(2) Attempt any **four** questions out of remaining six questions.
(3) Assumptions made should be **clearly stated**.
(4) **Figures** to the **right** indicate **full** marks.
(5) Assume **suitable** data wherever **required** but **justify the same**.

Q. No.1 a) Design the DFA which accepts set of strings such that every string containing 00 as a substring but not 000 as a substring. (08)

b) (i)Prove that $L = \{ 0^i1^j2^i3^j \mid i >= 1 \text{ and } j >= 1 \}$ is not context free. (08)

(ii)Show that $0(0+1)^* + (0+1)^* 00 (0+1)^* = (1^*0)^*(01^*)^*$ (04)

Q.No.2 a) Convert the given grammar to grebaic normal form . (10)

$S \rightarrow aSB \mid aA$

$A \rightarrow Aa \mid Sa \mid a$

b) Design the turing machine to find the value of $\log_2 n$ where n is any binary number and a perfect square. (10)

Q.No.3 a) Design the push down automata to accept language containing all odd length palindromes over $\sum = \{0,1\}$. (10)

b) Prove that it is undecidable whether Context free grammar is ambiguous. (10)

Q.No.4 a) State and prove pumping lemma for regular languages and prove that L_{pr} consisting of all strings of 1's whose length is prime is not regular. (10)

b) Design finite state machine that compares two binary numbers to determine whether they are equal and which of the two are larger. (10)

Q.No.5 a) i) Determine the solution for following instance of Post correspondence problem.(05)

	List A	List B
i	wi	xi
1	01	0
2	110010	0
3	1	1111
4	11	01

ii) Write note on 'Post Machine'. (05)

b) i) Write note on 'Multitape Turing machine'. (05)

ii)Design mealy machine to find 2's complement of binary number. (05)

Q.No.6 a)Construct DFA equivalent to NFA $(\{p,q,r,s\},\{0,1\},\delta_N, p, \{q,s\})$ where δ_N is given In following table. (10)

Q \ Σ	0	1
→ p	{q,r}	{q}
*q	{r}	{q,r}
r	{s}	{p}
*s	-	{p}

b) i) Write note on 'Universal turing machine'. (05)

ii) Prove that if L and M are regular languages then L-M is also regular. (05)

Q.No.7 a) Write regular expressions for following languages. (05)

i) $L = \{ a^n b^m : (n+m) \text{ is even} \}$

ii) $L = \{ w \in (a,b)^* : (\text{number of a's in w}) \bmod 3 = 0 \}$

b) Construct context free grammar equivalent to following PDA . (05)

$\delta(q_0, b, Z_0) = \{(q_0, ZZ_0)\}$

$\delta(q_0, \epsilon, Z_0) = \{(q_0, \epsilon)\}$

$\delta(q_0, b, Z) = \{(q_0, ZZ)\}$

$\delta(q_0, a, Z) = \{(q_1, Z)\}$

$\delta(q_1, b, Z) = \{(q_0, \epsilon)\}$

$\delta(q_1, a, Z_0) = \{(q_0, Z_0)\}$

c) Write short notes on any two. (10)

i) Myhill Nerode Theorm.

ii) Halting Problem.

iii) Grebaic Theorm.