SH-V/Com. Sc.-502-C-12/19

B.Sc. 5th Semester (Honours) Examination, 2019-20

COMPUTER SCIENCE

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

Course Title: Theory of Computation

Time: 2 Hours **Full Marks: 40**

The figures in the right hand side margin indicate full marks.

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

1. Answer *any five* questions: 2×5=10

(a) Define *dfa* and *nfa*.

(b) What is regular grammar?

(c) What is simple grammar? How does it differ from a regular grammar?

(d) Define ambiguous grammar. Give example.

(e) What is λ-production? When a variable is called nullable?

(f) Define CNF of a context free grammar.

(g) State pumping lemma for context free languages.

(h) Define computable function.

2. Answer *any four* questions: 5×4=20

(a) Prove $1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$ by method of induction. What is meant by a language? 4+1=5

(b) Find all strings of length less than or equal to 4 from $L = a(a + b)^* b$. Find *dfa* for the following languages on $\sum = \{a, b\}$

(i) $L = \{w: |w| mod\ 3 \neq 0\}$

(ii) $L = \{w: n_a(w) mod\ 4 > 1\}$ 1+2+2=5

(c) Draw an *nfa* for $L = (a + b)^* abb$. Then find a *dfa* from it which accepts *L*. 1+4=5

(d) Prove that $L = \{a^n b^n : n \geq 0\}$ is not a regular language. If L_1 and L_2 are regular languages then prove that $L_1 \cup L_2$ is a regular language. 4+1=5

(e) Find a regular expression for

(i) $L = \{w \in \{0,1\}^* : w$ has exactly one pair of consecutive zeroes.

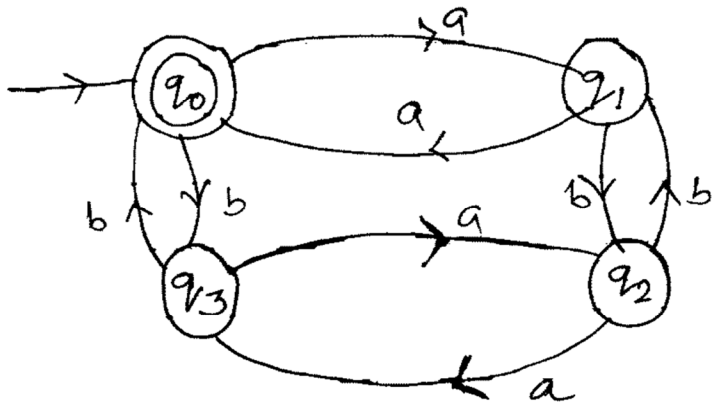
(ii) All string not ending in 01.

Find a context free grammar for $L = \{ww^R : w \in \{a, b\}^*\}$. 2+3=5

(f) Design a *pda* for $L = \{a^n b^n : n > 0\}$. Write difference between *dpda* and *npda*. 4+1=5

3. Answer *any one* question: 10×1=10

(a) State Arden's theorem. Find a regular expression for the *dfa* given below.



Draw *nfa* for Q and $\{\lambda\}$. 2+6+2=10

(b) (i) Design a Turing machine for the following language.

$L = \{a^n b^n c^n : n > 0\}$

(ii) Design a Turing machine that will compute $f(x) = 3x$ where x is a *+ve* integer represented in unary.

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