Code No: R22055 **R10** SET - 1

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
FORMAL LANGUAGES AND AUTOMATA THEORY
(Computer Science and Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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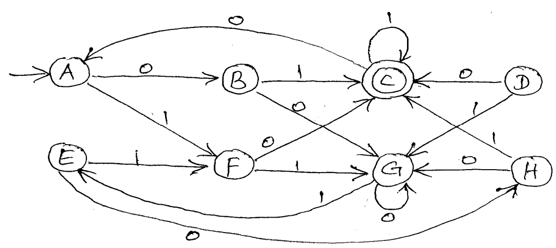
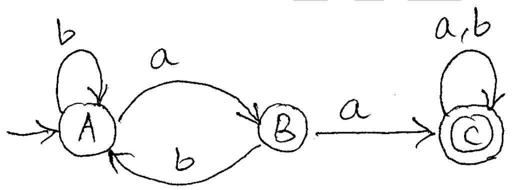
1. a) Construct a DFA that accepts an identifier of a 'C' programming language.
   b) Differentiate between NFA and DFA? (7M+8M)

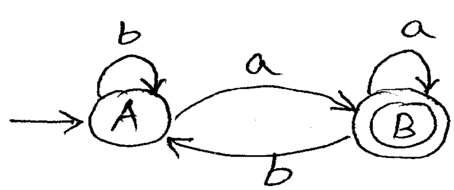
2. a) Design a DFA that accepts the language over $\Sigma = \{0, 1\}$ of all strings that contain neither the sub-string 00 nor the sub-string 11.
   b) Construct a minimal state finite automaton to the following state diagram: (7M+8M)



3. a) Find the regular expression for the following finite automaton:



   b) Show that the simplified regular expression recognized by the following DFA is the set of all strings of a's and b's that end with letter a. (7M+8M)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4. a) Consider the following context free grammar:
$E \rightarrow I \mid E+E \mid E*E \mid (E)$
$I \rightarrow a \mid b \mid Ia \mid Ib \mid I0 \mid I1$
Find the leftmost derivation, rightmost derivation, and parse tree for the string: a*(a+b00).
b) Write a context free grammar for the while statement in 'C' language. (7M+8M)

5. a) Consider the following context free grammar, G:
$S \rightarrow ABAC$
$A \rightarrow aA \mid \in$
$B \rightarrow bB \mid \in$
$C \rightarrow d$
Convert the **G** equivalent to **G′** that has: no null productions, and no unit productions one after the other.
b) Find the Greibach normal form of the following grammar:
$S \rightarrow AA \mid x$
$A \rightarrow SS \mid y$
(7M+8M)

6. Let M = ($\{q_0, q_1\}, \{a, b\}, \{X, Z_0\}, \delta, q_0, Z_{0,} \phi$) be a push down automata (PDA) and δ is defined by:
$\delta(q_0, b, Z_0) = \{(q_0, xZ_0)\}$ $\delta(q_0, \varepsilon, Z_0) = \{(q_0, \varepsilon)\}$ $\delta(q_0, b, X) = \{(q_0, XX)\}$
$\delta(q_1, b, X) = \{(q_1, \varepsilon)\}$ $\delta(q_0, a, X) = \{(q_1, X)\}$ $\delta(q_1, a, Z_0) = \{(q_0, Z_0)\}$
i) Find the language accepted by the PDA, M by empty store.
ii) Construct a context free grammar (CFG), G that accepts null store, N(M) (7M+8M)

7. a) Explain, briefly, about the different types of Turing Machines.
b) Design a Turing Machine (TM) that accepts the language, L = $\{ 0^n1^n0^n \mid n \geq 1 \}$ (7M+8M)

8. a) State and explain the undecidability of post correspondence problem
b) What do you meant by decidable and undecidable problems? Explain, in detail, P and NP problems with examples. (8M+7M)

