Q.P. Code: 22217

(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 next state of an automaton at any instant of time is determined by the present _____ and the present _____.
   a) state, output
   b) input, output
   c) state, input
   d) output, start state

ii. A type 1 grammar is also called_____
   a) context dependent
   b) natural grammar
   c) context free
   d) regular grammar

iii. Turing machines can accept _____languages.
   a) type-0
   b) type-1
   c) type-2
   d) type-3

iv. If L is context-sensitive language, then L is _____ by linear bound automata. The converse is _____.
   a) rejected, true
   b) accepted, true
   c) rejected, false
   d) accepted, false

v. The set of all strings of 0's and 1's ending in 00 can be described by the regular expression
   a) (01)*00
   b) 01*00
   c) (0+1)*00
   d) (0+1)*(00)*

B. Fill in the blanks (Choose correct one from the pool) **(5M)**

{*moore, tree, terminal, accepting, non-regular, regular, mealy,* pumping lemma}

i. Final state is also called _____ state.
ii. The set L= $\{0^i1^i \mid i \geq 1\}$ is _____.
iii. An automaton in which the output will depend on both the present input and the present state is called_____ machine.
iv. Context free grammar can be represented using _____.
v. A _____ gives a necessary condition that can be used to show that certain sets are regular.

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

i. What does the language L represented by $(11)^*$ describe?
ii. What are equivalent states?
iii. Find if the following statement is true or false.
"The language L = $\{a^n b^n \mid n \geq 1\}$ is context free language but not regular"
iv. If G is $S \rightarrow aS \mid a$, then what is L(G)?
v. Prove that A + (AB*)B = AB*.

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

A. Define Grammar. Obtain the grammar generating $\{a^i b^n c^n \mid n \geq 1, j \geq 0\}$?
B. Find the deterministic acceptor equivalent to $M=(\{q_0, q_1, q_2\},\{a,b\},\delta, q_0, \{q_2\})$ where δ is given in the table below.

states/Σ	*a*	*b*
→q_0	q_0, q_1	q_2,
q_1	q_0	q_1
q_2		q_0, q_1

C. Briefly explain the steps of construction of minimum automaton.
D. If G = ({S},{0,1},{S→0S1, S→λ},S), find L(G).
E. Write a note on Chomsky Classification of Grammar.
F. Write a note on operations on languages.

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

A. What is derivation tree? Give example.
B. Prove $(a+b)^*=a^*(ba)^*$. Also draw the transition system for $a^*(ba^*)^*$.
C. Write a note on Normal forms for context free grammar.
D. Define Regular Expression. Also prove that
$(1 + 00^*1) + (1 + 00^*1)(0+10^*1)^*(0+10^*1) = 0^*1(0+10^*1)^*$
E. State and prove Arden's theorem.
F. Explain the pumping lemma for CFG.

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

A. Write a note on the model of a linear bound automata.
B. What is the halting problem of a Turing machine? Explain.
C. Write a note on unsolvable problems.
D. Write a note on Variants of Turing Machine.
E. Design a Turing machine that accepts $\{0^n 1^n \mid n \geq 1\}$
F. Write a note on halting problem of Turing Machines.

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

A. Construct a DFA with reduced states equivalent to the regular expression: 10+(0+11)0*1

B. a. Null productions: Production of the form $A \rightarrow \lambda$
   b. Unit productions: Production of the form $A \rightarrow B$
   c. Empty string: String of length zero
   d. Terminal symbols: cannot appear on left side of production, cannot be further derived….
   e. Natural language: language generated by type 0 grammar.

C. What are ambiguous grammar? Give example.

D. Construct a PDA A accepting $L = \{wcw^T \mid w \in \{a,b\}^*\}$ by final state.

E. Define NFA. Give an example.

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