

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 \odot represents a state and \rightarrow 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 $\{\odot, 0, 00, 000, \dots\}$ can also be represented by

- a) 0^* b) 0^+
c) $\odot + 0$ d) $0^* + 0^+$

iii. A derivation tree is also called

- a) null tree b) binary tree
c) acyclic graph d) parse tree

iv. A PDA 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)

{one, zero, Turing machine, Arden's theorem, Pumping Lemma, nondeterministic, derivation, deterministic}

- i. Empty string (ϵ) 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

(5M)

symbol and the present state, such an automaton is called automaton.

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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

*q0

q1

q2

q3

Next State $\begin{matrix} _ \\ _ \end{matrix}$

a=0

a=1

q3

q1

q1 q2

q2 q3

q3 q0

Output

0

1

0

0

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

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: $S \xrightarrow{*} \text{if } b \text{ then } U$

$S \xrightarrow{*} \text{if } b \text{ then } U \text{ else } S$

$S \xrightarrow{*} a$

U * for c do S

U * a

D. Show that $L = \{ ap \mid p \text{ is a prime} \}$ 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

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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

* q_1

q_2

q_3

q_4

q5

Tape symbol

b 0 1

1Lq2 0Rq1

bRq3 0Lq2 1Lq2

bRq4 bRq5

0Rq5 0Rq4 1Lq4

0Lq2

Write the computation sequence of the input string 00.

E. Write a note on unsolvable problems.

F. Design a Turing machine that accepts $\{0^n 1^n \mid n \geq 1\}$

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

A. Construct a deterministic automaton equivalent to

$M = (\{q_0, q_1\}, \{0, 1\}, _ _, q_0, \{q_0\})$ where $_ _$ is defined by its state table give below.

states/	0	1
*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. $(1+01+001)^*(\ominus+0+00)$

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

e. ab^*a

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