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Answer any **FIVE** Questions
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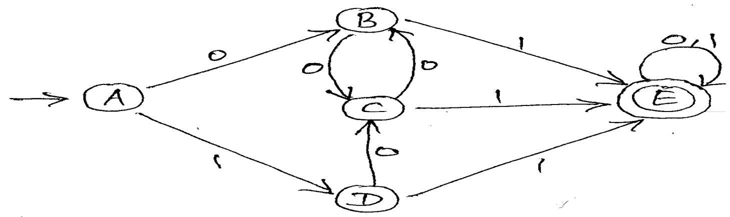
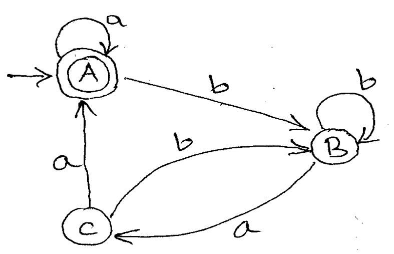
1. a) Give a finite state diagram that accepts all the floating-point numbers.
   b) Design NFA to accept strings with a's and b's such that the string end with 'ab' (7M+8M)

2. a) Construct a minimal state Finite Automaton to the following state diagram:



   b) Design a Moore machine and Mealy machine that accepts strings over $\sum = \{0, 1\}$ where, if the input ends in 001, output a A; if the input ends in 100 , output a B; else output a C. (7M+8M)

3. a) Construct an NFA and DFA for the Regular Expression: (0 + 1)*(00 + 11) 110.
   b) Find the regular expression for the following finite automaton: (7M+8M)



4. a) Give the context free grammar that generates the set $\{0^n1^n \mid n \geq 1\}$
   b) Consider the following context free grammar: $E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$
   Find the leftmost derivation, rightmost derivation, and parse tree for the string: + * − x y x y (8M+7M)
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5. a) Convert and reduce the following grammar such that there are no UNIT productions.

$S \rightarrow AA$

$A \rightarrow B \mid BB$

$B \rightarrow abB \mid b \mid bb$

b) Find the Greibach normal form of the following grammar: (7M+8M)

$E \rightarrow E+T \mid T$

$T \rightarrow T*F \mid F$

$F \rightarrow (E) \mid a$

6. a) Construct the equivalent grammar for the PDA

$M = (\{q_0, q_1\}, \{0,1\}, \{R, Z_0\}, \delta, q_0, Z_0, \Phi)$ and δ is given by

$\delta(q_0, 0, Z_0) = (q_0, RZ_0)$

$\delta(q_0, 0, R) = (q_0, RR)$

$\delta(q_0, 1, R) = (q_1, R)$

$\delta(q_1, 1, R) = (q_1, R)$

$\delta(q_1, 0, R) = (q_1, \in)$

$\delta(q_1, \in, Z_0) = (q_1, \in)$

b) Design a PDA for a language $L = \{w \mid w \in (0+1)^* \text{ and number of 0's} < \text{number of 1's}\}$ by final state. (7M+8M)

7. a) Consider following transition table (States versus Tape symbols) of a Turing Machine, M:

	0	1	B
→q1	q1, 0, R	-	q2, 1, L
q2	q2, 0, L	q2, 1, L	q3, B, R
q3	q4, B, R	q5, B, R	-
q4	q4, 0, R	q4, 1, R	q5, 0, R
(q5)	-	-	q2, 0, L

Find the computation sequence of the input string: 00B

b) Design a Turing Machine, M that accepts e set of strings with an equal number of 0's and 1's (7M+8M)

8. a) What is a universal Turing machine? Explain Turing reducibility.

b) Construct the LR(0) parser for the following grammar:

$E' \rightarrow E$

$E \rightarrow E + n \mid n$ (7M+8M)

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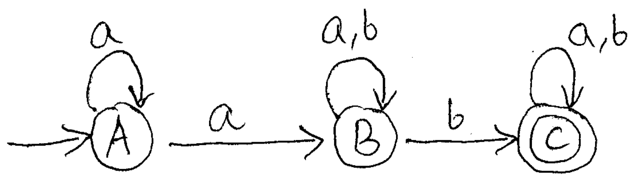
1. a) Construct NFA in which double 1's followed by double 0's
   b) Design FA that accepts set of all string with three consecutive 0's over $\Sigma = \{0, 1\}$.
   (7M+8M)

2. a) Design a DFA over $\Sigma = \{0, 1\}$ accepting all strings of even number of decimal numbers in binary.
   b) Construct a DFA equivalent to the following NFA diagram: (7M+8M)



