Time: 3 Hours **Total Marks: 80**

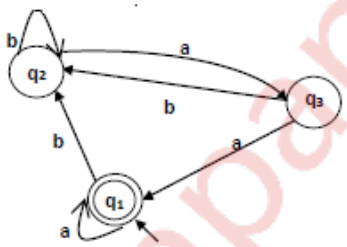
N.B.: (1) Question No.1 is compulsory.
(2) Attempt any three questions from the remaining five questions.
(3) Make suitable assumptions wherever necessary but justify your assumptions.

1. (a) Differentiate DFA and NFA. **05**
(b) Design a DFA to accept string of 0's and 1's ending with the string 100. **05**

(c) Explain the applications of Regular Expressions. **05**
(d) What are Recursive and Recursively Enumerable Languages? **05**

2. (a) Design NFA for recognizing the strings that end in "aa" over $\sum$ ={a,b} & convert above NFA to DFA. **10**
(b) Design moore m/c for following:- **10**
If input ends in '101' then output should be A, if input ends in '110' output should be B, otherwise output should be C and convert it into mealy m/c.

3. (a) Obtain a regular expression for the FA shown below**:** **10**



(b) Explain the types of Turing machine in detail. **10**

4. (a) Design a turing machine that computes a function f(m,n)=m+n i.e. addition of two integers. **10**
(b) State and explain pumping Lemma for Context Free Languages. Find out whether the language L= $\{x^n y^n z^n \mid n \geq 1\}$ is context free or not. **10**

5. (a) Design PDA for the following language: **10**

L(M) = $\{wcw^R \mid w \ \{a,b\}^*\}$ where w^R is reverse of w & c is a constant.
(b) Convert the following Grammars to the Chomsky normal form (CNF). **10**

S →0A0 | 1B1| BB
A →C
B →S | A
C →S | ε

6. Write detailed note on **(any two):-** **20**
(a) Post Correspondence Problem
(b) Halting Problem.
(c) Rice's Theorem.

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68476

Time: 3 Hours **Total Marks: 80**

N.B.: (1) Question No.1 is compulsory.
(2) Attempt any three questions from the remaining five questions.
(3) Make suitable assumptions wherever necessary but justify your assumptions.

1. (a) Explain Chomsky Hierarchy. 05

(b) Differentiate between PDA and NPDA. 05

(c)Define Regular Expression and give regular expression for 05
i) Set of all strings over { 0, 1 } that end with 1 has no substring 00

(d) Explain Halting Problem. 05

2. (a) Design a Finite State Machine to determine whether ternary number (base 3) is divisible 5. 10

(b) Give and Explain formal definition of Pumping Lemma for Regular Language and prove that following language is not regular. 10

$L=\{ a^m b^{m-1} \mid m>0 \}$

3. (a) Construct PDA accepting the language $L=\{a^{2n}b^n \mid n\geq 0\}$. 10

(b) Consider the following grammar 10

$S \rightarrow i\ C\ t\ S \mid i\ C\ t\ S\ e\ S \mid a$

$C \rightarrow b$

For the string 'ibtaeibta' find the following:

(i) Leftmost derivation
(ii) Rightmost derivation
(iii) Parse tree
(iv) Check if above grammar is ambiguous.

4. (a) Construct TM to check wellformedness of parenthesis. 10

   (b) Convert following CFG to CNF 10

$$S \rightarrow ASA \mid aB$$
$$A \rightarrow B \mid S$$
$$B \rightarrow b \mid \in$$

5. (a) Convert (0+1) $(10)^*$(0+1) into NFA with ε-moves and obtain DFA. 10

   (b) Construct Moore and Mealy Machine to convert each occurrence of 100 by 101. 10

6. Write short note on following (any 4) 10

   (a) Closure properties of Context Free Language 10
   (b) Applications of Regular expression and Finite automata
   (c) Rice's Theorem
   (d) Moore and Mealy Machine
   (e) Universal Turing Machine

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Q. P. Code: 37715

Duration : 3 hours Total marks : 80

N.B.: (1) Question No. 1 is Compulsory

(2) Attempt any three questions out of remaining five questions

(3) Assume suitable data wherever required but justify that

(4) Assumptions should be clearly stated.

