T.E. (Computer) (Semester – V) Examination, May/June 2012
(Revised Course)
AUTOMATA LANGUAGE AND COMPUTATION

Duration : 3 Hours

Max. Marks : 100

*Instructions : 1) Answer **any five** questions, selecting at least **one** from **each** Module.*
*2) Make **necessary** assumptions if **required**.*

MODULE – I

1. a) Design the deterministic finite automation for the following language : $L = \{|x|_0 \bmod 2 \text{ and } |x|_1 = 0 \bmod 2 \mid x \in \{0, 1\}^*\}$. 8

b) Prove the language $L(G) = \{ww \mid w \in \{0, 1\}^*\}$ is not regular. 6

c) Construct a NFA for the language $L(G) = \{x \in \{01\}^* \mid x$ is starting with 1 and $|x|$ is divisible by 3$\}$. Validate the string 1001110. 6

2. a) Construct a finite state machine that will subtract 2 binary numbers. 6

b) Using the Kleen's Part 2 theorem find the regular expression for the DFA $M = (\{1, 2, 3\}, \{a, b\}, \delta, 1, \{2, 3\})$ where δ is defined as

$\delta(1, a) = 2$, $\delta(1, b) = 3$, $\delta(2, a) = 1$, $\delta(2, b) = 3$, $\delta(3, a) = 2$, $\delta(3, b) = 2$. 6

c) Construct the DFA for the following languages $L_1 = \{w \mid w$ has odd number of b's$\}$, $L_2 = \{w \mid$ each b is followed by atleast one a $\}$. Find the $L_1 \cap L_2$, $L_2 - L_1$ for the above two languages. Draw the minimized DFAs. 8

MODULE – II

3. a) Show that $L(G) = \{w \# t \mid w$ is a substring of t where $w, t \in \{a, b\}^*\}$ is not context-free. 6

b) Construct the CFG for the languages $L = \{a^n b^m c^o d^p \mid n + m = o + p\}$. Convert the CFG to CNF. (4+4)

c) Construct a PDA that accepts the same language generated by the CFG $G = (\{S, X\}, \{a, b\}, P, S)$ where $P = \{S \rightarrow XaaX, X \rightarrow aX \mid bX \mid \varepsilon\}$. Explain the behaviour the PDA with the help of the string aaab. 6

P.T.O.

4. a) Design the pushdown automata that accepts set of strings composed of zeros and ones which are of the form $0^n 1^n$ or $0^n 12^n$. 4

b) Construct the GNF for the following CFG

$S \to S \wedge S, S \to (S), S \to S \vee S, S \to \neg S, S \to p$ 6

c) Construct a CFG which accepts the PDA where

$M = (\{1, 2\}, \{a, b\}, \{B, X\}, \delta, 1, B, \phi)$ δ is given by

$\delta(1, b, B) = (1, XB)$, $\delta(1, \varepsilon, B) = (1, \varepsilon)$, $\delta(1, b, X) = (1, XX)$, $\delta(1, a, X) = (2, X)$ $\delta(2, b, X) = (2, \varepsilon)$, $\delta(2, a, B) = (1, B)$. 10

MODULE – III

5. a) Design a Turing machine which computes 2^n given n as input, where n is non-negative integer. Describe the behaviour of the TM for n = 3. 10

b) Discuss the power of Turing machine. Construct a TM that insert σ such that the tape contents are changed from yz to y σ z where $y \in (\Sigma \cup \{\Delta\})^*$, $\sigma \in (\Sigma \cup \{\Delta\})$, $z \in \Sigma^*$, $\Sigma = \{a, b\}$. 10

6. a) Design a TM to compute the minimum of two given unary numbers. 6

b) Explain the description of a multitape Turing machine for computing factorial of a given non-negative integer. 8

c) Explain the variants of Turing Machine. 6

MODULE – IV

7. a) Show that recursively enumerable languages are closed under intersection. 6

b) Explain the equivalence of LBA's and CSG's. 6

c) Construct type 0 for the language $L = \{0^n 1^n 2^n 3^n \mid n > 0\}$. 6

d) Construct type 3 grammar for the language $L(G) = \{a^{2n} \mid n \geq 1\}$. 2

8. a) State the properties of recursively enumerable languages. 2

b) Construct the type 1 grammar that generates the language $L = \{ww \mid w \in \{0, 1\}^+\}$. Show the right most derivation for the string abab. (6+2)

c) Explain the following : (4+6)

i) Rice Theorem

ii) Closure properties of families of languages.
