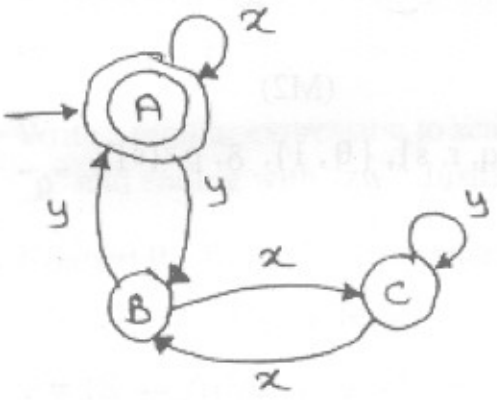
T.E. (Information Technology) (Semester – I) Examination, 2010
THEORY OF COMPUTATION (New)
(2008 Course)

Time : 3 Hours | Max. Marks : 100

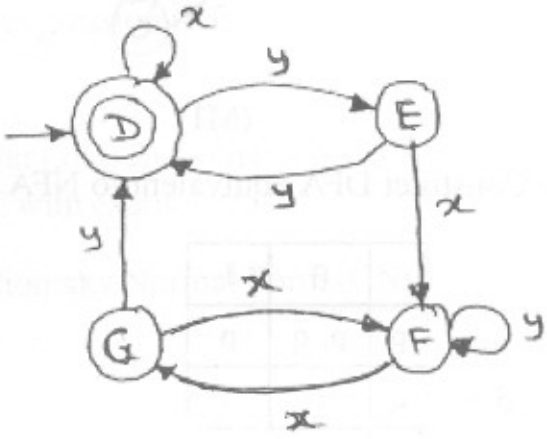
SECTION – I

1. a) Design an FSM for divisibility by 3 tester for a binary number. **6**

   b) Find out whether M1 and M2 are equivalent. **6**



(M1)



(M2)

   c) Construct DFA equivalent to NFA ({p, q, r, s}, {θ, 1}, δ, p, {q, s}) **6**

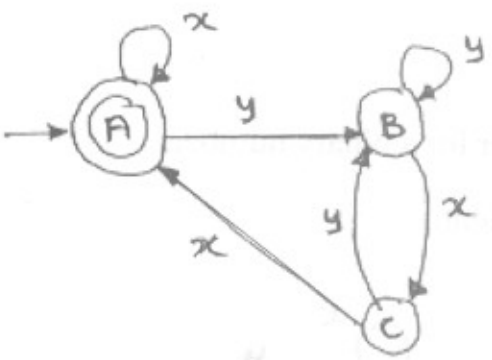
δ =

	θ	1
p	q, s	q
q	r	q, r
r	s	p
s	–	p

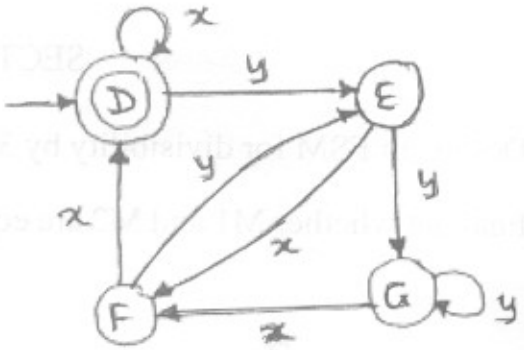
OR

2. a) Design an FSM for divisibility by 3 tester for a unary number. 6

   b) Find out whether M1 and M2 are equivalent. 6



(M1)



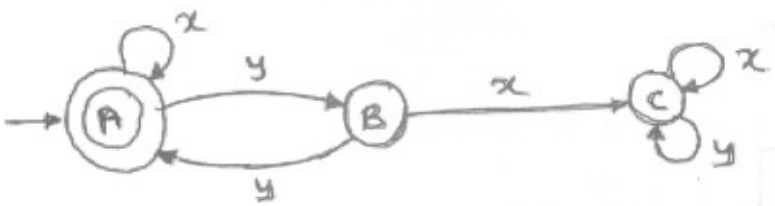
(M2)

   c) Construct DFA equivalent to NFA ({p, q, r, s}, {θ, 1}, δ, p, {s}). 6

$\delta =$

	θ	1
p	p, q	p
q	r	r
r	s	–
s	s	s

3. a) Construct regular expression for following transition diagram : 6

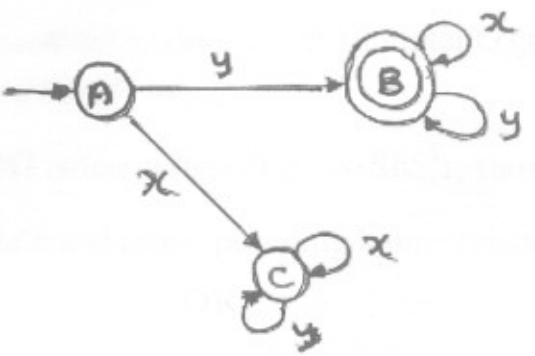


   b) Construct DFA for following regular expression (RE)
   RE = (a + b) * a b b. 6

   c) Write a regular expression to identify valid decimal integer constant for 'C' language. Justify RE with example. 4

OR

4. a) Construct regular expression for following transition diagram. **6**



b) Construct DFA for following regular expression (RE)
RE = b (a + b)* a. **6**

c) Write a regular expression to search dat (.dat) file(s) having starting character "p" and ending with "zw". Justify RE with example(s). **4**

5. a) Convert the following grammar to Chomsky Normal Form (CNF). **6**

G = ({S, A, B}, {a, b, ∈ }, P, {S})

