4. Attempt any **two** : **(10×2=20)**

(a) Design a PDA for

$L = \{a^i b^j c^k | i=j \text{ or } j=k\}$

(b) Consider a PDA M = $\{\{q_0, q_1, q_2\}, \{a, b\}, \{A, Z_0\}, \ , q_0, Z_c, \square\}$ where is given as follows :

$(q_0, a, Z_c) = (q_0, AZ_0)$

$(q_0, b, A) = (q_1, A)$

$(q_1, a, A) = (q_1, \square)$

$(q_1, \square, Z_0) = (q_2, \square)$

Obtain the CFG that generates the same language which is accepted by PDA M.

(c) Consider the CFG where production P are as follows :

S->aABB|aAA

A->aBB|a

B->bBB|A

Convert the grammar to PDA that accepts the same language by empty stack.

5. Attempt any **two** : **(10×2=20)**

(a) Write a short note on (any **two**) :

(i) Post correspondence problem with example

(ii) Multi tape Turing machine

(iii) Church's Hypothesis

(iv) Halting problem of a Turing machine.

(b) (i) Prove that if a language L and complement of both are recursively enumerable then L is recursive.

(ii) Differentiate with suitable example between recursive and recursively enumerable languages.

(c) Describe how to design the Turing machine and hence design a Turing machine for :

$L = a^n b^n c^n | n \geq 1.$

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

PAPER ID : 1071 **Roll No.**

B.Tech.

(SEM. IV) EVEN THEORY EXAMINATION 2012-13

THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time : 3 Hours *Total Marks : 100*

Note :– (1) Attempt **all** questions.

(2) Be precise in your answers.

1. Attempt any **four** : **(5×4=20)**

(a) Give the Chomsky hierarchy of grammars specifically giving form of production rules in each class of Grammar ?

(b) Consider the language S*, where S = {XX, XXX}. In how many ways can X^{19} be written as the product of words in S ? This means : How many different factorizations are there of X^{19} into XX and XXX ?

(c) Find transitive closure R^+ and reflexive and transitive closure R* of the relation :

R = {(1, 2), (2, 3), (3, 4), (5, 4)}

(d) Draw a DFA that accepts set of all strings of 0 and 1 that end in the last two same symbols.

(e) Let S = {ab, bb} and T = {ab, bb, bbbb} show that S* = T* ?

(f) When asked to give a recursive definition for the language, PALINDROME over the alphabet w = {a, b},

a student wrote :

Rule 1 : a and b are in PALINDROME

Rule 2 : If x is in PALINDROME, then so are axa and bxb.

But all the words in the language defined above have an odd length and so it is not all of PALINDROME. Correct this problem.

2. Attempt any **four** : **(5×4=20)**

(a) Explain the various properties of regular expression and also explain Ardens theorem with proof.

(b) Write the regular expression :

(i) A set of string of 0's and 1's not containing 101 as substring.

(ii) A set of all string of 0's and 1's such that every pair of adjacent 0's appear before any pair of adjacent 1's.

(c) Convert NFA into DFA :

STATES	a	b
p	{p, q}	p
q	r	r
r	s	?
s	s	s

(d) Construct a finite atuomata equivalent to following regular expression :

$10 + (0 + 11)\ 0^*1$

(e) State Pumping lemma for regular language. Prove that language given below are NOT REGULAR.

$L = a^n b^k \mid n > k \geq 0.$

(f) Simplify the following expressions :

(i) $(r_1 + r_2 + r_1r_2 + r_2r_1)^*$

(ii) $r_1(r_1\ r_1 + r_1) + r1$

3. Attempt any **four** : **(5×4=20)**

(a) Explain CYK algorithm and determine whether the string S = 00111 belongs to the language generated by the following CFG :

S->XY

X->0|XY

Y->1|XY

(b) Find the CFG for the language :

(i) $L = a^i b^j c^k \mid i = j \text{ or } j = k$

(ii) $L = a^i b^j c^k \mid j = i + k$

(c) By drawing two rightmost or two leftmost derivation for a suitably selected string, show that the following grammar is an ambiguous grammar :

E->E+E|E-E|E*E|E\E|D

D->a|b|c|d

Also convert the grammar into un-ambiguous grammar.

(d) State pumping lemma for CFG and using it prove that the language

$L = \{a^n b^n c^n \mid n \geq 1\}$

(e) Convert the CFG into GNF

S->AB|AC

A->aA | bAa |a

B->bbA | aB | AB

C->aCa | aD

D->aD | bC

(f) L_1 be a CFL and L_2 be regular language then prove $(L_1 \cap L_2)$ is context free.