1 a Differentiate between DFA and NFA. [5]

b Show that L= $\{(0^n1^n \mid n>0\}$ is not regular using pumping lemma. [5]

c Define FA. List down the applications of FA. [5]

d Explain Recursively Enumerable Language. [5]

2 a Construct the NFA with €-moves for the regular expression [10]

a) for the language which ends in either 01 or 101 over $\sum = \{ 0,1 \}$

b) for the R.E $(a^*b^*+(ab)^*)$ over $\sum = \{ a,b \}$

b Construct the DFA that accepts the language represented by 0*1*2*. [10]

3 a Convert the given grammar into Griebach Normal Form [10]

S → ABA|AB|BA|AA|A|B

A→ aA|a

B→bB|b

b Design Mealy Machine for the language represented as (0+1)*(00+11) [10]

4 a State and prove pumping lemma for context free languages. [10]

b Write Short note on [10]

i) Post Correspondence problem

ii) Chomsky Heirarchy

5 a Design PDA that accepts the language $L=\{a^nb^ma^n \mid m,n>=1\}$ [10]

b Design turing machine to accept languages over $\sum=\{0,1\}$ where $L=\{0^n 1^n, n \geq 0\}$ [10]

6 a Draw a parse tree for the string aabbaa for the CFG given by G where [10]

P= { S→aAS|a

A→SbA |SS|ba

Perform both leftmost and rightmost derivation.

b Briefly Explain the types of Turing Machine. [10]

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Q.P. Code :09887

[Time: Three Hours] **[Marks:80]**

Please check whether you have got the right question paper.

N.B:
1. Question No. 1 is compulsory.
2. Attempt any **three** out of remaining **five** questions.
3. Assumptions made should be clearly stated.
4. Figures to the right indicate full marks.
5. Assume suitable data whenever required but justify that.

Q. 1	a)	Differentiate between NFA and DFA	5
	b)	Explain Chomsky Hierarchy	5
	c)	Explain Rice's Theorem	5
	d)	Explain Pumping Lemma for CFG	5
Q. 2	a)	Design FA to check divisibility by 3 to binary number.	10
	b)	Using Pumping Lemma prove that following language is not regular: L = { $0^m 1^{m+1}$ | m>0 }	10
Q. 3	a)	Design Moore Machine to generate output A if string is ending with abb, B if string ending with aba and C otherwise over alphabet (a,b).And Convert it to Mealy machine.	10
	b)	Simplify the given grammar. S → aAa/bBb/BB A →C B →A/S C →S/ε.	10
Q. 4	a)	Construct NFA for Given Regular expressions: i) (a+b)*ab, ii) aa(a+b)*b, iii) aba(a+b)*, iv) (ab/ba)*/(aa/bb)*	10
	b)	Construct PDA accepting the language L= {$a^{2n}b^n$ | n>0}.	10
Q.5	a)	Design minimized DFA for accepting strings ending with 100 over alphabet (0,1).	10
	b)	Design Turing machine to recognize wellformedness of parenthesis.	10
Q. 6	Write short note on (any four)		20
	a)	Greibach Normal form	
	b)	Deterministic PDA and Multistack PDA	
	c)	Variants of Turing Machine	
	d)	Halting Problem	
	e)	Church-Turing Thesis	

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Sem III (T.C.S.) CMPN (C841) 15/12/2014

SE

QP Code :12552

(3 Hours) [Total Marks : 80

N. B. : (1) Question **No. 1** is **compulsory.**
(2) Attempt **any three** questions out of remaining **five** questions.
(3) Assumptions made should be clearly stated.
(4) Figures to the right **indicate full** marks.
(5) Assume **suitable data** wherever **required** but justify the same.

