Printed Page:- 05 **Subject Code**:- **AMICSE0404**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech (Integrated)

SEM: IV - THEORY EXAMINATION (2023 -2024)

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. Mealy and Moore machine can be categorized as: (CO1) 1

(a) Inducers

(b) Transducers

(c) Turing Machines

(d) Linearly Bounder Automata

1-b. A Language for which no DFA exist is a_____ (CO1) 1

(a) Regular Language

(b) Non-Regular Language

(c) May be Regular

(d) Cannot be said

1-c. A language is regular if and only if (CO2) 1

(a) accepted by DFA

(b) accepted by PDA

(c) accepted by LBA

(d) accepted by Turing machine

1-d. Which of the following is not a regular expression? (CO2) 1

(a) [(a+b)*-(aa+bb)]*

(b) [(0+1)-(0b+a1)*(a+b)]*

(c) (01+11+10)*

(d) (1+2+0)*(1+2)*

1-e. A grammar that produce more than one parse tree for same sentence is called : (CO3) 1

(a) Ambiguous

(b) Unambiguous

(c) Regular

(d) None

1-f. Type-3 grammars generate _____languages. (CO3) 1

(a) Regular

(b) context-free

(c) context-sensitive

(d) All of above

1-g. Which of the following language over {a , b, c } is accepted by deterministic push down automata ? (CO4) 1

(a) **{ w c w^R / w ∈ (a , b)* }**

(b) **{ ww^R / w** ∈ { a, b, c}* }

(c) **{ $a^n b^n c^n$ / n >=0 }**

(d) **{ w / w is palindrome {a , b , c}**

1-h. A language L is said to be a deterministic context free language if and only if (CO4) 1

(a) There exists a dpda M such that L=L(M)

(b) There exists a dpda M such that L≠L(M)

(c) Both A and B

(d) None of the above

1-i. Turing Machine consist of : (CO5) 1

(a) Input Tape

(b) Blank Symbol

(c) Tape head

(d) All of these

1-j. If Turing machine accepts all the words of the language L and rejects or loops for other words, which are not in L, then L is said to be ___ (CO5) 1

(a) recursively enumerable

(b) recursive

(c) context free language (cfl)

(d) none of them

2. Attempt all parts:-

2.a. Define relationship between grammar and language in theory of computation. (CO1) 2

2.b. Write regular expression for language over ∑ = {0, 1} where every string contains exactly three 0's (CO2) 2

2.c. Explain the concept of ambiguity with example. (CO3) 2

2.d. Define 2 Stack PDA . (CO4) 2

2.e. Explain Church's Thesis. (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Design DFA for the following Language. (CO1) 6

a) L = {w : Na(w) <=3, w ∈ (a ,b)*}

b) L= { w : IwI =2, w ∈ (a ,b)*}

3-b. Draw a DFA to accept string of 0's and 1's ending with the string 011. (CO1) 6

3-c. State and prove pumping lemma theorem of the regular sets. (CO2) 6

3-d. Design a Right Linear Grammar for a language L= all strings containing even number of a's over an alphabet (a,b). (CO2) 6

3.e. Simplify the following context free grammar. (Here, Λ stands for epsilon (ϵ)). (CO3) 6

S → TUV

T → aTb / Λ

U → cU / Λ

V → aVcW

W → bW / Λ

3.f. Explain string acceptance by PDA using final state and using empty stack. (CO4) 6

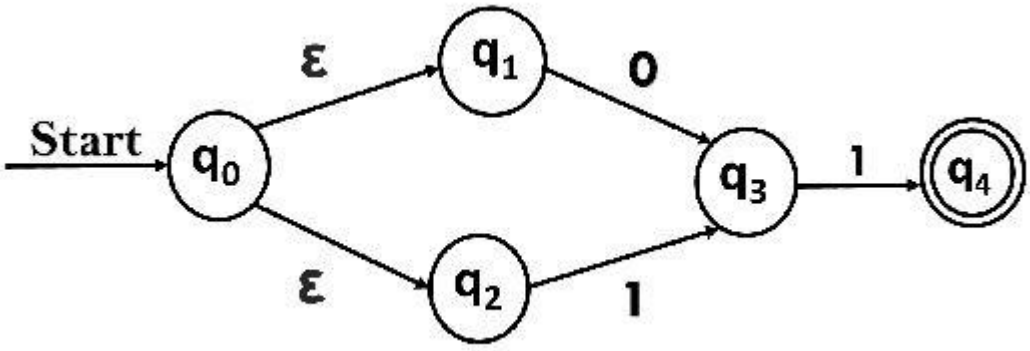
3.g. Design a Turing machine which recognizes the language L = { $a^n b^n$ | n >=1 6

}. (CO5)

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. Convert epsilon-NFA to NFA without epsilon . (CO1) 10



4-b. Design DFA for Following Languages: (CO1) 10

(a) Design a FA with ∑ = {0, 1} which accepts those string which starts with 0 and ends in 1.

(b) Draw a DFA that accepts a language L over input alphabets ∑ = {a, b} such that L is the set of all strings that does not contain 'ba' as substring.

(c) Design a FA with ∑ = {0, 1} that accepts those string where number of 1's are even.

(d) Design a FA with ∑ = {0, 1} accepts the only input 101.

5. Answer any <u>one</u> of the following:-

5-a. Explain Closure properties of Regular Expression. (CO2) 10

Prove that the Union, Intersection and compliment of regular language is regular

5-b. Construct a regular grammar G generating the regular set represented by (CO2) 10

i) P=a*b(a+b)*

ii) P= ab*(a+b)

6. Answer any <u>one</u> of the following:-

6-a. Discuss the Chomsky Normal Form . Change the following grammar into Chomsky Normal Form (CNF). (CO3) 10

S ---> abSb / a / aAb

A ----> bS / aAAb

6-b. Design Left Most Derivation and Right Most Derivation and Parse Tree for the given grammar (CO3)

E → E+T/T

T → T*F/F

F → (E)/id

Generate the String id+id * id

7. Answer any <u>one</u> of the following:-

7-a. Compare Deterministic PDA with Non-deterministic PDA. Construct the Pushdown Automata for the following language : (CO4) 10

$L = \{ a^n b^{n+1} \ / \ n = 1,2,3 .....\}$

7-b. Compare Deterministic and Non deterministic PDA. Is it true that non deterministic PDA is more powerful than deterministic PDA? Justify your answer. (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. Explain any two of the following : (CO5) 10

(i) Universal Turing Machine

(ii) Recursively Enumerable Language

(iii) Halting Problem

(iv) Post's Correspondence Problem

8-b. Design a Turing machine which recognizes the language consisting of all strings of 0s whose length is a power of 2. i.e., it decides the language $L = \{0^n 2^n \mid n >= 0\}$. (CO5) 10