Printed Pages : 4 MCA – 244 (3)

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1460 Roll No.

M. C. A.

(END SEM.) EXAMINATION, 2006-07

THEORY OF FORMAL LANGUAGES & AUTOMATA

Time : 3 Hours] *[Total Marks : **100***

Note : *Attempt **all** questions. Every question carries **20** marks. Make suitable assumption wherever needed.*

1 Attempt any **four** parts of the following : **5×4=20**

(a) Convert the following NFA to an equivalent DFA

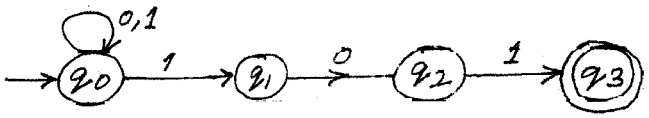

Fig. 1

(b) Obtain a minimum state DFA equivalent to the following

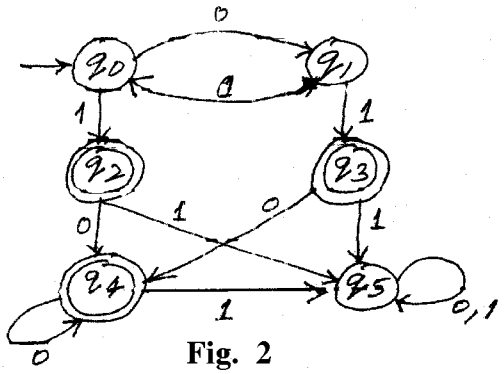

Fig. 2

(c) For the regular expression given below, obtain an NFA without E-moves.
(0 + 1) * (00 + 11)

(d) Design a moore machine that accepts all strings of 0's and 1's treated as binary integer number return a remainder 1 when divided by 3.

(e) Give the statement of pumping lemma and using it prove that the following language is not regular.

$$L = \left\{ 0^{L^2} \mid i \text{ is integer, } i \geq 1 \right\}$$

(f) Prove that regular sets are closed under union and complementation.

2 Attempt any **four** parts of the following : **5×4=20**

(a) Consider the CFG with the following production rules :
S → aB | bA
A → bAA | aS | a
B → aBB | bS| b
Give a right most derivation and draw derivation tree for the string abbaab.

(b) Prove that the following grammar of arithmetic expressions is ambiguous
E → E + E | E * E | (E) | id

(c) Find a CFG with no useless symbols equivalent to the following grammar :
S → AB | CA
A → a
B → BC | AB
C → AB | b

(d) Convert the grammar of question no. 2 (a) into chomsky normal form (CNF).

(e) Construct a Greibach Normal Form (GNF) grammar equivalent to the following :

CFG

$S \rightarrow AA \mid 0$

$A \rightarrow SS \mid 1$

(f) Remove all E and unit production rules from the following CFG :

$S \rightarrow AaA \mid CA \mid BaB$

$A \rightarrow aaBa \mid CDA \mid aa \mid DC$

$B \rightarrow bB \mid bAB \mid bb \mid aS$

$C \rightarrow Ca \mid bc \mid D$

$D \rightarrow bD \mid A$

3 Attempt any **two** parts of the following : **10×2=20**

(a) What are deterministic and non – deterministic PDA? Design a PDA for the following language

L = { WW^R | WE (0+1) * and W^R is reverse of W}

(b) Consider the following transition functions of a PDA that accepts strings through empty stack mechanism:

$$\delta(q_0, 1, z_0) = \{(q_0, X z_0)\}$$

$$\delta(q_0, \in, z_0) = \{(q_0, \in)\}$$

$$\delta(q_0, 1, X) = \{(q_0, XX)\}$$

$$\delta(q_1, 1, X) = \{(q_1, \in)\}$$

$$\delta(q_0, 0, X) = \{(q_1, X)\}$$

$$\delta(q_1, 0, z_0) = \{q_0, z_0\}$$

Find out a CFG for the above PDA.

(c) For the following CNF, using CYK algorithm check the membership of the string aaaaa.

$S \rightarrow AB \mid BC$

$A \rightarrow BA \mid a$

$B \rightarrow CC \mid b$

$C \rightarrow AB \mid a$

4 Attempt any **two** parts of the following: **10×2=20**

(a) Design a Turing machine that accepts the language of question no. 3 (a).

(b) Prove the following:

(i) The union of two recursive languages is recursive and so is for two recursively enumerable languages.

(ii) Complement of a recursive language is also recurvise.

(c) (i) Define universal Turing machine and universal language.

(ii) What is post correspondence problem? Explain with an example.

5 Attempt any **two** parts of the following :

(a) Give a complete overview of Type-0, type-1, type-2 and type-3 grammer with Chomsky hierarchy.

(b) If L is a Context Free Language (CFL) and R is a Regular Set, then prove that LDR is a CFL.

(c) Construct right-linear grammers for the following languages

(i) (0+1) * 11 (0+1)*

(ii) (0+1) * 00