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Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2023 - 2024)

Subject: Formal Language & Automata Theory

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 DFA the transition function δ is given by: (CO1) 1

(a) $\delta: Q \times \Sigma \rightarrow 2Q$

(b) $\delta: Q \times q0 \rightarrow Q$

(c) $\delta: Q \times \Sigma \rightarrow Q$

(d) $\delta: Q \times q0 \rightarrow F$

1-b. Finite Automata has ____ tuple (CO1) 1

(a) 5

(b) 4

(c) 3

(d) 6

1-c. Which of the following does not belong to CFG ? (CO2) 1

(a) Terminal Symbol

(b) End Symbol

(c) Start symbol

(d) Non Terminal

1-d. Grammar is defined by number of _____tuples. (CO2) 1

(a) 4

(b) 5

(c) 3

(d) 2

1-e. Turing machine is more powerful than FSM because _____ . (CO3) 1

(a) Tape movement is confined to one direction only

(b) It has no finite state control

(c) It has the capability to remember arbitrary long sequence of input symbols

(d) None of these

1-f. According to Church's thesis : (CO3) 1

(a) Anything done by the FSM can be easily done by Turing Machine

(b) Anything done by the digital computer can be easily done by PDA

(c) Any real-world computation can be translated into an equivalent computation involving a Turing Machine.

(d) None of these

1-g. A language 'L' said to be recursive if (CO4) 1

(a) There exists a Turing machine which will accept all the strings in 'L' and reject all Strings not in 'L'.

(b) There exists a Turing machine which will reject all the strings in 'L' and accept all strings not in 'L

(c) The Turing machine will halt every time and give an answer (accepted or rejected) for each and every input string.

(d) A language 'L' is not undecidable if it is recursive enumerable language.

1-h. A language L= {an bn cn n>=1} is (CO4) 1

(a) Recursive Enumerable Language

(b) Recursive Language

(c) Both a and b

(d) CFL

1-i. The problem 3-SAT and 2-SAT are (CO5) 1

(a) both in P

(b) both NP complete

(c) NP-complete and in P respectively

(d) undecidable and NP-complete respectively

1-j. Travelling Salesman Problem belongs to (CO5) 1

(a) NP-Complete Problem

(b) NP-Hard Problem

(c) NP-soft Problem

(d) None of them

2. Attempt all parts:-

2.a. Define Arden's Theorem and its implementation with an example. (CO1) 2

2.b.	Construct a CFG for the language of palindrome string over {a, b}. (CO2)	2
2.c.	Define instantaneous description of a Turing Machine. (CO3)	2
2.d.	Define post correspondence problem. (CO4)	2
2.e.	Write short note on NP-complete problem. (CO5)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	State Pumping Lemma and prove that L={a^n b^{2n}n >=0} is not regular. (CO1)	6
3-b.	Give the regular expression for the set of all strings ending in 00. (CO1)	6
3-c.	Define ambiguity.? Show that the grammar with following production is ambiguous. A → AA I (A) (C02)	6
3-d.	Remove all unit-productions, all useless productions, and all λ-productions from the grammar (CO2) $S \rightarrow aA \mid aBB,$ $A \rightarrow aaA \mid \lambda,$ $B \rightarrow bB \mid bbC,$ $C \rightarrow B.$	6
3.e.	Write short note on Church Turing Thesis. (CO3)	6
3.f.	Explain the Decidable Problems with examples. (CO4)	6
3.g.	How to prove given problem is NP-complete or not? (CO5)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Find NFA's that accept the following languages. (CO1) (a) L = (aa* + aba*b*). (b) L = (ab (a + ab)* (a + aa)).	10
4-b.	Discuss Chomsky's Hierarchy of formal languages.Explain briefly about DFA and NFA? (CO1)	10

5. Answer any one of the following:-

5-a.	What is meant by ambiguous grammar? Test whether the grammar is ambiguous or not. (CO2) S →A B A→ aAb ab B B→abB ϵ	10
5-b.	Given a reduce grammar S→AB, A→a , B→C b ,C→D, D→E, E→a. find whether the grammar is in CNF form if not than convert it (CO2)	10

6. Answer any one of the following:-

6-a.	Show that the union of two recursively enumerable languages is recursively	10

enumerable and union of two recursive languages is recursive. (CO3)

6-b. If L and L' are both recursively enumerable. Show that L and L' are recursive. (CO3) 10

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

7-a. Prove that the problem of determining whether or not a TM over {0,1} will ever print the symbol 1 , with a given tape configuration , is unsolvable (CO4) 10

7-b. Describe the Universal Turing machine. Build a Turing Machine that accepts the language $L = \{ a^n b^{n+1} \}$. (CO4) 10

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

8-a. Discuss the general plan for analyzing Time efficiency of recursive algorithm. (CO5) 10

8-b. Differentiate Time Efficiency and Space Efficiency. (CO5) 10