1. (a) Give chomsky hierarchy of grammar with examples. **5**
   (b) State and explain any 5 closure properties of regular languages. **5**
   (c) Compare recursive and recursively enumerable languages. **5**
   (d) State and prove equivalence of NFA and DFA. **5**

2. (a) Design a DFA to accept strings over the alphabet set {a, b} that begin with 'aa' but not end with 'aa'. **10**
   (b) Convert $(0 + \in)(1\ 0)^*(\in + 1)$ into NFA with $\in$-moves and hence obtain a DFA. **10**

3. (a) Design a MOORE and MEALY machine to decrement a binary number. **10**
   (b) Give statement of pumping lemma for regular sets and hence prove that $\{w\, c\, w^R \mid W \in (a+b)^*\}$ is not regular where w^R is reverse of w. **10**

4. (a) Obtain leftmost derivation, rightmost derivation and derivation tree fbr the string "cccbaccba". The grammar is **10**
   $S \rightarrow SSa \mid SSb \mid c$
   (b) Design Turing machine as generator to add two binary numbers and hence simulate
   for"110 + 10". **10**
   Hint : Assume two way infinite tape.

5. (a) Design a PDA to accept language $\{ a^{n-1} b^{2n+1} \mid n \geq 1\}$. **10**
   (b) Convert the below given grammar to Chomsky Normal Form (CNF) and Griebach Normal Form (GNF) **10**
   $E \rightarrow E+E \mid E*E \mid (E) \mid id$
   Consider "id" as a single terminal/symbol.

6. (a) Design a Turing machine as acceptor for the language $\{a^n b^m \mid n, m \geq 0 \text{ and } m \geq n\}$. **10**
   (b) Design PDA to check even parentheses over $\Sigma = \{0,1\}$ **10**

SE (SEM IV) (Rev-2012) (Regular) Comp Dec. 2015

T.C.S.

5485

Q.P. Code :

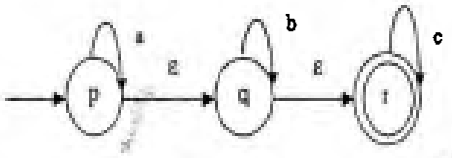
(3 Hours) **[Total Marks : 100**

N.B. : (1) Question Number **1** is compulsory.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) **Assumptions** made should be **clearly** stated.
(4) **Figures** to the **right** indicate **full** marks.
(5) Assume suitable **data** whenever **required** but **justify** the same.

1. (a) Consider the following grammar G = (V, T, P, S), V = {S, X}, T {0, 1} and productions P are **5**
$S \rightarrow 0 \mid 0X1 \mid 01S1$
$X \rightarrow 0XX1 \mid 1S$
S is start symbol. Show that above grammar is ambiguous.

(b) State and prove the halting problem. **5**

(c) Convert following ε-NFA to NFA without ε. **5**



(d) Prove that Language L = $\{0^n10^n$ for n = 0, 1, 2, ... $\}$ is not regular. **5**

2. (a) Consider the following grammar G = (V, T, P, S), V = {S, X, Y}, T {a, b}and productions P are **10**
$S \rightarrow XYX$
$X \rightarrow aX \mid \varepsilon$
$Y \rightarrow bY \mid \varepsilon$
Convert this grammar in Chomsky Normal Form (CNF).

(b) Design DPDA to accept language L={ $x \in \{a, b\}^* \mid N_a(x) > N_b(x)$ }, **10**
$N_a(x) > N_b(x)$ means number of a's are greater than number of b's in string x.

3. (a) Design Turing machine to accept the language L = set of strings with equal number of a's and b's. **10**

(b) Design the DFA to accept the language containing all the strings over Σ = {a, b, c} that starts and ends with different symbols. **10**

[TURN OVER

Sem-IV/ COMP/ CBGS/ TCS/ NOV-2016
Theoretical Comp. Science
21-12-16

QP Code:541703

(3 Hours) **[Total Marks :80**

N.B. : (1) Question No. **1** is **compulsory**
(2) Attempt any **three** questions from remaining questions
(3) **Draw** suitable **diagrams** wherever **necessary**
(4) **Assume** suitable **data**, if **necessary**.

