Q.P. Code: 22218

(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.   A transition graph is a finite directed labelled graph in which each
     represents a state and _ indicate the transition of a state and the edges are
     labelled with input/output.
     a) undirected edge, vertex   b) vertex, undirected edge
     c) directed edge, vertex   d) vertex, directed edge

ii. The set $\{\Lambda, 0, 00, 000, …\}$ can also be represented by _____
     a) 0^* b) 0^+
     c) $\Lambda + 0$ d) $0^* + 0^+$

iii. A derivation tree is also called _____
     a) null tree   b) binary tree
     c) acyclic graph   d) parse tree

iv. A_____has a read-only input tape, an input alphabet, a finite state control,
     set of final states, an initial state and a stack called pushdown store.
     a) Moore machine   b) pushdown automata
     c) Mealy machine   d) DFA

v.   The acceptability of a string is decided by the reachability from the_____state
     to some_____state.
     a) initial, current   b) current, final
     c) initial, final   d) next, final

B. **Fill in the blanks (Choose correct one from the pool)**   **(5M)**
     {one, zero, Turing machine, Arden's theorem, Pumping Lemma,
      nondeterministic, derivation, deterministic}

i.   Empty string (Λ) has length_____.
ii. _____provides an ideal theoretical model of a computer.
iii. _____is used to show that certain sets are not regular.
iv. _____involves application of productions.
v.   When the moves of the machine cannot be determined uniquely by the input
     symbol and the present state, such an automaton is called _____
     automaton.

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

i. Define language.

ii. What is the regular expression corresponding to the set of all the strings over {a, b} containing exactly 2a's.

iii. Compare between Moore and Mealy Machines.

iv. What is a sentence?

v. When do we say two regular expressions are equivalent?

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

A. Define an automaton. Explain its various components.

B. Construct a Mealy Machine which is equivalent to the Moore machine given by the following table.

Present state	Next State δ		Output
	a=0	a=1	
→q_0	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

C. Construct a DFA accepting all the string w over {0, 1} such that the number of 1's in w is 3 mod 4.

D. Construct a grammar G accepting the set L of all strings over {a, b} having more a's than b's.

E. Construct a finite automaton equivalent to $(0+1)^*(00+11)(0+1)^*$

F. State and prove Pumping Lemma for regular sets.

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

A. Define pushdown automata. Explain its design.

B. What is context free grammar? Construct a context free grammar G generating all integers.

C. Define ambiguous grammar. Find if the following set of production of a grammar make it ambiguous?

P: S → *if b then* U
S → *if b then* U *else* S
S → *a*
U → *for c do* S
U → a

D. Show that L= { a_p / p is a prime} is not regular.

E. Define Regular grammar. Also Generate the transition diagram for the following regular expressions.

a. $a^*b(a+b)^*$
b. a^*+b

F. What is derivation tree? Give example to explain the concept.

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

A. What is Turing machine? Explain its composition and its operation.
B. Describe the characteristics of a linear bound automata model.
C. What are the ways in which we can represent Turing machines? Explain.
D. Consider the Turing machine with five states with initial state q_1 and final state q_5 and the transition table given below.

Present state	Tape symbol		
	b	0	1
$\rightarrow q_1$	$1Lq_2$	$0Rq_1$	
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3		bRq_4	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Lq_4$
q_5	$0Lq_2$		

Write the computation sequence of the input string 00.

E. Write a note on unsolvable problems.
F. Design a Turing machine that accepts $\{0^n1^n \mid n \geq 1\}$

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

A. Construct a deterministic automaton equivalent to
$M=(\{q_0, q_1\},\{0,1\},\delta,q_0,\{q_0\})$ where δ is defined by its state table give below.

states/Σ	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_1	q_0, q_1

B. Find if the set L= $\{ww \mid w \in \{a,b\}^*$ is not regular.
C. Write a note on multitape Turing machines.
D. Briefly describe Halting problem.
E. Describe the sets represented by the following regular expressions.
   a. $(a+b)^*(aa+bb+ab+ba)^*$
   b. $(aa)^*+(aaa)^*$
   c. $(1+01+001)^*(\Lambda+0+00)$
   d. $a+b(a+b)^*$
   e. ab^*a

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