Date: 12.10.2019   Time : (2 ½ Hours)   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   (5)
   a)   A finite automation can be converted into a _____ by introducing $\Delta = \{0, 1\}$ and defining $\lambda(q) = 1$ if q $\in$ F and $\lambda(q) = 0$ if q does not belong to F

        i) DFA   ii) NDFA   iii) Mealy Machine   iv) Moore Machine

   b)   A phase-structure grammar is $(V_N, \sum, P, S)$, where V_N is a finite nonempty set whose elements are called as _____

        i) terminal   ii) variable   iii) strings   iv) start symbol.

   c)   The set of _____ is the kernel of grammars and language specification.

        i) sentence   ii) naun   iii) symbols   iv) productions.

   d)   A phase-structure grammar is $(V_N, \sum, P, S)$, where $V_N \cap \sum =$_____

        i) terminal   ii) ϕ iii) P   iv) V_N.

   e)   Study the automation given in figure and state true or false for whether the statement 010101010 is not accepted by machine *M*.
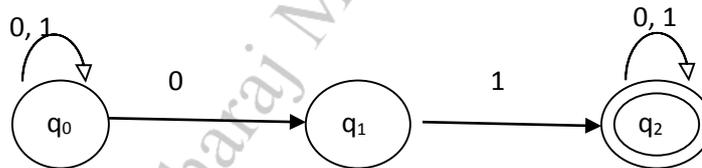
   B)   Fill in the blanks (Choose correct one from the pool)   (5)
        {Turing machine, Arden's theorem, nondeterministic, derivation, deterministic, a+, a*, type 2, type 1, regular expression}
   a)   _____ provides an ideal theoretical model of a computer
   b)   _____ can be used to prove that certain sets are not regular.
   c)   A pushdown automata contains _____ besides a input tape, a input alphabet, a finite state control, a set of final states and an initial state.
   d)   Context free languages (Type-2) can be accepted by _____
   e)   Regular expression (aaa)* denotes the string *x* whose length is divisible by____

   C)   Explain the following terms in one or two lines   (5)
   e)   Nondeterministic finite state machine
   b)   Grammar
   c)   Acceptance by PDA
   d)   Derivation tree
   e)   What is a sentence?

Q.2   **Attempt the following (Any THREE)**   (15)
   a)   If G = ({S}, {0, 1}, {S $\rightarrow$ 0S1, S $\rightarrow \Delta$}, S), find L(G).
   b)   Write a note on classification of Grammar.
   c)   Compare between Mealy and Moore models.

d) What is finite automaton? Briefly explain with suitable example the acceptability of a string by a finite automaton.
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)** (15)
a) Write a note on Chomsky Normal Form.
b) Define Regular grammar. Also Generate the transition diagram for the following regular expressions.
   i) $a*b(a+b)*$ ii) $a*+b$
c) Show that L= { ap / p is a prime} is not regular.
d) Draw the transition diagram for the expressions
   i) $a*+ba*$ ii) $a*b+ba*$
e) Convert the nondeterministic systems to deterministic systems.
f) State and prove Arden's theorem.

Q.4 **Attempt the following (Any THREE)** (15)
a) Write a note on Halting problem of Turing Machine.
b) Explain the structure and operation of pushdown automata.
c) Write a note on model of Linear Bounded Automaton.
d) Write a note on properties of recursive languages.
e) What are the ways in which we can represent Turing machines? Explain.
f) Write a note on unsolvable problems.

Q.5 **Attempt the following (Any THREE)** (15)
a) Construct a deterministic automaton equivalent to M=({q0, q1},{0,1},δ,q0,{q0}) where δ is defined by its state table give below.

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

b) Write a note on multitape Turing machines.
c) Briefly explain with example the steps of construction of minimum automaton.
d) Consider the grammar G given by S $\rightarrow$ 0SA12, S $\rightarrow$ 012, 2A1 $\rightarrow$ A12, 1A1 $\rightarrow$ 11
   Test whether (a) 00112 $\in$ L(G) (b) 001122 $\in$ L(G)
e) Construct a DFA with reduced states equivalent to the regular expression $10+(0+11)0*1$
f) Consider a Mealy machine represented by the figure given below. Construct a Moore machine equivalent to this Mealy machine.