1. (a) Design a DFA over an alphabet $\Sigma = \{a, b\}$ to recognize a language in which every 'a' is followed by 'b'. **5**
   (b) Give formal definition of a Push Down Automata. **5**
   (c) State and explain the power and limitations of a Turing machine **5**
   (d) Design a mealy machine to determine the residue mod 3 of a binary number. **5**

2. (a) Convert the following NFA to an equivalent DFA **10**

State	a	b	ε
$\rightarrow q_0$	$\{q_0, q_1\}$	q_1	{}
q_1	$\{q_2\}$	$\{q_1, q_2\}$	{}
$*q_2$	$\{q_0\}$	$\{q_2\}$	$\{q_1\}$

   (b) State and explain pumping lemma for regular languages. Using pumping lemma prove that the language $L = \{0^n 1^n \mid n \geq 0\}$ is not regular. **10**

3. (a) Design a Turing machine that computes a function f(m,n) = m + n i.e. addition of two integers **10**
   (b) Design a Turing machine to accept the language $0^n 1^n 2^n$ **10**

4. (a) Draw a state diagram and construct a regular expression corresponding to the following state transition table. **10**

State	0	1
$\rightarrow *q_1$	q_1	q_2
q_2	q_3	q_2
q_3	q_1	q_2

   (b) State and explain decision properties of regular languages **10**

[Turn Over

5. (a) (i) Convert the following CFG to GNF **10**

$S \rightarrow AA|a$

$A \rightarrow SS \mid b$

(b) Design a PDA corresponding to the grammar **10**

$S \rightarrow aSA \mid \varepsilon$

$A \rightarrow bB$

$B \rightarrow b$

6. Write detailed notes on (any **two**):- **20**

(a) Recursive and Recursively Enumerable Languages.

(b) Chomsky Hierarchy

(c) Rice's Theorem

(d) Halting problem

(3 Hours) [Total Marks: 80]

N.B. (1)Question No. 1 is compulsory
(2) Attempt any three out of remaining five questions
(3) Assumptions made should be clearly stated

1. (a) Explain Chomsky Hierarchy 5
(b) Differentiate between DFA and NFA 5
(c) Explain Recursive and Recursively enumerable languages 5
(d) Define Regular Expression. Design R.E. for strings ending in consecutive 1's over $\sum=\{0,1\}$. 5

2. (a)Design a Finite State Machine to determine whether ternary number(base 3) is divisible 5. 10
(b) Give and Explain formal definition of Pumping Lemma for Regular Language and prove that following language is not regular. 10
$L=\{ a^n b^n \mid n >=1 \}$

3. (a) Design a PDA that checks for well -formed parenthesis. 10
(b) Consider the following grammar 10

$S \rightarrow i\ C\ t\ S \mid i\ C\ t\ S\ e\ S \mid a$

$C \rightarrow b$

For the string 'ibtibtaea' find the following:

(i) Leftmost derivation
(ii) Rightmost derivation
(iii) Parse tree
(iv) Check if above grammar is ambiguous.

4. (a) Design a Turing Machine that recognizes palindrome string where $\sum=\{a,b\}$. 10
(b) Reduce following grammar to GNF. 10

$S \rightarrow AB$

$A \rightarrow BSB|BB|b$

$B \rightarrow a$

(i) $S \rightarrow 01S|01$

$S \rightarrow 10S|10$

$S \rightarrow 00|\varepsilon$

5. (a) Convert $(0+\varepsilon)\ (10)^*(\varepsilon+1)$ into NFA with ε-moves and obtain DFA. 10
(b) Design a PDA to accept language $\{ a^{n-1}\ b^{2n+1} \mid n>=1 \}$ 10
6. Write short note on following (any 4) 20
(a) Closure properties of Context Free Language
(b) Applications of Regular expression and Finite automata
(c) Rice's Theorem
(d) Moore and Mealy Machine
(e) Differentiation between DPDA and NPDA

(3 Hours) [Total Marks : 80]

N.B. (1)Question No. 1 is compulsory
(2) Attempt any three out of remaining five questions
(3) Assumptions made should be clearly stated

