Printed Page:- Subject Code:- ACSBS0306

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2022 - 2023)

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) δ: $Q \times \Sigma \rightarrow 2Q$

(b) δ: $Q \times q0 \rightarrow Q$

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

(d) δ: $Q \times q0 \rightarrow F$

1-b. If $\Sigma = \{a\}$ then $\Sigma^* - \Sigma+$ is: (CO1) 1

(a) {aa}

(b) {a}

(c) {a,aa,aaa,___ _ _}

(d) {Null}

1-c. A grammar that produces more than one parse tree for the same sentence is called _____ . (CO2) 1

(a) Contiguous

(b) Ambiguous

(c) Unambiguous

(d) Regular

1-d. Pumping lemma is generally used for proving that : (CO2) 1

(a) Given grammar is regular

(b) Given grammar is not regular

(c) Whether two given regular expressions are equivalent or not

(d) None of these

1-e. 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-f. Turing machine was invented in _____ by Alan Turing.(CO3) 1

(a) 1938

(b) 1936

(c) 1836

(d) 1838

1-g. Halting problem is an example for__(CO4) 1

(a) Decidable problem

(b) undecidable problem

(c) complete problem

(d) traceable problem

1-h. Undecidable problems are unsolvable. This statement is _____ . (CO4) 1

(a) TRUE

(b) FALSE

(c) Canot say

(d) sometimes true

1-i. Which of the following is true about NP-Complete and NP-Hard problems.(CO5) 1

(a) If we want to prove that a problem X is NP-Hard, we take a known NP-Hard problem Y and reduce Y to X

(b) The first problem that was proved as NP-complete was the circuit satisfiability problem.

(c) NP-complete is a subset of NP Hard

(d) All of the above

1-j. Cook's theorem, states that the Boolean (CO5) 1

(a) satisfiability problem is NP-complete

(b) satisfiability problem is not NP-complete

(c) NP hard

(d) None

2. Attempt all parts:-

2.a. Differentiate between non deterministic finite automata and deterministic finite automata. (CO1) 2

2.b. Define instantaneous description of a PDA. (CO2) 2

2.c. Define instantaneous description of a Turing Machine. (CO3) 2

2.d. What are UTMs or Universal Turing machines? (CO4) 2

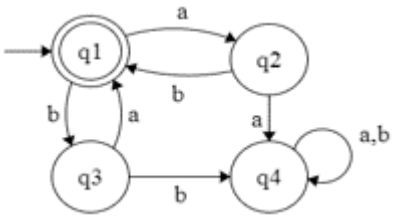
2.e. Define NP-Hard Problem. (CO5) 2

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. Derive the regular expression corresponding to the Finite automata. (CO1) 6



3-c. Find Context free Grammar for the following language (with n>= 0, m>=0) (CO2) 6

$L=\{a^n b^m : n \neq m\}$

3-d. Construct the PDA for the $L= \{a^n c b^{2n} n \geq 1\}$ Over the alphabet $\sum = \{a, b, c\}$ (CO2) 6

3.e. Design a TM 'M' to recognize the Language $\{1^n 2^n 3^n , n \geq 1\}$. (CO3) 6

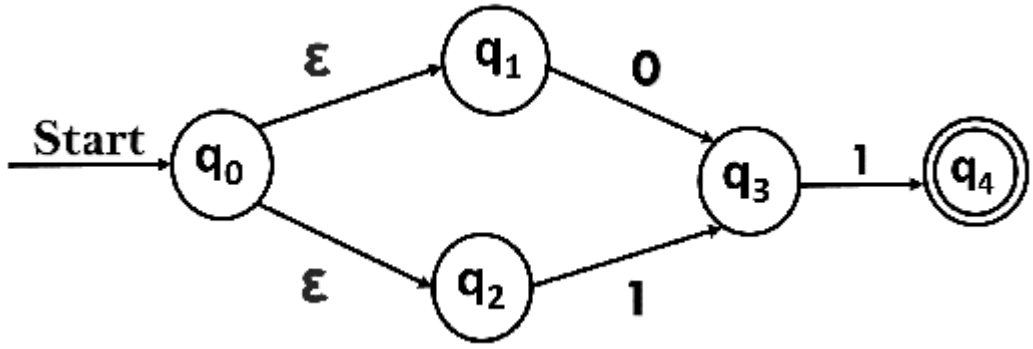
3.f. State and prove the Rice theorem. (CO4) 6

