Printed Page:- **Subject Code:- BCSE0404/BCSEH0404**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (20..... - 20.....)

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 20

1. Attempt all parts:-

1-a. In given diagram, FSM represents: (CO1, K1) 1

(a) Mealy machine
(b) Moore Machine
(c) Kleen machine
(d) All of these

1-b. In a Deterministic Finite Automaton (DFA), for each state and input symbol, there is: (CO1,K1) 1

(a) No transition
(b) At most one transition
(c) Exactly one transition
(d) More than one transition

1-c. Identify the type of automaton that recognizes regular languages. (CO2, K1) 1

(a) Finite Automaton
(b) Pushdown Automaton
(c) Turing Machine
(d) Linear Bounded Automaton

1-d. Construct a regular expression for the language consisting of all strings over {0,1} 1

that start with 1. (CO2,K1)

(a) 1(0+1)*

(b) (0+1)*1

(c) 0*1*

(d) None of these

1-e. Select the root of the parse tree: (CO3,K1) 1

(a) Production P

(b) Terminal T

(c) Variable V

(d) Starting Variable S

1-f. The Grammar can be defined as: G=(V, Σ, P, S) In the given definition, what does P represents? (CO3,K1) 1

(a) Accepting State

(b) Sensitive Grammar

(c) Starting Variable

(d) Production Rules

1-g. Limitation of PDA can overcome by: (CO4,K1) 1

(a) Mealy machine

(b) Moore machine

(c) Turing machine

(d) FA

1-h. Analyze the language L = $\{a^n b^n c^n \; n \geq 1\}$. Can a single-stack PDA accept this language? (CO4, K1) 1

(a) Yes, by using both acceptance by final state and empty stack

(b) Yes, with non-deterministic transitions

(c) No, because it requires comparing three symbols with one stack

(d) No, because it requires two final states

1-i. A Turing Machine (TM) is: (CO5,K1) 1

(a) A finite state machine with memory

(b) A computational model capable of simulating any algorithm

(c) A machine with limited processing power

(d) A simple calculator for basic arithmetic operations

1-j. _____is a fundamental concept in the Turing machine model. (CO5,K1) 1

(a) Quantum entanglement

(b) Infinite tape

(c) Neural networks

(d) Bayesian inference

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2. Attempt all parts:-

2.a.	Differentiate between Kleene Closure ($\sum^*$) and Positive Closure ($\sum^+$). (CO1, K2)	2
2.b.	Define regular expression for the language containing all the words over {a,b,c } ending in *a*. (CO2, K2)	2
2.c.	Define ambiguous grammar? Give an example. (CO3,K2)	2
2.d.	Give reason why PDA cannot accept the language $\{a^n b^n c^n d^n , n \geq 0.\}$ (CO4, K2)	2
2.e.	Define Church's Turing Thesis. (CO5, K2)	2

