Printed Page:- 04 **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. A regular language over an alphabet ∑ is one that cannot be obtained from the basic languages using the operation. (CO1) 1

(a) Union

(b) Concatenation

(c) Kleene*

(d) All of the mentioned

1-b. Under which of the following operation, NFA is not closed? (CO1) 1

(a) Negation

(b) Kleene

(c) Concatenation

(d) None of the mentioned

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. Find the regular expression for language L={set of strings of a's and b's end with a}. (CO2) 1

(a) (a+b) * a

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(b) a(a+b)*b

(c) (a*b*)*a

(d) Both option A and C

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. Push down automata accepts _____ languages. (CO3) 1

(a) Type 3

(b) Type 2

(c) Type 1

(d) Type 0

1-g. Context Sensitive Grammar can be recognized by : (CO4) 1

(a) Deterministic Pushdown Automata

(b) Non- Deterministic Pushdown Automata

(c) Finite State Machine

(d) Linear Bound Automata

1-h. A non deterministic pushdown acceptor is defined by _____ tuples (CO4) 1

(a) 5

(b) 6

(c) 8

(d) 7

1-i. Which of the following problems is undecidable? (CO5) 1

(a) Finiteness problem for FSAs

(b) Membership problem for CFGs

(c) Equivalence problem for FSAs

(d) Ambiguity problem for CFGs

1-j. The language recognized by Turing machine is: (CO5) 1

(a) Context free language

(b) Context sensitive language

(c) Recursively enumerable language

(d) Regular language

2. Attempt all parts:-

2.a. Construct a DFA for language over $\sum = \{a, b\}$ where every strings ends with ab. (CO1) 2

2.b. Write application of pumping lemma for regular languages. (CO2) 2

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2.c.	Discuss the procedure to eliminate useless symbol from a Context Free Grammar. (CO3)	2
2.d.	Differentiate between DPDA and NPDA. (CO4)	2
2.e.	Explain Universal Turing Machine. (CO5)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	Design Finite Automata which accepts the language L = {w ε (0,1)* / second symbol of w is 0 and fourth input is 1}. (CO1)	6
3-b.	Design a DFA to accept string of 0's & 1's when interpreted as binary numbers would be multiple of 3. (CO1)	6
3-c.	Explain Left Linear Grammar and Right Linear Grammar with the help of suitable examples. (CO2)	6
3-d.	Draw NFA with epsilon transition for the R.E. a*(a+b)*(ab*a)*. (CO2)	6
3.e.	Write the procedure and Eliminate left recursion from the following Grammar (CO3) E→E+T/T T→T*F/F F→(E)/id	6
3.f.	Design a PDA for the language L = { w c w^r w ∈ { a, b }* } . (CO4)	6
3.g.	Define Recursive language and Recursively enumerable languages? (CO5)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Define moore and melay machine Construct a Moore machine that determines whether an input string contains an even or odd number of 1's. The machine should give 1 as output if an even number of 1's are in the string and 0 otherwise. (CO1)	10
4-b.	Explain Chomsky Classification of Grammars in detail. (CO1)	10

5. Answer any one of the following:-

5-a.	Write regular expression for the following Languages over ∑ = {x, y} that contains: (CO2) (i) Strings where number of x's are even (ii) Strings with length at least 5. (iii) Strings where 4^{th} symbol from the end is y. (iv) Strings where there are no two consecutive x's. (v) Strings with length at most two.	10
5-b.	Discuss the tuple with Production rule of Regular Grammar. What are the rules for constructing Finite Automata from Regular Grammar. Construct a Finite Automata to accept the language generated by the following grammar. (CO2) S ---> 01A A ---> 10B	10

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B ---> 0A / 11

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

6-a. Write CFG for language L = {0^n 1^m 2 ^p} where n <= m or m <= p. (CO3) 10

6-b. Consider the grammar (CO3) 10

S ---> aB / bA
A ----> aS / bAA / a
B ---> bS / aBB / b

For the string aaabbabbba , find
(i) The left most derivation and left most derivation tree
(ii) The right most derivation and right most derivation tree

7. Answer any <u>one</u> 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 = { $a^{m+n}b^mc^n$ / m, n > 1} (CO4) 10

7-b. Construct a deterministic pda accepting L={w ∈ {a,b}* the number of a's in w equal number of b's in w} by final state. (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^n2^n | n >=0}. (CO5) 10

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