3.g. If P = NP, all of these problems have efficient solutions. Justify the statement. (CO5) 6

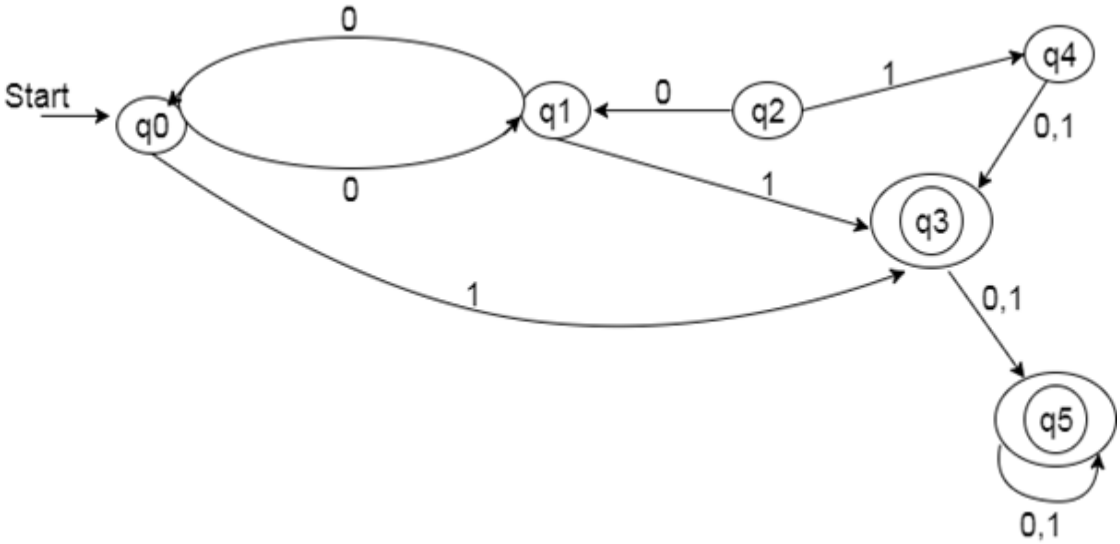
SECTION C 50

4. Answer any one of the following:-

4-a. Convert the given NFA into its equivalent DFA. (CO1) 10



4-b. Minimize the Following automata: (CO1) 10



5. Answer any one of the following:-

5-a. Explain about derivation and parse trees. (CO2) 10

(i) Construct the string 0100110 from the Leftmost and Rightmost derivation.

S→0S/1AA

A→0/1A/0B

B→1/0BB

(ii) Find the parse tree for generating the string 11001010 from the given grammar.

S→1B/0A

A→1/1S/0AA

B→0/0S/1BB

5-b. Compare Deterministic and Non deterministic PDA. Is it true that non deterministic PDA is more powerful than that of deterministic PDA? Justify your answer. (CO2) 10

6. Answer any one of the following:-

6-a. Show that the union of two recursively enumerable languages is recursively enumerable and union of two recursive languages is recursive. (CO3) 10

6-b. Define Post's Correspondence Problem. Show that the PCP with two lists x = (b, bab ^{3}, ba) and y = (b ^{3,} ba, a) has a solution. Give the solution sequence. (CO3) 10

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

7-a. How turing machine can be converted into Universal turing machines? (CO4) 10

7-b. What do you understand by undecidable problem ? State the Halting Problem and prove that Halting problem is undecidable. (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. Explain the relationship between class P, NP, NP-complete and NP hard problem with example of each class. (CO5) 10