3. a) When are two regular expressions said to be equivalent? Obtain the regular expression represented by the regular set: {0, 1, 00, 01, 000, 001, 0000, 0001, … }
   b) Prove the following regular expression identities:
   i) $(\in + 0)(\in + 0)^* = 0^*$ ii) $1 + (\in + 0)(\in + 0)^* 1 = 0^*1$
   iii) $\in + 1^*(011)^*(1^*(011)^*)^* = (1 + 011)^*$ (7M+8M)

4. a) For the following grammar give the leftmost and rightmost derivation for the string '00101'.
   $S \rightarrow A \mid B$
   $A \rightarrow 0A \mid \in$
   $B \rightarrow 0B \mid 1B \mid \in$
   b) Construct the right linear grammar and left linear grammar for the language $(0+1)^*00(0+1)^*$
   (7M+8M)
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5. a) Consider the following grammar G:

$S \to ASB \mid \epsilon$
$A \to aAS \mid a$
$B \to SbS \mid A \mid bb$

Find an equivalent grammar that has: no null productions, and no unit productions one after the other.

b) Convert the given CFG into GNF

$S \to CA$
$A \to a$
$C \to aB \mid b$ (7M+8M)

6. a) Design a PDA that accepts a string of a well formed parenthesis. Consider parenthesis is as ( ), [ ], { }.

b) Construct PDA equivalent to the following CFG

$S \to 0A$
$A \to 0ABC \mid 1B \mid 0$
$B \to 1$
$C \to 2$ (7M+8M)

7. a) Consider the following transition table (States versus Tape symbols) of a Turing Machine, M:

	(	*	)	B
q_1	q_1, (, R	q_1, *, R	q_2, *, L	q_3, B, L
q_2	q_1, *, R	q_2, *, L	q_2,), L	Halt
q_3	Halt	q_3, *, L	q_3,), L	Halt

If the initial Instantaneous Description (ID) is: q_1 (( ) B, then what is the final ID?

b) Design Turing Machine over $\sum=\{1\}$ to accept the language $L=\{1^m/m \text{ is odd}\}$ (7M+8M)

8. a) What is a modified PCP? Explain with some suitable example.

b) Explain, in detail, NP Complete and NP hard problems with examples. (7M+8M)

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1. a) Give a finite state diagram that accepts all the floating-point numbers.
   b) Design NFA which accepts the language containing either '01' or '10' over $\Sigma=\{0,1\}$.
   (7M+8M)

2. a) Design a DFA that accepts the language over the alphabet, $\sum = \{0, 1, 2\}$ where the decimal equivalent of the language is divisible by 3.
   b) Design a Moore machine and Mealy machine that accepts strings over $\sum = \{0, 1\}$ where, if the input ends in 001, output a A; if the input ends in 100 , output a B; else output a C.
   (7M+8M)

3. a) Show that $L=\{ 0^i1^j \mid gcd(i,j) =1\}$ is not regular
   b) Show that the following regular expression identities are equivalent: (7M+8M)
   i) $r^+ = r^* r^+$ ii) $(r + s)^* = (r + s^*)^*$

4. a) Construct a context free grammar for generating the balanced parentheses, like ( ), [ ], [( ) ( )], ([ ]), etc. and find the moves of the grammar to derive the string: ([( )] ( ))
   b) Draw the parse tree for the production grammar: $S \rightarrow (S) \mid S \supset S \mid \sim S \mid i \mid j$, generating the symbolic formula: $(\sim \sim i \supset (i \supset \sim \sim j))$. (7M+8M)

5. a) State and prove the pumping lemma for context free languages.
   b) Give CFG for generating odd palindromes over the string {a,b} (7M+8M)

6. a) Design a PDA that accepts a string of a well formed parenthesis. Consider parenthesis is as ( ), [ ], { }.
   b) Construct PDA equivalent to the following CFG

   $S \rightarrow 0A$
   $A \rightarrow 0ABC \mid 1B \mid 0$
   $B \rightarrow 1$
   $C \rightarrow 2$ (7M+8M)

7. a) State and prove the Turing Machine (TM) halting problem.
   b) Design a Turing Machine, M that accepts a palindrome consisting of 0's and 1's of any length. (7M+8M)

8. a) Describe in detail about halting problem of a Turing machine
   b) Describe about modified Post's correspondence problem. (7M+8M)
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