \{a, b\}, P, A1\}$ where P is

$A1 \rightarrow A2A3$

$A2 \rightarrow A3A1 \mid b$

$A3 \rightarrow A1A2 \mid a$

(c) Construct the context-free grammar for language $L = \{0^n 1^{2n} \mid n \geq 0\}$ **06**

4. (a) Construct Pushdown automata to accept language $L = \{ wCw^R \mid w \text{ is in } (0+1)^* \}$ **06**

(b) Design a Turing machine that reads binary strings and performs the following actions. If the input represents an odd number, subtracts one to the number. If the input represents an even number, add one to the number. For example, for input "101" the output should be "100" and for input "1010" the output should be "1011". **06**

5. (a) Prove that **06**

i) The Complement of recursive language is recursive

ii) The union of recursive language is recursive.

iii)The union of two recursively enumerable language is recursively enumerable.

(b) Construct Turing machine to accept language $L = \{ ww^R \mid w \text{ is in } (a + b)^* \}$ **06**