5405

(2 ½ Hours) [Total Marks: 75

N.B. 1) **All** questions are **compulsory.**
2) **Figures** to the **right** indicate marks.
3) **Draw** suitable **diagrams** and illustrations **wherever necessary**.
4) **Mixing** of sub-questions is **not allowed.**

Q. 1 Attempt All the Questions

A. Choose the correct alternative **(5M)**

i. The grammar G = ({S}, {a, b}, P, S) where P consists of
$S \rightarrow aSbb$, $S \rightarrow aab$
generates the language _____
a) $a^m b^n \mid m > n, m, n \geq 1$ b) $a^n b^{2n} \mid n \geq 1$
c) $a^m b^n \mid m < n, m, n \geq 1$ d) none of these

ii. The regular expression (P+Q)* is equal to
a) (P*+Q*)* b) (P*Q*)$^+$
c) (P*+Q*)$^+$ d) (P*+Q*)

iii. Pumping lemma for context-free languages are used to prove that certain languages are not context-free.
a) True b) False

iv. PDA stands for _____
a) pull down automata b) push direct automata
c) push down automata d) pull direct automata

v. In ___ machine, the output function Z(t) depends only on the present state and is independent of the current input.
a) Moore b) Mealy
c) Both a and b d) None of these

B. Fill in the blanks (Choose correct one from the pool) **(5M)**
(type 2, type 1, one, three, not regular, regular, a^+, a^*, initial, finial)

i. The regular expression aa^* is same as _____.
ii. A finite automaton can have more than one _____ state.
iii. The language L = {$a^p \mid p$ is a prime} is _____.
iv. Regular expression (aaa)* denotes the string x whose length is divisible by____
v. Context sensitive grammar is also known as _____ grammar

C. Explain the following terms in one or two lines **(5M)**

i. Non deterministic finite automaton
ii. Regular expression
iii. Acceptance by PDA
iv. Derivation tree
v. Decidable languages

Q.2 Attempt the following: (Any THREE) **(15M)**

A. What is finite automaton? Briefly explain with suitable example the acceptability of a string by a finite automaton.
B. Compare between Mealy and Moore models.
C. Construct DFA accepting all strings w over $\{a, b\}$ such that the number of a's in w is 3 mod 4.
D. Define Grammar. Also explain what is a language generated by a grammar. Give examples.
E. Compare between deterministic and non-deterministic finite automaton. Give suitable examples.
F. Write a note on operations on Languages.

Q.3 Attempt the following: (Any THREE) **(15M)**

A. Prove that $(a+b)^* = a^*(ba^*)^*$.
B. Explain with suitable example the leftmost derivation and rightmost derivations. Give example.
C. What is meant by ambiguity in context free grammar? Give example to explain the concept.
D. Write a note on Chomsky Normal Form.
E. State and prove pumping lemma for regular sets.
F. Draw the transition diagram for the expressions
   i. a^*+ba^* ii. a^*b+ba^*

Q.4 Attempt the following: (Any THREE) **(15M)**

A. Briefly explain the structure and operation of Push down automata.
B. Write a note on representation of Turing machine.
C. Design a Turing machine to recognize all strings consisting of even number of a's
D. Write a note on model of Linear Bounded Automaton.
E. Write a note on nondeterministic Turing machine.
F. Write a note on properties of recursive languages.

Q.5 Attempt the following: (Any THREE) **(15M)**

A. Briefly explain with example the steps of construction of minimum automaton.
B. Consider the grammar G given by
   $S \rightarrow 0SA_12 \quad S \rightarrow 012 \quad 2A_1 \rightarrow A_12 \quad 1A_1 \rightarrow 11$
   Test whether (a) $00112 \in L(G)$ (b) $001122 \in L(G)$
C. Construct a DFA with reduced states equivalent to the regular expression $10 + (0+11))0^*1$
D. Design a Turing Machine that accepts $\{a^n 1^n \mid n \geq 1\}$
E. Write a note on Universal Turing machines
F. Briefly outline the halting problem of Turing machine.