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T.E. (Information Technology) (Semester – I) Examination, 2010
THEORY OF COMPUTATION
(2003 Course)

Time: 3 Hours Max. Marks : 100

Instructions : *1) Answer **any three** questions from **each** Sections.*
*2) Answers to the **two** Sections should be written in **separate** answer books.*
*3) **Neat** diagrams must be drawn **wherever** necessary.*
*4) Figures to the **right** indicate **full** marks.*
*5) Assume suitable data, if **necessary**.*

SECTION – I

1. a) Construct a NFA and its equivalent DFA for accepting a language defined over $\Sigma = \{0, 1\}$, such that each string has two consecutive zeroes followed by 1. **10**

   b) Design a Moore machine for the 1's complement of a binary numbers. **4**

   c) Compare the following :
   i) DFA and NFA ii) Moore machine and Mealy machine. **4**

OR

2. a) Design a Finite State Machine for divisibility by 5 tester of a given decimal number. **6**

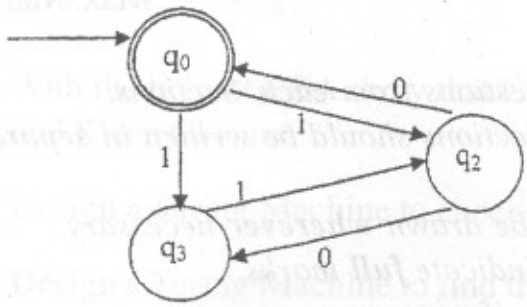
   b) Design a Moore machine for checking divisibility by 3 of a given decimal number (residue of 3). **6**

   c) Design a Mealy machine for a binary input sequence such that if the sequence ends with 100 the output is 1 otherwise output is 0. **6**

3. a) Find a regular expression correponding to each of the following subsets of $\{0, 1\}^*$.
   i) The language of all strings ending in 01.
   ii) The language of all strings that contain at least one occurrence of each symbol in Σ.
   iii) The language of all string containing an even no of 0's. **6**

P.T.O.

b) Consider the following transition diagram. Convert it to equivalent regular expression. **6**



c) Prove that $L = \{a^{n^2} / n \geq 1\}$ is not regular (use pumping lemma theorem). **4**

OR

4. a) Give regular expression for the following :

i) For $\Sigma = \{0,1\}$ such that

$L(r) = \{w \in \Sigma^* s : w$ has at least one pair of consecutive zeroes$\}$

ii) For $\Sigma = \{0,1\}$ such that

$L(r) = \{w \in \{0,1\}^* :$ w has no pair of consecutive zeroes$\}$

iii) For $\Sigma = \{0,1\}$ such that

$L(r) = \{a^n, b^m, n \geq 4, m \leq 3\}$

iv) For $\Sigma = \{0,1\}$ such that

L = {all strings containing even numbers of zeroes}. **8**

b) Construct DFA equivalent to the following Regular Expression (01/10)*00. **8**

5. a) Find the GNF equivalent to the CFG

$S \rightarrow AB$

$A \rightarrow aA \mid bB \mid b$

$B \rightarrow b$ **4**

b) Consider the following productions :

$S \rightarrow aB \mid bA$

$A \rightarrow aS \mid bAA \mid a$

$B \rightarrow bS \mid aBB \mid b$

For the string aaabbabbba find :

i) The leftmost derivation ii) The right most derivation iii) Parse tree

Check whether the given grammar is ambiguous **8**

c) Find the CFG to generate the language defined the following Regular Expressions.

i) ab* ii) a* b* **4**

OR

6. a) Convert the following grammars to their equivalent Chomsky Normal Forms :

i) $S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow AC$

ii) $S \rightarrow 1A \mid 0B$

$A \rightarrow 1AA \mid 0S \mid 0$

$B \rightarrow 0BB \mid 1S \mid 1$. **8**

b) Construct right linear and left linear grammar for the language

$L = \{a^n, b^m, n \geq 2, m \geq 3\}$ **8**

SECTION – II

7. a) Construct a PDA that accepts the language.

$L = \{a^n b^n \mid n \geq 0\}$ **10**

b) Compare DPDA and NPDA. **4**

c) Write a short note on closure properties of CFLs. **4**

OR

8. a) Define Push Down Automata. **2**

   b) Design a PDA to accept a language defined by the following CFG.

   $S \rightarrow S+S \mid S*S \mid a$. **10**

   c) With the help of PDA show that CFL are closed under union, concatenation and Kleen Closure. **6**

9. a) Design a Turing Machine to check the equality of two given numbers. **8**

   b) Design a Turing Machine to find the 1's complement of a given binary input. **8**

OR

10. a) Design a Turing machine with no more than three states that accepts the language (a(a+b)*) assume that $\Sigma = \{a, b\}$. **8**

    b) Write a short note on : **8**

       i) Universal Turing Machine

       ii) Halting problem of Turing machine.

11. a) Explain in brief the applications of CFG in compilers. **4**

    b) Enlist the various applications of Regular Expressions and explain any one of them. **6**

    c) Write a short note on : Recursive and recursively enumerable language. **6**

OR

12. Write a short note on : **16**

    i) Application of PDA in Expression conversion

    ii) Limitation of TM

    iii) FSM limitations and properties.
