1. Attempt any **four** of the following: \(5 \times 4 = 20\)
   
   (a) Construct a DFA that accepts the strings which contains the alphabets pattern 011 \((\Sigma = \{0, 1\})\).

   (b) For the given state diagram of a NFA. Convert it to an equivalent DFA.

   ![State Diagram]

   (c) Construct the **FA** for the language \(L_n\)

   \[L_n = \{x \in \{0, 1\}^* \mid 1 \times 1 \geq n \text{ and } n^{th} \text{ symbol from the right in } x \text{ is } 1\}\]
(d) Draw a Moore or Mealy machine that generates output 'Yes' when accepts a set of strings from $(0+1)^*$ terminating in last two same symbols.

(e) Construct a DFA from the given NFA with $\epsilon$ moves.

(f) Minimize the DFA corresponding to NFA of question 1(b).

2 Attempt any two: \[10 \times 2 = 20\]

(a) Illustrates the pumping lemma for regular languages. Prove that language \( L = \{ O^{i^2} \mid i \geq 0 \} \) is not regular.

(b) Show that CFG G with following productions

\[ S \to a | Sa | bSS | SSb | SbS \]

is an ambiguous grammar. Can you convert it to an unambiguous grammar?

(c) Convert the given grammar into GNF:

\[ S \to AA | a \]

\[ A \to SS | b \]
3 Attempt any two: 10x2=20

(a) Construct the grammar for the language

\[ L = \{ a^n b^n \mid n \geq 1 \} \]

Identify the type of the grammar obtain.

(b) How to make a PDA deterministic i.e. DPDA.

Construct the DPDA for the language

\[ L = \{ x \in \{a, b\}^* \mid x \text{ has equal number of } a's \text{ and } b's \} \]

(c) Given a context free grammar. How do you determine that the grammar as:

(i) Empty or Non-empty

(ii) Finite or non-finite

(iii) Whether a string \( x \) belongs to the language of the grammar.

4 Attempt any two: 10x2=20

(a) State and prove that Post correspondence problem (PCP) is undecidable.

(b) Let \( f_1 \) and \( f_2 \) are two natural functions which are computed by TMs \( M_1 \) and \( M_2 \) respectively. Construct a TM that computes \( \max (f_1, f_2) \).

(c) Design a turing machine that recognises the following \( L = \{a^n b^n \mid n \geq 1 \} \).

V-1032] 3 [Contd...
Attempt any two parts of the following: 10×2=20

(a) Give the complete hierarchy of grammars with their recognizers as well as the form of production rules.

(b) Write a left linear grammar for the following language. All strings of \((a+b)^*\) such that bbb is a substring in them.

(c) Define context sensitive grammars and Linear Bound Automata (LBA).