P = {S → ABA, A → aA, A → ∈

B → bB, B → ∈ }

[epsilon – ∈]

b) Construct the parse trees for the strings using specified derivation format for given grammar G. **6**

G = ({S, A, B}, {a, b}, P, {S})

P = {S → aB, S → bA,

A → a, A → aS, A → bAA,

B → b, B → bS, B → aBB}

Strings :

I) a a a b b b (leftmost derivation)

II) a b a b a b b a (rightmost derivation).

c) Convert right linear grammar to equivalent left linear grammar. **4**

$G = (\{S, A, B, C\}, \{\theta, 1\}, P, \{S\})$

$P = \{S \rightarrow \theta A, S \rightarrow 1B,$

$A \rightarrow 1A, A \rightarrow \theta C, A \rightarrow \theta,$

$B \rightarrow 1A, B \rightarrow 1B, B \rightarrow 1,$

$C \rightarrow \theta A, C \rightarrow \theta\}$

OR

6. a) Convert the following grammar to Chomsky normal form (CNF). **6**

$G = (\{S\}, \{a\}, P, \{S\})$

$P = \{S \rightarrow a\,a\,a\,a\,a\,S, S \rightarrow a\,a\,a\}$

b) Construct the parse trees for the strings using specified derivation format for given grammar G **6**

$G = (\{S, A, B\}, \{a, b\}, P, \{S\})$

$P = \{S \rightarrow aB, S \rightarrow bA,$

$A \rightarrow a, A \rightarrow aS, A \rightarrow bAA,$

$B \rightarrow b, B \rightarrow bS, B \rightarrow aBB\}$

Strings :

I) a a a b b b (rightmost derivation)

II) a a b a b b (leftmost derivation)

c) Convert right linear grammar to equivalent left linear grammar. **4**

$G = (\{S, B, C\}, \{a, b\}, P, \{S\})$

$P = \{S \rightarrow bB, B \rightarrow bC, B \rightarrow aB, B \rightarrow b,$

$C \rightarrow a\}$

SECTION – II

7. a) Construct a context free grammer G generating all integers (with sign). Derive an example integer. **4**

   b) If G is the grammar $S \rightarrow SbS|a$, show that G is ambiguous. **4**

   c) State and prove pumping lemma theorem. **8**

OR

8. a) Write regular expressions for

   i) Set of strings of 0's and 1's whose tenth symbol from the right end is 1.

   ii) Set of strings of 0's and 1's not containing 101 as substring.

   iii) Set of strings with even number of a's followed by odd number of b's that is for the language. $L = \{a^{2n} b^{2m+1} : n \geq 0, m \geq 0\}$

   iv) Set of strings of an equal number of 0's and 1's such that in every prefix, the number of 0's differs from the number of 1's by at most 1. **8**

   b) Construct the regular expressions for the transition diagrams given. **8**

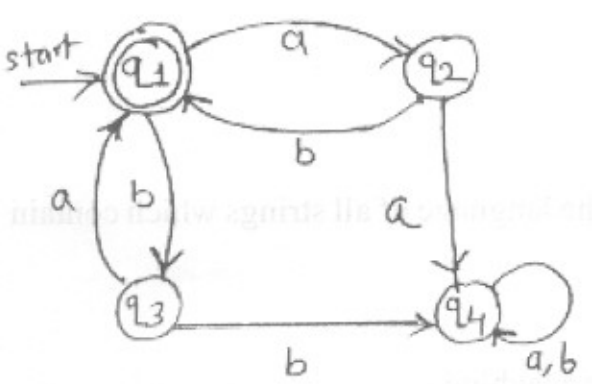


Fig. (i)

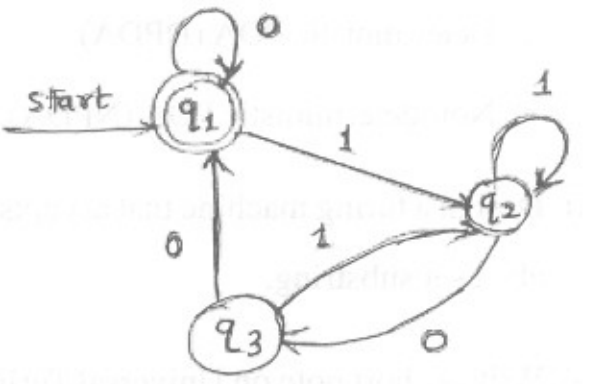


Fig. (ii)

9. a) Design a pushdown automata for the following language

$L = \{a^n b^{2n} : n > 0\}$. **8**

b) Design a PDA for the following CFG,

$G = (V_n, V_t, P, S)$ with

$V_n = \{S\}$, $\{V_t = \{(,)\}$ and P is defined as follows

$S \rightarrow \in$

$S \rightarrow SS$

$S \rightarrow (S)$. **8**

OR

10. a) Write a note on closure properties of CFLs. **6**

b) Write a note on post machines. **6**

c) Write definitions :

i) Deterministic PDA (DPDA)

ii) Non-deterministic PDA (NPDA). **4**

11. a) Design a turing machine that accepts the language of all strings which contain aba as a substring. **8**

b) Write a short note on Universal Turing Machine. **8**

c) What are 'Multi-Tape TMs'? **2**

OR

12. a) Explain Chomsky Hierarchy and describe the machines that you have learnt in this course that accept each type of grammar of Chomsky Hierarchy. **8**

b) Explain the following : **10**

i) Limitations of finite Automata

ii) Recursive sets

iii) Partial Recursive functions

iv) Recursively enumerable sets

v) Limitations of TM.
