T.E. (Computer) (Semester – V) Examination, Nov./Dec. 2012
(Revised Syllabus in 2007-2008)
AUTOMATA LANGUAGE AND COMPUTATION

Duration : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any five** full questions, atleast **one** from **each** Module.*

*2) Make **suitable** assumptions **wherever** necessary.*

MODULE – I

1. a) Construct a DFA for the following language

$L = \{x \varepsilon \{a, b\}^* \mid x$ has neither consecutive a's nor consecutive b's$\}$. 4

b) Convert the following ε-NFA to minimized DFA

$M = (\{A, B, C, D\}, \{a, b, c\}, \delta A, \{A\})$ where δ is $\delta = \{\delta(A, a) = B, \delta(B, b) = C, \delta(B, \varepsilon) = A, \delta(C, c) = D, \delta(D, \varepsilon) = B\}$. 4

c) What are the equivalence classes of R_L in Myhill-Nerode theorem for $L = \{0^n 1^n \mid n \geq 1\}$? 4

d) Construct a Mealy Machine to subtract two binary numbers. Convert the Mealy Machine to equivalent Moore Machine. 8

2. a) Construct a NFA which accepts set of strings such that every string contains '00' as a substring and does not contain '000' as a substring. Validate the string 100100. (4+2)

b) Is the following language a regular language ? Prove your answer.

$L = \{0^m 1^n 0^{n+m} \mid n \geq 1$ and $m \geq 1\}$. 5

c) Let h be the homomorphism h(a) = 01, h(b) = 0

Find $h^{-1}(L_1)$ where $L_1 = (10 + 1)^*$

Find $h(L_2)$ where $L_2 = (a+b)^*$. . 4

d) Construct the regular expression for the following DFA

$M = (\{A, B, C\}, \{0, 1\}, \delta, A, \{B, C\}$ where $\delta = \{\delta(A, 0) = B, \delta(A, 1) = C, \delta(B, 0) = A, \delta(B, 1) = C, \delta(C, 0) = B, \delta(C, 1) = A\}$. 5

P.T.O.

MODULE – II

3. a) Construct a CFG to generate PDA where $M = (\{p, q\}, \{0, 1\}, \{X, Z_0\}, \delta, q, Z_0, \phi)$ where δ is defined as $\delta(q, 1, Z_0) = (q, XZ_0), \delta(q, 1, X) = (q, XX), \delta(q, 0, X) = (p, X)$. $\delta(q, \varepsilon\ Z_0) = (q, \varepsilon), \delta(q, 1, X) = (p, \varepsilon), \delta(q, 0, Z_0) = (q, Z_0)$. Validate the string 11010. 8

b) Convert the following language into CNF. Convert the CNF to PDA using bottom up approach.

$L = \{w \mid w\ \varepsilon\ \{a, b\}^*, |w| \text{ is divisible by } 3\}$. 8

c) Let $L = \{0^n1^m | n \neq m, n, m \geq 1\}$. Construct a DPDA that recognizes L. 4

4. a) Prove that the language $L = \{a^n\ b^n\ c^j\ | n \leq j \leq 2^n\}$ is not a CFL. 5

b) Convert CFG into PDA

$G = (\{S, A, B\}, \{a, b\}, P = \{S \rightarrow aB|bA, A \rightarrow a|aS|bAA, B \rightarrow b|b\ S|aBB\}, S)$. Explain the behavior of the PDA with the help of a string bbaaba. (3+2)

c) Define the GN form of CFG and reduce the following grammar into GNF

$G = (\{S, A, B\}, \{a, b\}, P = \{S \rightarrow AB, A \rightarrow BS|b, B \rightarrow SA|a\}, S)$. 5

d) Construct the CFG for the following language

$L = \{a^ib^jc^k | i \neq j \text{ or } i \neq k\}$. Validate the given string aabbbc. 5

MODULE – III

5. a) Construct the Turing machine that recognizes the following language $L = \{a^n\ b^n\ c^j \mid n \leq j \leq 2^n\}$. 6

b) Design the Turing Machine to compute n! where $n \geq 1$. 8

c) Explain the variants of Turing Machine. 6

6. a) Design the Turing Machine that computes the sum of two binary numbers. 8

b) Construct the Turing machine that recognizes the following language $L = \{a^x | x = i^2, i \geq 1\}$. 6

c) Explain the following :

i) Church-Turing Thesis ii) Nondeterministic Turing Machine. 6

MODULE – IV

7. a) Construct the type 1 grammar for the language $\{a^i \mid i \text{ is a positive power of } 2\}$. Validate the given string aaaa. 8

b) Prove that the class of recursively enumerable languages are closed under union operation. 6

c) Explain the following : 6

i) Rice Theorem ii) Full Trio

8. a) Prove that language L is recursive iff both L and complement of L is also recursive. 6

b) Construct the type 0 grammar for the language $L = \{a^n b^m c^{n+m} d^{n-m} \mid n, m \geq 1\}$. Validate the given string aabcccd. 8

c) Explain the following :

i) Unsolvable decision problem

ii) Full AFL. 6