Reg. No. :

Question Paper Code : X 10319

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020

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. Define Deterministic Finite Automaton.

2. State any four types of proofs.

3. Write the regular expression for all strings that contain no more than one occurrence of aa.

4. Write a regular expression for even number of a's and even number of b's of a string w = {a, b}*.

5. Write a Context Free Grammar for the language consisting of equal number of a's and b's.

6. Define Deterministic PDA.

7. What are the two normal forms of CFG ? Write their productions format.

8. Define the language recognized by any Turing Machine.

9. What are recursive languages ?

10. Define the classes P and NP problem. Give example problems for both.

PART – B   (5×13 = 65 Marks)

11. a) Prove that for every L recognized by an NFA, there exists an equivalent DFA accepting the same language L.

    (OR)

    b) Prove that for every L recognized by an $\in$-NFA, there exists an equivalent DFA accepting the same language L.

12. a) Prove that the following languages are not regular using pumping lemma.
   i) All unary strings of length prime. **(7)**
   ii) $L = \{uu \mid u \in \{0, 1\}^*\}$. **(6)**

   (OR)

   b) State and Prove any two closure properties of Regular Languages.

13. a) How $\in$-productions are eliminated from a grammar whose language doesn't have empty string ? Remove $\in$-productions from the grammar given below.

   $S \rightarrow a \mid aA \mid B \mid C \quad A \rightarrow aB \mid \in \qquad B \rightarrow Aa \qquad C \rightarrow aCD \qquad D \rightarrow ddd$

   (OR)

   b) Write procedure to find PDA to CFG. Give an example for PDA and its CFG.

14. a) How a CFG for L is converted into CNF accepting the same language ? Convert the following CFG into CFG in CNF.

   $S \rightarrow b A \mid a B \qquad A \rightarrow b A A \mid a S \mid a \qquad B \rightarrow a B B \mid b S \mid b$

   (OR)

   b) Construct a Turing Machine for proper subtraction, which is defined as m – n if m > n and 0 otherwise.

15. a) Prove that Universal language is recursively enumerable but not recursive.

   (OR)

   b) Define PCP and prove that PCP is undecidable.

<div align="center">

PART – C   **(1×15 = 15 Marks)**

</div>

16. a) Construct a Turing Machine for multiplying two non negative integers using subroutine.

   (OR)

   b) How PDA is converted into CFG ? Convert the following PDA into CFG.

   $P = (\{p, q\}, \{0, 1\}, \{Z, X\}, \delta, p, Z, \Phi)$

   $\delta (p, 1, Z) = \{(p, XZ)\}, \delta (p, \in, Z) = \{(p, \in)\} \; \delta (p, 1, X) = \{(p, XX)\},$

   $\delta (q, 1, X) = \{(q, \in)\}, \delta (p, 0, X) = \{(q, X)\}, \delta (q, 0, Z) = \{(p, Z)\}$

   _____