Reg. No. :

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

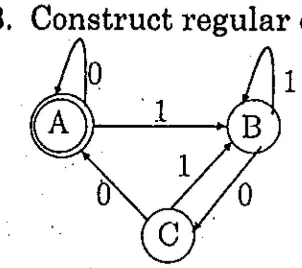
Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Prove by induction on $n \geq 1$ 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.



4. 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 ?

10. Define NP-Class.

PART – B (5×13=65 Marks)

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

δ	0	1
p	{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 $i \geq 0$.

12. a) i) Prove that any language accepted by a DFA can be represented by a regular expression. **(7)**

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) $\{w \in \{a, b\}^* \mid w = w^R\}$ **(7)**

ii) Set of strings of 0's and 1's, beginning with a 1, whose value treated as a binary number is a prime. **(6)**

13. a) Suppose L = L(G) for some CFG G = (V, T, P, S), then prove that $L - \{\epsilon\}$ is L(G′) for a CFG G′ with no useless symbols or ϵ-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)

16. 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

$\delta(q_0, 1, Z_0) = \{(q_0, XZ_0)\}$ $\delta(q_0, \epsilon, Z_0) = \{(q_0, \epsilon)\}$

$\delta(q_0, 1, X) = \{(q_0, XX)\}$ $\delta(q_1, 1, X) = \{(q_1, \epsilon)\}$

$\delta(q_0, 0, X) = \{(q_1, X)\}$ $\delta(q_1, 0, Z_0) = \{(q_0, Z_0)\}$ **(8)**

(OR)

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

ii) Design a Turing machine to recognize the language $\{0^n1^n0^n \mid n \geq 1\}$. **(7)**