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

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

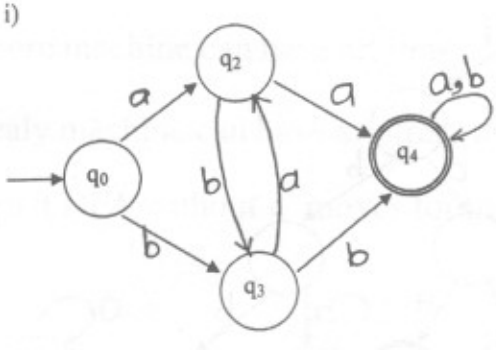
1. a) Describe in simple english the language defined by following regular expressions : **4**

i) (a+b)* aa (a+b)** ii) (b+ba)*

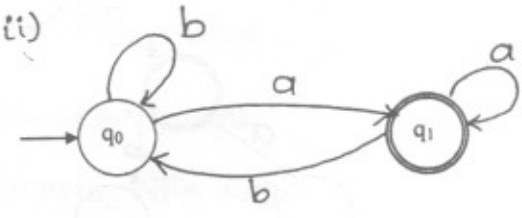
iii) a (a+b)*b iv) $a^+b^*c^+$

b) Express the language accepted by following Transition Graph in the form of regular expressions. **6**

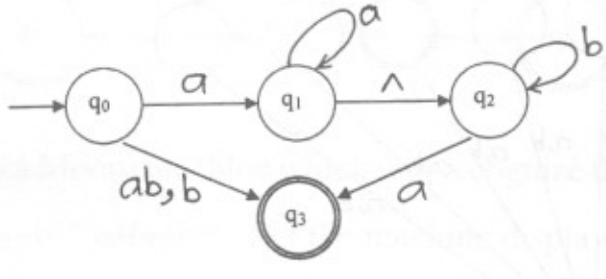
i)



ii)



iii)



c) Design a FSM for divisibility tester of urinary number by 2. 8

OR

2. a) Write the regular expressions for :

i) $\Sigma = \{a,b,c\}$ the language containing strings, such that each string has "any number of a's followed by any number of c's".

ii) $\Sigma = \{0,1,2\}$, and language set $L(r) = \{0,2,01,21,011,211,0111,...\}$

iii) $\Sigma = \{0,1\}$ and language set $L(r) = \{00,010,0110,01110,....\}$

iv) Language defined over $\Sigma = \{a,b\}$ has to have the strings beginning with 'a' and not to have two consecutive a's

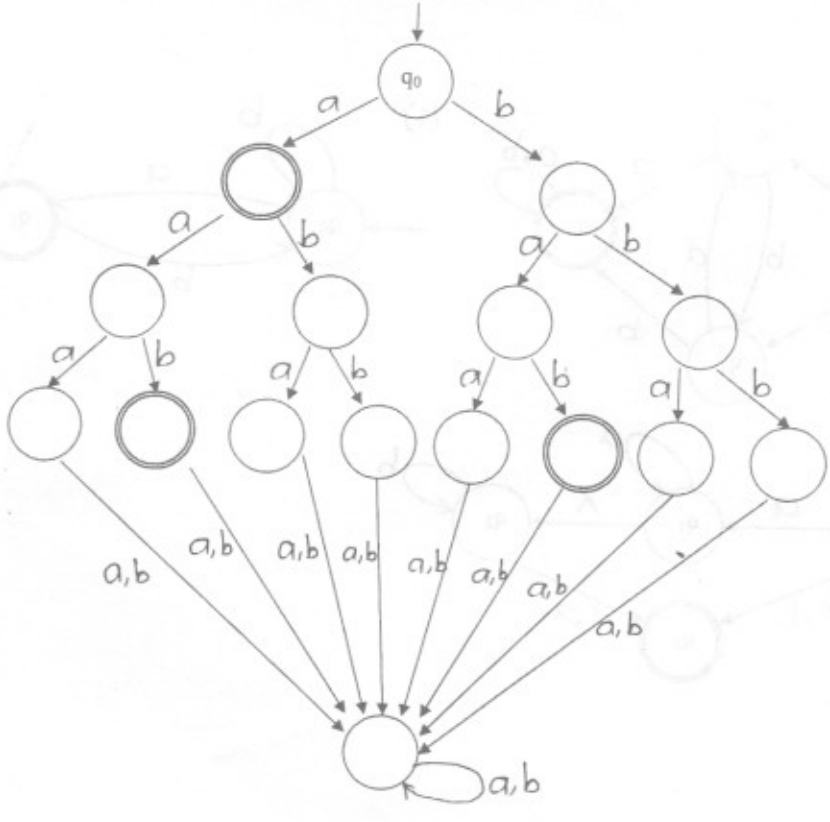
v) $\Sigma = \{a,b\}$ such that each of string do not have aa or bb as a substring in it.