1. (a) Write short note on Myhill Nerode theorem 5
   (b) Differentiate between NFA and DFA. 5
   (c) State and explain Closure properties of Context Free Language 5
   (d) Explain Post Correspondence problem. 5
2. (a) Construct the NFA-ϵ
   i for the language in which strings starts and ends different letter over the set $\sum$ = { a, b }
   ii) for the R.E (01+2*) 10

   (b) Give and Explain formal definition of Pumping Lemma for Regular Language and prove that following language is not regular. 10
   $L=\{ a^n b^m \mid 1<=n<=m \}$
3. (a) Convert the given grammar into Griebach Normal Form 10
   S -> aSB| aA
   A -> Aa | Sa | a
   (b) Construct PDA for a language $L=\{wcw^R \mid w \varepsilon \{a,b\}$ and w^R is reverse of w} 10
4. (a) Construct TM to check palindrome over $\Sigma=\{0,1\}$ 10
   (b) Design a DFA which accepts all strings not having more than 2 a's over $\sum=\{a, b\}$ 10
5. (a) Convert (0+1) $(01)^*(0+\in)$ into NFA with ε-moves and obtain DFA. 10
   (b) Design Mealy Machine that accepts an input from (0+1)* if the input ends in 101, output A; if the input ends in 110, output B, otherwise C. then convert into Moore Machine. 10
6. (a) Draw a parse tree for the string "abaaba" for the CFG given by G where 10
   P= { S-> aSa
   S -> bSb
   S -> a |b |ε}.
   Also Determine whether the given CFG is ambiguous or not.
   (b) Write short note on following 10
   i) Halting problem
   ii) Rice's Theorem

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SE comp Sem-4 10/06/2014

TCS

QP Code :**NP-19836**

(3 Hours) **[Total Marks : 80**

N.B. : (1) Questions No.**1** is **compulsory**.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) Assumptions made should be **clearly** stated.
(4) **Figures** to the **right** indicate **full** marks
(5) Assume **suitable** data wherever **required** but **justify** the same.

1. (a) Differentiate between NFA and DFA. **5**
(b) Explain CNF and GNF with example. **5**
(c) State and prove closure properties of Context Free Languages. **5**
(d) Give Applications of Regular Expression and Finite Automata. **5**

2. (a) Construct an NFA with epsilon transition for following RE. **5**
$(00 + 11)^*(10)^*$
(b) Give formal definition of Regular expression. Give R.E. for following :— **5**
(i) Set of all strings over {1, 0} that end with 1 and has no substring 00.
(ii) Set of all strings over {1, 0} with even number of 1's followed by odd number of 0's.
(c) Compare and Contrast Moore and Mealy Machine. Construct Moore Machine to find out the residue-modulo-3 for binary numbers. **10**

3. (a) Consider the following grammar :— **10**
$S \rightarrow i\ C\ t\ S \mid i\ C\ t\ S\ e\ S \mid a$
$C \rightarrow b$
For the String 'ibtibtaea' find the following :
(i) Leftmost derivation
(ii) Rightmost derivation
(iii) Parse Tree
(iv) Check if the above grammar is Ambiguous
(b) Design PDA that checks for well- formed parentheses. **10**

4. (a) Design a TM that recognizes palindrome strings where $\Sigma = \{0, 1\}$ **10**
(b) Construct NFA that accepts a set of all strings over {a, b} ending with "abb" Convert this NFA to Equivalent DFA. **10**

[TURN OVER

5. (a) Convert the following Grammar to CNF form :— **10**

$S \rightarrow ABA$

$A \rightarrow aA \mid bA \mid \in$

$B \rightarrow bB \mid aA \mid \in$

(b) Give and explain the formal statement of Pumping Lemma for regular languages and use it to prove that the following language is not regular : **10**

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

6. Write short note on :— **20**

(a) Chomsky Hierarchy of Grammar

(b) Variants of Turing Machine

(c) Rice's Theorem

(d) Recursive and Recursively enumerable languages.

