

12. (a) (i) Convert the following CFG into Griebach Normal Form: (10)

$$\begin{aligned} X_1 &\rightarrow X_2 X_3 \\ X_2 &\rightarrow X_3 X_1 | b \\ X_3 &\rightarrow X_1 X_2 | a \end{aligned}$$

(ii) Remove ϵ - production from the following grammar

$$S \rightarrow ASA | aB | b, A \rightarrow B, B \rightarrow b | \epsilon. \quad (3)$$

Or

(b) (i) Write short notes on Chomsky hierarchy of grammar. (5)

(ii) Convert the following grammar in to CNF: (5)

$$\begin{aligned} S &\rightarrow bA | aB \\ A &\rightarrow bAA | aS | a \\ B &\rightarrow aBB | bS | b \end{aligned}$$

(iii) Eliminate left recursion for the following grammar : (3)

$$A \rightarrow A + B | A * B | B | a$$

13. (a) (i) Construct PDA for $L = \{a^n b^n \mid n \geq 0\}$. (6)

(ii) Construct PDA for $L = \{w \in (a|b)^* \mid \text{where 'w' is a PALINDROME}\}$. (7)

Or

(b) (i) Construct PDA for $L = \{0^n 1^m 2^{n+m} \mid \text{where } n, m \geq 1\}$. (6)

(ii) Illustrate the equivalence between PDA and CFL with example. (7)

14. (a) Discuss about the techniques for constructing the various types of Turing Machine. (13)

Or

(b) (i) Construct Turing Machine for $L = \{w \in (a|b)^* \mid \text{where 'w' is a PALINDROME}\}$. (8)

(ii) Construct Turing Machine for $L = \{1^n 2^n 3^n \mid \text{where } n \geq 1\}$. (5)

15. (a) (i) Explain in detail about the various properties of recursive and recursive enumerable languages. (8)

(ii) How does a primitive recursive function help to identify computable function. (5)

Or

(b) Describe in detail about NP-Hard and NP-Complete problems with example. (13)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Construct Turing machine for language over the input alphabet $\Sigma = \{a, b\}$ to shift the input symbol two positions left. (5)

(ii) Analyze and brief the concept of tractable and intractable problems. (10)

Or

(b) (i) State and prove the pumping lemma for CFL. (7)

(ii) Write an algorithm for minimization of DFA. (8)