vi) $\Sigma = \{0,1)$ the language such that it contains strings with even number of 0's. 8

b) What are the properties and limitations of Finite State Machine ? 6

c) Prove that for any Σ, $\Sigma^* = \Sigma^{**}$ 4

3. a) Consider the following F A

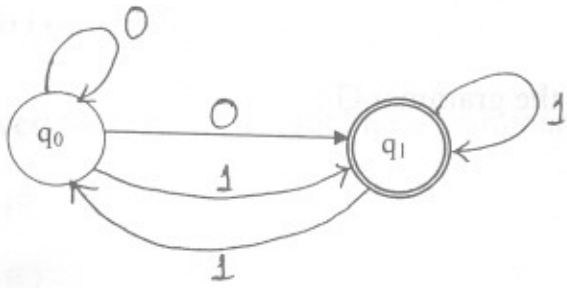


Answer the following questions :

i) What is the max length of string accepted by this F A ?

ii) What are the words accepted by this F A ? **4**

b) Show stepwise process of constructing DFA equivalent to the NFA : **6**



c) Design FA that reads strings made up of $\Sigma = \{0,1\}$ and accepts only those strings which ends with "00" or by "11". **6**

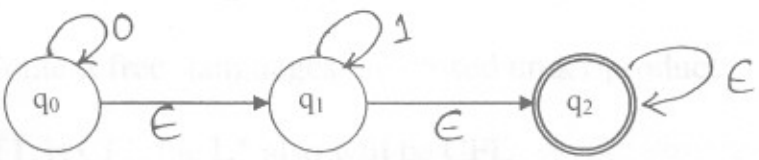
OR

4. a) State true or false

i) Moore machine can have arbitrary number of final states.

ii) Mealy machine can have arbitrary number of start states. **2**

b) Construct NFA without $\in$ moves for the following NFA with $\in$ moves. **6**



c) Design a Moore machine which will recognize the language of all words of the form (a+b)* aa(a+b)*. Let the machine display "A" for acceptance and "R" for rejection of words. **8**

5. a) Write a CFG over $\Sigma=\{a,b\}$ such that CFL is palindrome. Show the derivation of the string "aabbaa" using the resulting grammar. **4**

   b) Convert the following CFG to it's equivalent CNF (clearly show the steps involved if any)

   $S \rightarrow 0S0 \mid 1S1 \mid 0 \mid 1 \mid 00 \mid 11$ **6**

   c) Eliminate ε productions from the grammar G :

   $S \rightarrow ABCa \mid bD$

   $A \rightarrow BC \mid b$

   $B \rightarrow b \mid \varepsilon$

   $C \rightarrow c \mid \varepsilon$

   $D \rightarrow d$ **6**

OR

6. a) Write a CFG over $\Sigma = \{a,b\}$ containing at least occurrence of "aa". **4**

   b) Write a CFG for (a+b)* bbb (a+b)*. **6**

   c) Simplify the following grammar.

   $S \rightarrow Ab$

   $A \rightarrow a$

   $B \rightarrow C/b$

   $C \rightarrow D$

   $D \rightarrow E$

   $E \rightarrow a$ **6**

SECTION – II

7. a) Find CFL defined by following CFG

$S \rightarrow aB \mid bA$

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

$b \rightarrow b \mid bS \mid aBB$ **4**

b) Convert the following right linear grammar to equivalent left linear grammar :

$S \rightarrow IP$

$P \rightarrow IQ$

$Q \rightarrow 0P$

$Q \rightarrow 0$

$P \rightarrow 1$ **6**

c) Show that $L = \{ww \mid w \in \{a,b\}^*\}$ is not a context free language. **8**

OR

8. a) With respect to CFL state whether the following statements are true or false. Justify your answers :

i) Context free languages need not be closed under union.

ii) Context free languages are closed under product

iii) If L is CFL the L* also will be CFL **6**

b) Give the left linear grammar for RE $(10)^*1$ **6**

c) Give the right linear grammar for RE $0^*1(0+1)^*$ **6**

9. a) Design a PDA to accept the language :

$L = \{a^n b^n \mid n >= 0\}$

(Let your answer be either in the pictorial form or mathematical model) **8**

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

$S \rightarrow 0BB$

$B \rightarrow 0S|1S|0$

Test whether 010 is accepted by the above PDA. **8**

OR

10. a) Compare PDM and FSM. **4**

b) Construct PDA equivalent to CFG , which defines language containing all strings only with even number of a's. Simulate the working of this PDA for the input "aa". **8**

c) Define PDA. Enlist at least any two applications of PDA. **4**

11. a) Design TM to increment value of binary number by one. **6**

b) Design TM to accept the set L of all strings over {0,1} ending with 010. **6**

c) State true or false :

i) FSM is a special case of the TM.

ii) TM can be deterministic.

iii) TM has an external memory which can remember arbitrary long sequences of inputs.

iv) Basis of TM is divide the process into primitive operations. **4**

OR

12. a) Design a TM to recognize all strings consisting of even number of 1's **8**

b) Explain the following

i) Composite T.M and iterative T.M

ii) Universal T.M **8**
