

U.G. 5th Semester Examination - 2020

COMPUTER SCIENCE

[HONOURS]

Course Code : COM.SC-H-CC-L-511

(Theory of Computation)

Full Marks : 60

Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

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

GROUP-A

1. Answer any **ten** questions: $2 \times 10 = 20$

- a) Define Regular expression.
- b) What are type-1 grammar?
- c) When do you say a grammar is ambiguous?
- d) Construct regular expression for the language that consists of all strings ending with 10. Assume $\Sigma = \{0, 1\}$.
- e) Differentiate between NFA and DFA.
- f) State Arden's theorem.
- g) Why parse tree is useful?

- h) Give example of NULL and UNIT productions.
- i) Describe the following set by Regular Expression $\{1, 11, 111, 1111, \dots\}$.
- j) Define grammar and language.
- k) Why non-terminal symbols are important?
- l) Differentiate between alphabet and string with respect to finite automata.
- m) Write a regular expression for the language over the set $\Sigma = \{a, b\}$ in which total number of a's are divisible by 4.
- n) What language will be generated by $\{S \rightarrow SaS; A \rightarrow b\}$? Justify.

GROUP-B

2. Answer any **four** questions: $5 \times 4 = 20$

- a) Prove that the following language is not regular.

$$L = \{0^{2^n} \mid n \geq 1\}$$

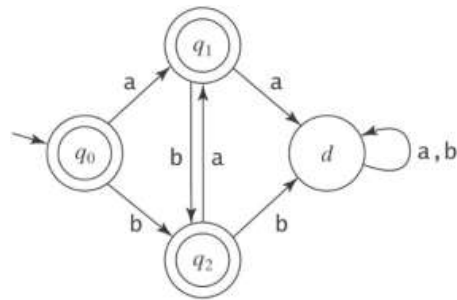
- b) Explain about the closure properties of CFL.
- c) Construct a DFA that accepts all strings over $\{0, 1\}$ except those containing the substring 101.

d) Find the sets represented by the following grammars:

i) $(a + b)^* (aa + ab + bb + ba)^*$

ii) $(ab)^+ + (a + ab^*)^*$

e) Find regular expression for the following transition diagram:



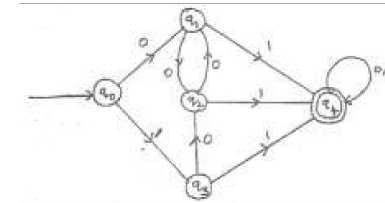
f) Write a note on Recursive Enumerable Languages.

GROUP-C

3. Answer any **two** questions: 10×2=20

a) Prove that if L is a regular language then L^R is also a regular language. Convert the grammar $S \rightarrow 0S1 \mid A$; $A \rightarrow 1A0 \mid S \mid \epsilon$ into PDA that accepts the same language. Check whether the string 1101 belongs to $N(M)$. 4+5+1=10

b) Minimize the finite automaton shown in the figure below and show given and reduced one are equivalent. 10



c) Define Non-deterministic Turing machine. Construct a Turing machine that recognizes the language:

$$L = \{ a^n b^n c^n \mid n > 0 \}. \quad 3+7=10$$

d) i) Derive any two representative strings with minimum length 4 from following context free grammar. $G = (\{S, A, B\}, \{a, b\}, P, S)$

$$S \rightarrow bA \mid aB$$

$$A \rightarrow bAA \mid aS \mid a$$

$$B \rightarrow aBB \mid bS \mid b$$

ii) Draw derivation tree corresponding to string **aabbab** with respect to aforementioned grammar. 4+6=10