COMP 5 – 2 (RC)

T.E. (Computer) (Semester – V) Examination, May/June 2014
(Revised Syllabus)
AUTOMATA LANGUAGE AND COMPUTATION

Duration : 3 Hours Total Marks : 100

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

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

MODULE – I

1. a) Construct the DFA M over $\Sigma = \{0, 1\}$ which accepts the word from Σ such that, the number of 0's are even and the number of 1's are not divisible by three. Verify if the string 1010 is acceptable by the above DFA. 6

b) Prove that the RL's are closed under the following : 4

i) Intersection ii) Complement

c) Find the regular expression for the given DFA. 6

$M = (\{q_0, q_1, q_2\}, \{0, 1\}, \delta, q_0, \{q_0\})$, where δ is $\delta = \{\delta(q_0, 1) = q_1, \delta(q_0, 0) = q_0, \delta(q_1, 1) = q_1, \delta(q_1, 0) = q_2, \delta(q_2, 1) = q_1, \delta(q_2, 0) = q_0\}$.

d) Construct the Moore Machine to subtract given two binary numbers. 4

2. a) Construct the NFA that recognizes the language given as follows : $L(M) = \{x \varepsilon \{a, b\}^* \mid x$ contains at the most one pair of consecutive 0's and at the most one pair of consecutive 1's$\}$. 4

b) Construct the ε-NFA for the regular expression $01 + (0^? 1^+)^*$. Convert the ε-NFA to minimized DFA. 8

c) Prove that the language $L(M) = (ww^r \mid w \varepsilon \{a, b\}^* \}$ is not regular language. 4

d) Write the regular expression for the following languages. 4

i) $L(M) = \{x \varepsilon \{a,b\}^* \mid x$ contains at the most one pair of consecutive 0's and at the most one pair of consecutive 1's$\}$.

ii) $L(M) = \{x \varepsilon \{0, 1\}^* \mid \ |x|_0 \bmod 2$ and $|x|_1 \equiv 0 \bmod 2\}$.

P.T.O.

MODULE – II

3. a) Construct the CFG for the following :

$L(G) = \{a^i b^j c^k \mid i = j + k, j, k \geq 1\}$. Validate the string aaabbc. 5

b) Construct the PDA for the language $L(M) = \{a^n b^m \mid n \neq m\}$. Explain the behavior of the pushdown automata with the help of a string. 5

c) Construct the CFG for the given PDA $M = (\{A, B\}, \{a, b\}, \{Z,X\}, \delta, A, Z, \phi)$ where δ is defined as $\{\delta(A, a, Z) = (A, XZ), \delta(A, a, X) = (A, XX),$
$\delta(A, b, X) = (B, X), \delta(B, b, X) = (B, X), \delta(B, a, X) = (B, \varepsilon),$
$\delta(B, \varepsilon, Z) = (B, \varepsilon)\}$. 6

d) Prove that the language $L(M) = \{a^{2n} b^n c^n \mid n \geq 1\}$ is not a CFL. 4

4. a) Convert the given CFG $G = (\{S,A,B\}, \{a, b\}, \{S \rightarrow Ab|Ba, A \rightarrow aS|bAA|a, B \rightarrow bS|bBB|b\}, S)$ to PDA. 5

b) Convert the CFG $G = (\{S, A\}, \{c\} \{S \rightarrow ASc, S \rightarrow Ab, A \rightarrow SA, A \rightarrow c\}, S)$ to GNF. 5

c) Prove that the CFL's are closed under kleene closure and are not closed under intersection and complement. 6

d) Convert the given CFG $G = (\{S, A\}, \{c\} \{S \rightarrow ASc, S \rightarrow Ab, A \rightarrow SA, A \rightarrow c|\varepsilon\}, S)$ to CNF. 4

MODULE – III

5. a) Construct the Turing Machine to compute the quotient and reminder when i is divided by j. Given input as $\# a^i \# b^j \#$ and output as $\# a^i \# b^j \# c^k \# d^l \#$ where k is the quotient when i is divided by j and l is the reminder. 12

b) Construct the Turing Machine which recognizes the language consisting of all strings of 0s whose length is a power of 2. 8

6. a) Construct the Turing Machine that recognizes the language $L(M) = \{a^{2n}b^{n}c^{2n} | n \geq 0\}$. 4

b) Construct the Turing Machine which computes $f(m, n) = 2m \times 3n$. Explain the behavior of the Turing Machine with the help of a string. 10

c) Explain the variants of Turing Machine. 6

MODULE – IV

7. a) Construct the grammar that generates the language $L(G) = \{a^{i} | \text{ i is the power of 2}\}$. State the type of grammar generated for the above grammar. Validate the string aaaa. 6

b) Describe the language set L(G), for each of the following grammars. 4

i) $G = (\{S, X\}, \{0, 1\} \{S \to 0X | 1X, X \to 1X | 1\}, S)$.

ii) $G = (\{S, X, Y, Z\}, \{0\}, \{S \to 0X | \lambda, X \to 0Y, Y \to 0Z | 0, Z \to 0Y\}, S)$.

c) Explain the closure properties of families of languages. 6

d) Explain the equivalence of Regular Grammar and Finite Automaton. 4

8. a) Explain the equivalence of Context Sensitive Grammar and Linear Bounded Automaton. 4

b) Construct the left linear and right linear grammar for the r.e $(10+01)^{*}10^{*}1(1+0)^{*}$. Show the derivation tree for the string to validate each of the above grammars. 8

c) Construct the grammar that generates the language $L = \{a^{n+2} b^{n+1} c^{n} | n \geq 1\}$. State the type of grammar generated for the above grammar. 4

d) Explain Trios and Halting problem. 4