SECTION-B 30

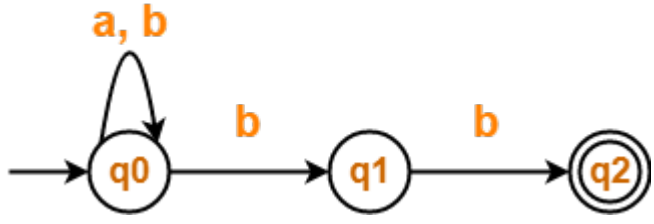
3. Answer any five of the following:-

3-a.	Explain the mathematical model of a finite automaton with an example. (CO1,K2)	6
3-b.	Construct a Finite automata (DFA) which accepts all binary numbers whose decimal equivalent is divisible by 4 over $\Sigma = \{0, 1\}$. (CO1, K4)	6
3-c.	State and prove Arden's Theorem. (CO2, K4)	6
3-d.	Define Regular Grammar. Also, convert given regular grammar to finite automata. $S \rightarrow aS, S \rightarrow bS, S \rightarrow bA, A \rightarrow bB, B \rightarrow aC, C \rightarrow \varepsilon$. (CO2, K4)	6
3.e.	Given the following CFG: (CO3, K4) $S \rightarrow aA \mid bB \mid C$ $A \rightarrow a \mid aA \mid B$ $B \rightarrow b \mid Bb \mid C$ $C \rightarrow cC \mid c$ a) Identify and remove the useless symbols from the grammar. b) Eliminate unit productions from the resulting grammar.	6
3.f.	Describe a two-stack PDA and explain its working with a suitable example. (CO4, K2)	6
3.g.	Explain Post Correspondence Problem (PCP) (CO5, K2)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	i) Convert the following Non-Deterministic Finite Automata (NFA) to Deterministic Finite Automata (DFA)	10



ii)Design a DFA over the alphabet {0,1} that accepts all strings ending with "0001". (CO1, K4)

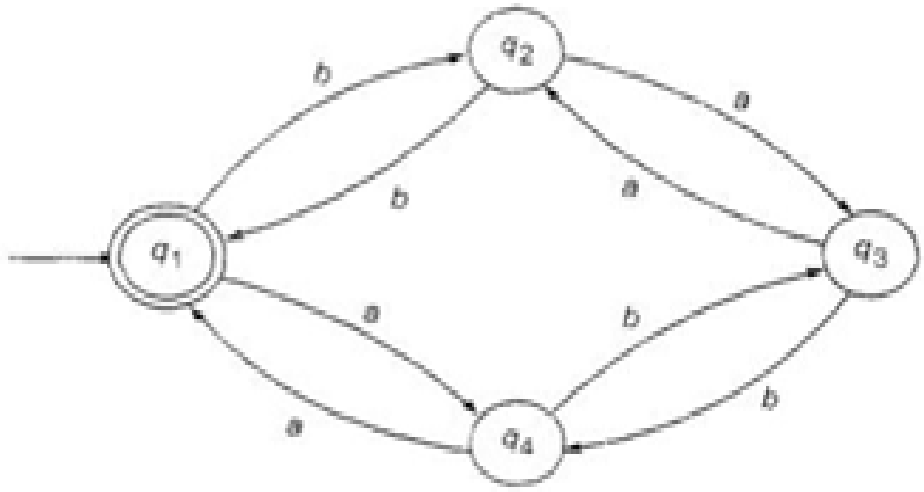
4-b.	Explain the mathematical model of Mealy machine and Moore machine.	10

(CO1, K2)

5. Answer any one of the following:-

5-a. Write short note on: 10
(CO2, K2)
(a)Closure properties of Regular Language
(b) Decision Properties of regular Language

5-b. Find the solution of DFA using Arden's theorem. (CO2, K4) 10



6. Answer any one of the following:-

6-a. Compare Chomsky normal form(CNF) and Greibach Normal form (GNF). 10
Convert the given CFG into CNF: (CO3,K4)
S→ aSa | bSb | a | b

6-b. Consider the grammar G, whose productions are: (CO3,K4) 10
S → aB | bA, A → a | aS | bAA, B → b | bS | aBB
.Find a) Leftmost b) rightmost derivation for string for the string baaabbabba and construct derivation tree also.

7. Answer any one of the following:-

7-a. Explain Pushdown Automata and analyze how its power compares to Finite Automata. Also, design a PDA for L = { $a^{m+n}b^mc^n$ m, n > 1 }. 10
(CO4, K4)

7-b. Explain Pushdown Automata. Also, construct a PDA that accepts all strings containing an equal number of 0's and 1's. (CO4, K4) 10

8. Answer any one of the following:-

8-a. Write short notes on: (CO5, K2) 10
i) Universal Turing Machine
ii) Variants of Turing machine

8-b. Explain the Turing machine. Construct the Turing machine for the language L= $\{a^nb^nc^n , n>=1\}$. (CO5, K4) 10