B.Sc. Semester-V Examination, 2022-23

COMPUTER SCIENCE [Honours]

Course ID : 51512   **Course Code : SH/CSC/502/C-12**

Course Title : Theory of Computations

Time : 2 Hours   Full Marks : 40

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer **all** the questions.

UNIT-I

1. Answer any **five** of the following questions:

$$2 \times 5 = 10$$

   a) What is dfa?

   b) Define ε-closure of a state in finite automata? Give example.

   c) Find all strings of length 3 or less in the regular set represented by $(a+b+c)^*$

   d) State pumping lemma of context free languages.

   e) Define right linear grammar. Give example.

   f) When a language is said to be regular? Give example.

   g) Define nullable variable.

   h) Draw a dfa for $L=(a+b)^*$.

[Turn Over]

UNIT-II

2. Answer any **four** of the following questions:

$$5 \times 4 = 20$$

   a) If L and M are regular languages then prove that L-M is also a regular language. Draw an nfa accepting λ.   4+1=5

   b) Draw a dfa to accept -

      i) A string of 0's and 1's ending with the string 011.

      ii) A string of 0's, 1's and 2's beginning with a 0 followed by odd number of 1's and ending with a 2. $2\frac{1}{2} \times 2 = 5$

   c) Design a pda for $L = \{WW^R : W\varepsilon\{a,b\}^*\}$. Explain functioning of it with instantaneous description.   4+1=5

   d) Write context free grammars for $L_1 = \{a^l b^m c^n : l,m,n > 0 \, \& \, l=m+n\}$ & $L_2 = \{a^n b^m : n \neq m\}$. $2\frac{1}{2} \times 2 = 5$

   e) Design a Turing machine for $L = \{a^{2n}b^n : n > 0\}$.

   f) Prove that $L = \{a^n b^n : n > 0\}$ is not regular. Give example of a finite regular language.   4+1=5

UNIT-III

3. Answer any **one** of the following questions:

$$10 \times 1 = 10$$

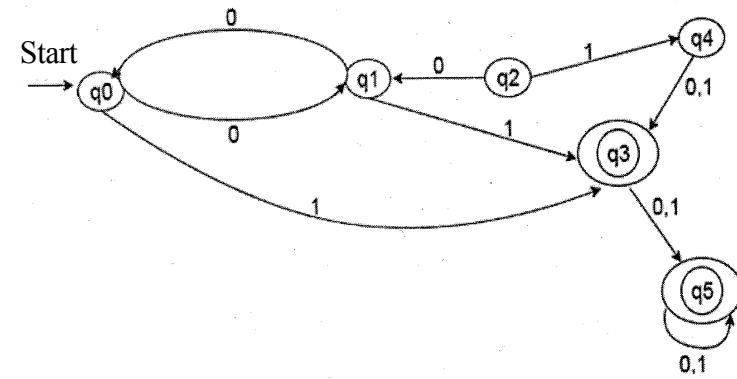a) Find a regular expression for the following dfa.
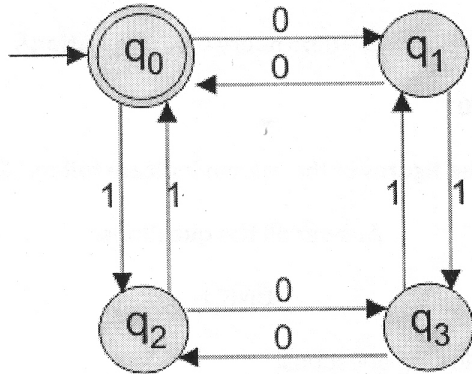
Prove the following theorem by method of induction

$$1^2 + 2^2 + 3^2 + \ldots + n^2 = \left[n(n+1)(2n+1)\right]/6$$

$$6+4=10$$

b) i) Minimize the following dfa-

ii) Consider the following production rules of a Context Free Grammar:

$$S \rightarrow S + T \mid T$$
$$T \rightarrow T * F \mid F$$
$$F \rightarrow (S) \mid a$$

Give a derivation for the string (a+a)*a

$$6+4=10$$

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