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COMP 5 – 2 (RC)

T.E. (Computer) (Semester – V) Examination, May/June 2015
(Revised Syllabus in 2007 – 2008)
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) Convert the following ε-NFA into NFA without ε-transitions.

   M = ({A, B, C, D}, {0, 1}, {d(A, 0) = B, d (A, e) = C, d(C, 0) = C, d(C, 1) = C, d(C, 1) = D, d(B, 1) = D}, A, {D}). Convert NFA to DFA. Write the regular expression for the above constructed DFA. **8**

   b) Prove that the following language L over the alphabet {a, b, c} is not regular : L – {wcx | w,x ε {a, b}* and number of a's in w is equal to number of b's in x}. **6**

   c) Design a finite state machine that compares two binary numbers to determine whether they are equal and which of the two is smaller. Assume that the digit of the two numbers come in one by one with the lowered digit coming in first. **6**

2. a) Find the regular expression for the given DFA **6**

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

   b) Construct the DFA for the following languages **8**

   L_1 = {w | w has even number of b's}, L_2 = {w | 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.

   c) Construct the NFA that recognizes the language **6**

   L = {x ε {a, b}* | (x contains(at least) two consecutive a's) and (x does not contain two consecutive b's)}.

P.T.O.

MODULE – II

3. a) Convert the following grammar to Chomsky Normal Form. **6**

   $G = (\{S, A, B\}, \{a, b\}, \{S \rightarrow ASB|\varepsilon, A \rightarrow aAS|a, B \rightarrow SbS|A|bb\}, S)$

   b) Construct the CFG for the following language **6**

   $L = \{0^i 1^j 2^k | i, j \geq 0 \text{ and } (i = 3j \text{ or } j = 3k)\}$

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

   Give the corresponding leftmost Derivation for string : bbabb. **8**

4. a) Is the following language context-free ? Justify your answer.

   $L = \{a^m b^n c^p \mid m = n \text{ or } n = p \text{ or } m = p\}$. **6**

   b) Convert the CFG to GNF. **4**

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

   c) Convert CFG into PDA. Explain the behaviour of the PDA for the string abba.

   $G = (\{S, A, B\}, \{a, b\}, \{S \text{-->} aB|bA, A \text{-->} a|aS|bAA, B \text{-->} b|bS|aBB\}, S)$. **8**

   d) Define deterministic pushdown automata. **2**

MODULE – III

5. a) Construct a Turing machine that accepts the language $L = \{a^n b^{n-1} c^{n-2} \mid n > 2\}$. **6**

   b) Explain the following :

   i) Nondeterministic Turing Machine

   ii) Universal Turing Machine. **6**

   c) Construct the Turing machine that recognizes the following language **8**

   $L = \{a^i b^j c^k d^l \mid i + k = j + 1 \; i, j, k, l \geq 0\}$

6. a) Define a Turing Machine. Construct a Turing Machine that concatenates two strings over the alphabet {a, b}. **6**

   b) Explain the variants of Turing Machine. **4**

   c) Construct the Turing Machine(TM) that recognizes the following language

   $L = \{a^x \mid x = i^2, i > 1\}$ explain the behaviour of the TM with the help of a string aaaa. **10**

MODULE – IV

7. a) Construct a right linear regular grammar for the following regular expression re = $((10)^*(011 + 1)^*)^* (0 + 101)^*$. Convert right linear grammar to left linear grammar. **8**

   b) Explain the following. **6**

      i) AFL

      ii) Non self accepting

      iii) Trio.

   c) Prove that language L is recursive iff both L and complement of L is also recursive. **6**

8. a) Construct the type 0 grammar for the following language. **6**

   $L = \{a^i b^j c^k d^l \mid i + k = j - 1, i, j, k, l \geq 0\}$

   Validate the string aabcdd.

   b) Explain the following : **6**

      i) Unsolvable Decision problems

      ii) Recursively enumerable languages.

   c) Find the context-sensitive grammar for the language $L(G) = \{a^n b^n a^{2n} \mid n \geq 1\}$. Using the CSG draw the parse tree for the string aabbaaaa. **6**

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