(3 Hours) **[Marks: 80]**

N.B.: 1) All Question carry equal Marks.
2) Solve any Four from the six questions.
3) Assume suitable data if necessary.
4) Figures to the right indicate full marks.

Q.1) Answer the following questions:

a) Define the following terms and give an example of each: Automata, String, Language, Alphabet, Grammar **[05]**

a) What are the limitations of Finite Automata? **[05]**

b) What do you mean by ambiguous grammar? **[05]**

c) Design Turing Machine to add two unary numbers. **[05]**

Q.2) a) I) Describe the language of the following regular expressions as concisely as possible. **[05]**

i. 1(0+1)*0
ii. (aa)*(bb)*(b)
iii. (ab+ba)*
iv. (A-Z) (a-z) *(a+e+i+o+u)
v. (a-z) (a-z | 0-9)*

II) Write down the regular expression for the following language. **[05]**

i. L is a language for all strings over {0,1} having an odd number of 1s and any number of 0s.
ii. L is language for all strings over {0,1} having number of 10 or 11

b) What is a compiler? Describe the different phases of a compiler. **[10]**

Q.3) a) Design Push Down Automata (PDA) for the language **[10]**

$L=\{a^n ba^{2n} | n \geq 0\}$

b) What do you mean by Deterministic Finite Automata (DFA)? **[10]**

Design DFA for the language defined over $\sum\{0, 1\}$ and consists of the strings ending with 10.

Q.4) a) Consider the grammar $S \rightarrow 0S0 \mid 1S1 \mid SS \mid \lambda$. **[10]**

Given the string 0101101110, find a leftmost and rightmost derivations with corresponding parse trees.

b) What are Moore and Mealy machines. Design Moore and Mealy machines to convert each occurrence of abb with aba. **[10]**

Q.5) a) Convert the following grammar into Chomsky Normal Form (CNF) **[10]**

$S \rightarrow a \mid aA \mid B$
$A \rightarrow aBB \mid \varepsilon$
$B \rightarrow Aa \mid b$

b) Design a Turing Machine to accept the language **[10]**

$L = \{a^m b^m : m>=1\}$

Q.6) Write short notes on **(Any FOUR):** **[20]**

a. Variants of TM
b. Chomsky hierarchy
c. Power and Limitations of PDA.
d. Halting Problem
e. Regular Expressions