Total No. of Questions : 10]

SEAT No. :

P1341

[Total No. of Pages : 3

[4858] - 1085

T.E. (Computer)

Theory of Computation

(2012 Pattern) (Semester - I) (End Sem.)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer five questions.*
2) *Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data wherever necessary.*

Q1) a) Write regular expressions for the following languages over the alphabet $\sum=\{a,b\}$ **[6]**

i) All strings that do not end with '*aa*'.

ii) All strings that contain an even number of '*b*' s.

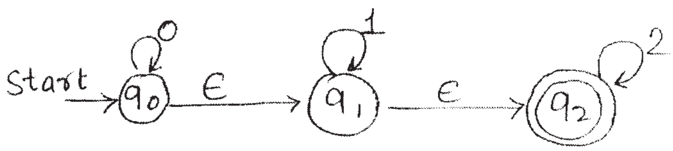
iii) All strings which do not contain the substring '*ba*'.

b) Show that for two recursive languages L1 and L2, the language L is also recursive, where L is given by **[4]**

$L1 \cap L2$

OR

Q2) a) Consider the following NFA with $\in$-transitions. Find $\in$-closures and then convert this into NFA without $\in$-moves. **[6]**

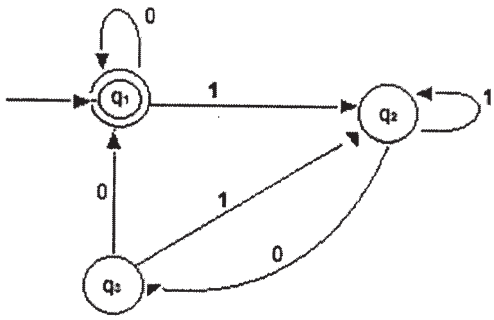


b) Prove using mathematical induction the following: **[4]**

$2^0+2^1+2^2+....+2^n=2^{n+1}-1$, for all integers $n\geq0$.

P.T.O.

Q3) a) Find the regular expression for the set of strings recognized by the given FA. Use Arden's theorem. **[6]**



b) Explain, with suitable examples, any two applications of context free grammars. **[4]**

OR

Q4) a) Convert the following CFG into Chomksy Normal Form (CNF): **[6]**

S-> AB

A-> CA | ^

B-> DB | ^

C-> 011|1

D-> 01

b) Prove the formula **[4]**

i) $(r * s^*)^* = (r + s)^*$.

ii) $(ab)^* \neq a^* b^*$.

Q5) a) Design Turing Machines for each of the following problems: **[10]**

i) Given two unary numbers, m and n, display,

'G', if m > n, 'E', if m = n, 'L', if m < n

ii) Given two unary numbers, find the Greatest Common Divisor (GCD) of the two numbers.

b) Justify how a Turing Machine can simulate a General Purpose computer and vice-versa. **[8]**

OR

Q6) a) Explain : "The halting problem in Turing Machines is undecidable". **[6]**

b) Design a Turing Machine to perform right shift operation on a binary number. **[6]**

c) Design Post Machine to accept strings that belong to the language L, given by, $L = \{a^n b^{3n} \mid n >= 0\}$. **[6]**

Q7) a) Design PDA for language L = $\{a^i b^j c^k \mid i, j, k >= 1 \text{ and } i + j = k\}$ that accepts language via **[10]**

i) Final state.

ii) Empty stack.

b) Explain the equivalence of PDA with acceptance by final state and empty stack. **[6]**

OR

Q8) a) Write context free grammar for accepting palindrome strings (even and odd). Also design PDA for the context free grammar. **[8]**

b) Consider the PDA with following moves; obtain its equivalent CFG. **[8]**

(q0, a, Z0) = (q0,aZ0),

(q0, a, a) = (q0, aa),

(q0, b, a) = (q1, ε),

(q1, b, a) = (q1, ε),

(q1, ε, Z0) = (q1, ε)

Q9) a) What do you mean by Polynomial-time reductions? Describe any problem in detail that is solvable through polynomial time reduction. **[8]**

b) What is Satisfiability (SAT) problem? Explain with a suitable example. **[8]**

OR

Q10) a) Explain the Vertex Cover problem in the context of polynomial-time reductions. Justify with a suitable example. **[8]**

b) Explain the following with example. **[4]**

i) Computational complexity.

ii) 3-SAT problem.

c) Differentiate between P-class problems and NP-class problems. **[4]**