(3 Hours) [Total Marks :80]

N.B. : (1) Question No. **1** is **compulsory**
     (2) Attempt any **three** questions from remaining questions
     (3) **Draw** suitable **diagrams** wherever **necessary**
     (4) **Assume** suitable **data**, if **necessary**.

1. (a) Design a DFA over an alphabet $\Sigma = \{a, b\}$ to recognize a language in which 5
every 'a' is followed by 'b'.

(b) Give formal definition of a Push Down Automata. 5

(c) State and explain the power and limitations of a Turing machine 5

(d) Design a mealy machine to determine the residue mod 3 of a binary number. 5

2. (a) Convert the following NFA to an equivalent DFA 10

State	a	b	ε
$\to q_0$	$\{q_0, q_1\}$	q_1	$\{\}$
q_1	$\{q_2\}$	$\{q_1, q_2\}$	$\{\}$
$*q_2$	$\{q_0\}$	$\{q_2\}$	$\{q_1\}$

(b) State and explain pumping lemma for regular languages. Using pumping lemma 10

prove that the language $L = \{0^n 1^n \mid n \geq 0\}$ is not regular.

3. (a) Design a Turing machine that computes a function $f(m,n) = m + n$ i.e. addition 10
of two integers

(b) Design a Turing machine to accept the language $0^n 1^n 2^n$ 10

4. (a) Draw a state diagram and construct a regular expression corresponding to 10
the following state transition table.

State	0	1
$\to *q_1$	q_1	q_2
q_2	q_3	q_2
q_3	q_1	q_2

(b) State and explain decision properties of regular languages 10

[Turn Over

5. (a) (i) Convert the following CFG to GNF   10
S→AA|a
A→SS | b

(b) Design a PDA corresponding to the grammar   10
S → aSA | ε
A→ bB
B→b

6. Write detailed notes on (any **two**):-   20
(a) Recursive and Recursively Enumerable Languages.
(b) Chomsky Hierarchy
(c) Rice's Theorem
(d) Halting problem

_____