

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

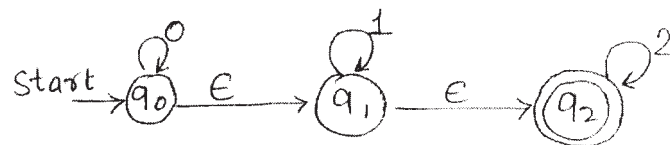
$$\Sigma = \{a, b\} \quad [6]$$

- 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 ϵ -transitions. Find ϵ -closures and then convert this into NFA without ϵ -moves. [6]

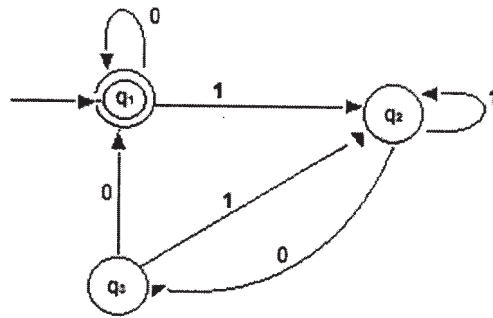


b) Prove using mathematical induction the following: [4]

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

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 Chomsky Normal Form (CNF): [6]

$S \rightarrow AB$

$A \rightarrow CA \mid \Lambda$

$B \rightarrow DB \mid \Lambda$

$C \rightarrow 011 \mid 1$

$D \rightarrow 01$

- 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, $L = \{a^n b^{3n} \mid n \geq 0\}$. [6]

- Q7)** a) Design PDA for language $L = \{a^i b^j c^k \mid i, j, k \geq 1 \text{ and } i + j = k\}$ 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]
 $(q_0, a, Z_0) = (q_0, aZ_0)$,
 $(q_0, a, a) = (q_0, aa)$,
 $(q_0, b, a) = (q_1, \epsilon)$,
 $(q_1, b, a) = (q_1, \epsilon)$,
 $(q_1, \epsilon, Z_0) = (q_1, \epsilon)$

- 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]



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