Question Paper Code: 90159

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019 Fifth Semester

Computer Science and Engineering CS 8501 – THEORY OF COMPUTATION (Regulations 2017)

Time: Three Hours

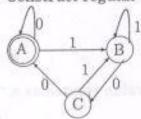
Maximum: 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

- 1. Prove by induction on $n \ge 1$ that $\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}$.
- 2. Formally define deterministic finite automata.
- 3. Construct regular expression corresponding to the state diagram.



- State pumping lemma for regular languages.
- 5. When do you say a CFG is ambiguous?
- 6. Give a formal definition of PDA.
- 7. What are the advantages of having a normal form for a grammar?
- 8. Define the language recognized by the Turing machine.
- 9. When do you say a Turing machine is an algorithm?
- Define NP-Class.



PART - B

(5×13=65 Marks)

 a) Construct DFA equivalent to NFA ({p, q, r, s}, {0, 1}, δ, p, {s}), where δ is defined as

δ	0	1
р	{p, q}	{p}
q	{r}	{r}
r	{s}	-
s	{s}	{s}
		(OR)

- b) Give non-deterministic finite automata accepting the set of strings in (0 + 1)* such that two 0's are separated by a string whose length is 4i, for some i ≥ 0.
- a) i) Prove that any language accepted by a DFA can be represented by a regular expression.
 - ii) Construct a finite automata for the regular expression 10 + (0 + 11)0*1. (6)(OR)
 - b) Prove that the following languages are not regular:
 - i) $\{w \in \{a, b\} * | w = w^R\}$ (7)
 - Set of strings of 0's and 1's, beginning with a 1, whose value treated as a binary number is a prime.
- 13. a) Suppose L = L(G) for some CFG G = (V, T, P, S), then prove that L {∈} is L(G') for a CFG G' with no useless symbols or ∈-productions.

(OR)

- b) Prove that the languages accepted by PDA using empty stack and final states are equivalent.
- 14. a) State and prove Greibach normal form.

(OR)

b) Design a Turing machine to compute proper subtraction.



15. a) Prove that Post Correspondence Problem is undecidable.

(OR)

b) Prove that the universal language L_u is recursively enumerable but not recursive.

PART - C

(1×15=15 Marks)

a) i) Suppose L = N(M) for some PDA M, then prove that L is a CFL.

(7)

ii) Give a CFG for the language N(M) where $M = (\{q_0, q_1\}, \{0, 1\}, \{Z_0, X\}, \delta, q_0, Z_0, \Phi)$ and δ is given by

$$\begin{array}{ll} \delta(q_0,\,1,\,Z_0) = \{(q_0,\,XZ_0)\} & \delta(q_0,\,\in,\,Z_0) = \{(q_0,\,\in)\} \\ \delta(q_0,\,1,\,X) = \{(q_0,\,XX)\} & \delta(q_1,\,1,\,X) = \{(q_1,\,\in)\} \\ \delta(q_0,\,0,\,X) = \{(q_1,\,X)\} & \delta(q_1,\,0,\,Z_0) = \{(q_0,\,Z_0)\} \end{array} \tag{8}$$

(OR)

b) i) Design a Turing machine to compute multiplication of two positive integers. (8)

Design a Turing machine to recognize the language {0ⁿ1ⁿ0ⁿ | n ≥ 1}.