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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech (Integrated)

SEM: IV - THEORY EXAMINATION (2024 -2025)

Subject: Theory of Automata and Formal Languages

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

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1. Attempt all parts:-

- 1-a. Identify the element that is not part of the 5-tuple definition of a finite automaton: 1
(CO1, K2)
- (a) Input alphabet
 - (b) Transition function
 - (c) Initial State
 - (d) Output Alphabet
- 1-b. Identify the wrong statement in the given definition? Definition: $(\{q_0, q_1, q_2\}, \{0,1\}, \delta, q_4, \{q_4\})$ 1
(CO1, K2)
- (a) The definition does not satisfy 5 Tuple definition of NFA
 - (b) There are no transition definition
 - (c) Initial and final states can't be same
 - (d) Initial and Final states do not belong to the set of states.
- 1-c. Pumping Lemma is used for proving _____. 1
(CO2, K1)
- (a) A given language is regular
 - (b) A given grammar is regular
 - (c) A given language is not regular
 - (d) All of the mentioned
- 1-d. A regular languages are accepted by the following machine _____. 1
(CO2, K1)

- (a) LBA
 - (b) PDA
 - (c) DFA
 - (d) NPDA
- 1-e. A context free language is called ambiguous if _____. (CO3,K1) 1
- (a) It has 2 or more left derivations for some terminal string $\omega \in L(G)$
 - (b) it has 2 or more right derivations for some terminal string $\omega \in L(G)$
 - (c) Both of the mentioned
 - (d) None of the mentioned
- 1-f. A CFG is closed under _____. (CO3, K1) 1
- (a) Union
 - (b) Intersection
 - (c) Complementation
 - (d) All of the above
- 1-g. The representation of PDA can be done through following ways: (CO4,K1) 1
- (a) Instantaneous Description
 - (b) Transition graph
 - (c) Transition table
 - (d) All of the mentioned
- 1-h. If the PDA does not stop on an accepting state and the stack is not empty, the string is _____. (CO4, K1) 1
- (a) Rejected
 - (b) goes into loop forever
 - (c) Both of above
 - (d) None of the mentioned
- 1-i. Turing machine was invented by _____. (CO5, K1) 1
- (a) Alan Turing
 - (b) Turing man
 - (c) Turing taring
 - (d) None of these
- 1-j. The language recognized by Turing machine is _____. (CO5, K1) 1
- (a) Context free language
 - (b) Context sensitive language
 - (c) Recursively enumerable language
 - (d) Regular language

2. Attempt all parts:-

- 2.a. Describe some points of difference between Moore and Mealy machine. (CO1, K2) 2

- 2.b. State Arden's Theorem. (CO2, K1) 2
- 2.c. Define Parse tree with an example . (CO3, K1) 2
- 2.d. Describe rules that are used to convert a CFG into PDA. (CO4, K2) 2
- 2.e. Explain Universal Turing Machine in brief. (CO5, K2) 2

SECTION-B

3. Answer any five of the following:-

- 3-a. Explain the procedure to convert a moore machine into its corresponding mealy machine. (CO1, K2) 6
- 3-b. Convert the following NFAs into DFAs: (CO1, K3) 6

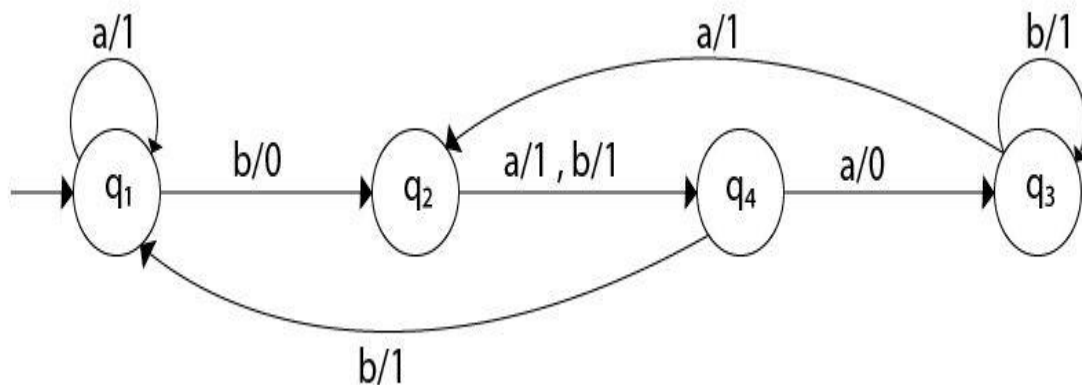


- 3-c. Convert the following regular expressions into Finite Automata: $a^*(a+b)^*(ab^*a)^*$. (CO2, K3) 6
- 3-d. Construct a Finite Automata for $1^*(1+0)^*(001^*(0^*1^*)1)$. (CO2, K3) 6
- 3.e. Construct Context Free Grammar (CFG) for the strings of balanced parenthesis. (CO3, K3) 6
- 3.f. Design a PDA for the language $L = \{ w c w^r \mid w \in \{ a, b \}^* \}$. (CO4, K3) 6
- 3.g. Explain the Halting Problem and analyze why it is considered undecidable. (CO5, K3) 6

SECTION-C

4. Answer any one of the following:-

- 4-a. Explain Chomsky Classification of Grammars in detail. (CO1, K2) 10
- 4-b. Convert the following Mealy machine into equivalent Moore machine. (CO1, K3) 10



5. Answer any one of the following:-

- 5-a. Define Regular grammar and Prove $(1+00^*1)+(1+00^*1)(0+10^*1)^*(0+10^*1)^* = 0^*1(0+10^*1)^*$ (CO2,K3) 10
- 5-b. Construct the finite automaton equivalent to the regular expressions (CO2, 10
K3)
i) $(0+1)^*(00+11)(0+1)^*$
ii) $(ab^*(a+b)c(a+b))^* ab^*a(a+b)^*$
6. Answer any one of the following:-
- 6-a. Discuss the Chomsky Normal Form . Change the following grammar into Chomsky Normal Form (CNF). (CO3, K3) 10
 $S \rightarrow abSb / a / aAb$
 $A \rightarrow bS / aAAb$
- 6-b. Consider the grammar (CO3, K3) 10
 $S \rightarrow aB / bA$
 $A \rightarrow aS / bAA / a$
 $B \rightarrow bS / aBB / b$
 For the string aaabbabbba , Design
 (i) The left most derivation and left most derivation tree
 (ii) The right most derivation and right most derivation tree
7. Answer any one of the following:-
- 7-a. Describe the Definition of Pushdown Automata. Is PDA more powerful than Finite Automata? if Yes than why? also Design PDA for Language $L = \{ a^{m+n}b^m c^n / m, n > 1 \}$ (CO4, K3) 10
- 7-b. Compare Finite Automata (FA) and Pushdown Automata (PDA). Construct a PDA accepting all palindromes over $\{a, b\}$. (CO4, K4) 10
8. Answer any one of the following:-
- 8-a. Design a Turing machine to compute the following (CO5, K3) 10
 a) Division of Two integers
 b) 2's complement of a given binary number
- 8-b. Explain the following terms: (CO5, K2) 10
 (i) Post's Correspondence Problem
 (ii) Recursively Enumerable Language