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S.E. - IV (CBSGS) TCS ~~08 May 2015~~ 08 June 2015

Computer

QP Code : 3552

(3 Hours) **[Total Marks : 80**

N.B. (1)Question No. 1 is compulsory
(2) Attempt any **three** out of remaining **five** questions
(3) Assumptions made shoud be clearly stated
(4) Figures to the right indicate full marks
(5) Assume sutaible data whenever required but justify that.

[Total Marks : 80

Q.1 (a) Differentiate between NFA and DFA [5M]

(b) State and Explain closure properties of Context Free Language [5M]

(c) Explain with an example the Chomsky hierarchy [5M]

(d) Compare recursive and recursively enumerable languages. [5M]

Q. 2 (a) Construct PDA accepting the language $L=\{a^n b^n \mid n>0\}$ [10M]

(b) Design minimized DFA for accepting strings ending with 100 over alphabet (0,1). [10M]

Q. 3 (a) Convert $(0+\varepsilon)(10)^*(\varepsilon+1)$ into NFA with ε-moves and obtain DFA [10M]

(b) Construct Turing machine that accepts the string over $\Sigma=\{0,1\}$ and converts every occurrence of 111 to 101. [10M]

Q. 4 (a) Convert following Grammar to CNF and GNF [10M]

$S \rightarrow ASB/a/bb$
$A \rightarrow aSA/a$
$B \rightarrow SbS/bb$

(b) Design PDA to accept language $L=\{ a^{n-1} b^{2n+1} \mid n \geq 1\}$ [10M]

Q.5 (a) Design Moore Machine to generate output A if string is ending with abb, B if string ending with aba and C otherwise over alphabet (a,b).And Convert it to Mealy machine. [10M]

(b) Construct TM to check wellformed ness of parenthesis [10M]

Q. 6 Write short note on [20M]

(a) Rice theorem

(b) Variant of TM

(c) Applications of Regular Expression

(d) Difference between PDA and NPDA

JP-Con. 12401-15.

SEM-IV COMP (CBSGS) 6/6/16

Theoretical Computer Science

QP Code:541700

(3 Hours) | Total Marks :80

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) Assumptions made should be clearly stated.
(4) **Figure** to the **right** indicate **full** marks.
(5) **Assume** suitable **data** whenever required but justify that.

1. (a) Explain post correspondence problem. **5**
(b) Differentiate between NFA and DFA. **5**
(c) Show that language L = $\{0^i \mid i \text{ is prime number}\}$ is not regular **5**
(d) Compare recursive and recursively enumerable languages. **5**

2. (a) Design the DFA to accept all the binary strings over $\sum = \{0,1\}$ that are beginning with 1 and having its decimal value multiple of 5. **10**

(b) Design DPDA to accept language $L = \{x \in \{a,b\}^* \mid N_a(x) > N_b(x)\}$. **10**

$N_a(x) > N_b(x)$ means number of a's are greater than number of b's in string x.

3. (a) Explain variations and equivalence of Turing machine. **10**
(b) State and prove pumping lemma for context free languages. **10**

4. (a) Design mealy machine to find out 2's complement of a binary number. **10**
(b) Convert the following NFA to an equivalent DFA **10**

State	a	b	$\in$
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_1\}$	$\{\}$
q_1	$\{q_2\}$	$\{q_1, q_2\}$	$\{\}$
$*q_2$	$\{q_0\}$	$\{q_2\}$	$\{q_1\}$

5. (a) Consider the following grammar G = (V, T, P,S) , V = {S, X}, T = {a,b} and productions P are **10**

$S \rightarrow aSb \mid aX$

$X \rightarrow Xa \mid Sa \mid a$

Convert this grammar in Greibach Normal Form (GNF).

(b) State and prove Rice's theorem. **10**

6. (a) Design a Tuning machine as an acceptor for the language $\{a^n b^m \mid n, m \geq 0 \text{ and } m \geq n\}$ **10**

(b) Design PDA to check even parentheses over $\Sigma = \{0,1\}$ **10**
