

(3 Hours)

| Total Marks :80

- N.B. :** (1) Question No. 1 is compulsory.
 (2) Attempt any **three** questions out of remaining **five** questions.
 (3) Assumptions made should be clearly stated.
 (4) **Figure** to the **right** indicate **full** marks.
 (5) **Assume** suitable **data** whenever required but justify that.

1. (a) Explain post correspondence problem. 5
 (b) Differentiate between NFA and DFA. 5
 (c) Show that language $L = \{0^i \mid i \text{ is prime number}\}$ is not regular. 5
 (d) Compare recursive and recursively enumerable languages. 5
2. (a) Design the DFA to accept all the binary strings over $\Sigma = \{0,1\}$ that are beginning with 1 and having its decimal value multiple of 5. 10
 (b) Design DPDA to accept language $L = \{x \in \{a, b\}^* \mid N_a(x) > N_b(x)\}$. 10
 $N_a(x) > N_b(x)$ means number of a's are greater than number of b's in string x.
3. (a) Explain variations and equivalence of Turing machine. 10
 (b) State and prove pumping lemma for context free languages. 10
4. (a) Design mealy machine to find out 2's complement of a binary number. 10
 (b) Convert the following NFA to an equivalent DFA 10
- | State | a | b | ϵ |
|-------------------|----------------|----------------|------------|
| $\rightarrow q_0$ | $\{q_0, q_1\}$ | $\{q_1\}$ | $\{\}$ |
| q_1 | $\{q_2\}$ | $\{q_1, q_2\}$ | $\{\}$ |
| $*q_2$ | $\{q_0\}$ | $\{q_2\}$ | $\{q_1\}$ |
5. (a) Consider the following grammar $G = (V, T, P, S)$, $V = \{S, X\}$, $T = \{a, b\}$ and productions P are
 $S \rightarrow aSb \mid aX$
 $X \rightarrow Xa \mid Sa \mid a$
 Convert this grammar in Greibach Normal Form (GNF). 10
 (b) State and prove Rice's theorem. 10
6. (a) Design a Turing machine as an acceptor for the language $\{a^n b^m \mid n, m \geq 0 \text{ and } m \geq n\}$ 10
 (b) Design PDA to check even parentheses over $\Sigma = \{0,1\}$ 10