PART-A

Answer all questions. Each question carries 4 marks

1. Design a Moore machine which outputs \((N \mod 3)\) where \(N\) is the integer value of the binary string given as input.
2. Prove that \(L = \{ 0^n / n \text{ is a perfect square} \}\) is not regular by applying Pumping Lemma for Regular Languages.
3. What is an ambiguous CFG? Illustrate with an example.
4. Show how the language \(L = \{ ww^R / w \in (0+1)^* \}\) can be recognized using the features of a multi-tape Turing Machine.
5. Prove that if a language \(L\) and its complement are both recursively enumerable, then both \(L\) and its complement are recursive.

PART-B

Answer one full question from each module. Each question carries 20 marks

MODULE - I

6. (a) State and prove Myhill-Nerode theorem.
7. (a) Convert the following regular expression to NFA. Then convert the NFA to DFA and minimize the DFA.

\[ (0+10)^* \text{ 100 } (0+1) \]

(b) Show that Regular Languages are closed under intersection operation.

MODULE – II

8. (a) Design a PDA which accepts \(L = \{ ww^R / w \in (0+1)^* \}\)

(b) Write a grammar for the above language \(L\) and convert it into Chomsky Normal Form.

MODULE – III

10. (a) Design a Turing Machine which accepts \(L = \{ a^n b^n / n > 0 \}\)

(b) List the Chomsky classification of languages and grammars.
11. Design a Turing Machine which computes \( m-n \), where \( m \) and \( n \) are integers.

**MODULE – IV**

12. When is a problem said to be undecidable? Explain the Post Correspondence problem.
13. What is “Universal Language”? Is it recursive? Why?