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 (2022-2023 **)**

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. Can a DFA simulate NFA? (CO1) 1

(a) NO

(b) YES

(c) Sometimes

(d) Depends on NFA

1-b. Finite State Machine can recognize ..... (CO1) 1

(a) Any Grammar

(b) Only CFG

(c) Any unambiguous Grammar

(d) Only Regular Grammar

1-c. Consider the following regular expression : (CO2) 1

R = (ab + abb)* bbab

which of the following is not in R.

(a) abababb

(b) ababbabbbab

(c) ababbbbab

(d) abbabbbab

1-d. The regular expression (a + b)* denotes all strings ..... (CO2) 1

(a) with zero or more instances of a and b both simultaneously

(b) with one or more instances of a and b

(c) any combination of a's and b's including null string.

(d) None of these

1-e. Every CFG can be transfered into equivalent : (CO3) 1

(a) Greiback Normal Form

(b) CNF

(c) Either GNF or CNF

(d) All of mention

1-f. CFG is not closed under : (CO3) 1

(a) Union

(b) Kleene Star

(c) Complementation

(d) Product

1-g. A push down automata can represented using: (CO4) 1

(a) Transition graph

(b) Transition table

(c) ID

(d) All of the mentioned

1-h. The transition a Push down automaton makes is additionally dependent upon the: (CO4) 1

(a) State

(b) Unconsumed input

(c) Stack content

(d) All of the mentioned

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

(a) Input Tape

(b) Blank Symbol

(c) Tape head

(d) All of these

1-j. A turing machine that is able to simulate other turing machines: (CO5) 1

(a) Nested Turing Machine

(b) Universal Turing Machine

(c) Counter Turing Machine

(d) None of the mention

2. Attempt all parts:-

2.a. Explain the term Alphabets, Strings, Language in Finite Automata. (CO1) 2

2.b. Describe the definition of Regular Expression. (CO2) 2

2.c. Explain the Mathematical description of Context Free Grammar. (CO3) 2

2.d. Describe the explanation for the Moves of Pushdown Automata. (CO4) 2

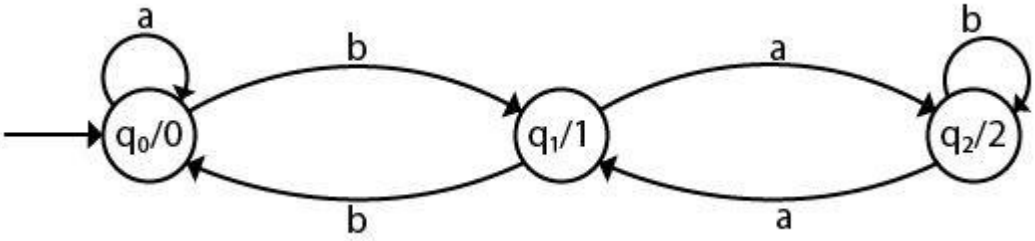
2.e. Explain Church's Thesis. (CO5) 2

SECTION B **30**

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

3-a. Design Finite Automata that accepts set of strings containing exactly four 1's in every string over alphabet {0,1}. (CO1) 6

3-b. Convert the given Moore machine into its equivalent Mealy machine. (CO1) 6



3-c. Write the regular expression for the language L = { $a^n b^m$: (n+m) is even } (CO2) 6

3-d. Prove that L = { $a^n b^n ab^{n+1}$ for n = 1,2,3, ...} is not regular. (CO2) 6

3.e. If CFG (G) is S ----> SbS / a , Show that G is ambigous. (CO3) 6

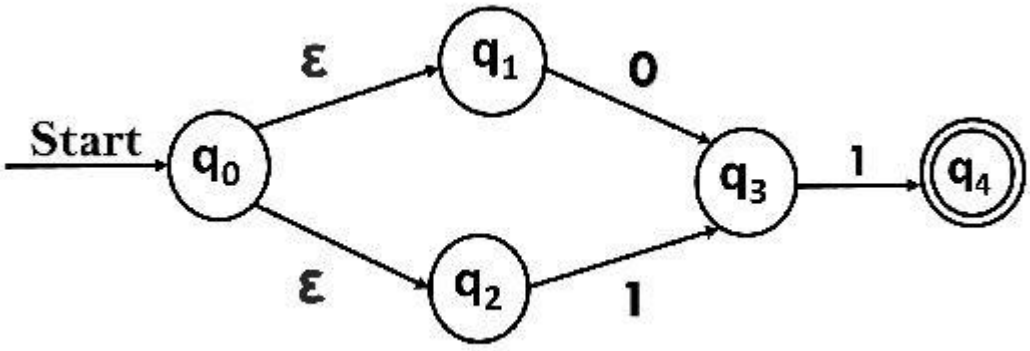
3.f. Design a PDA for the language L={ $0^n 1^{2n}$, n >0} (CO4) 6

3.g. Design a Turing Machine which recognize the language of Regular Expression (0 1* 0) . (CO5) 6

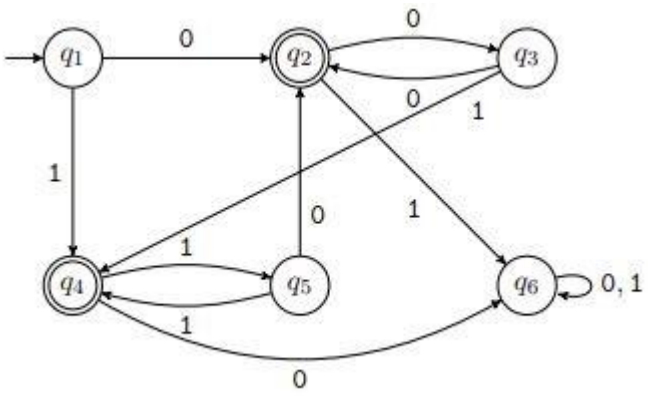
SECTION C **50**

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

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



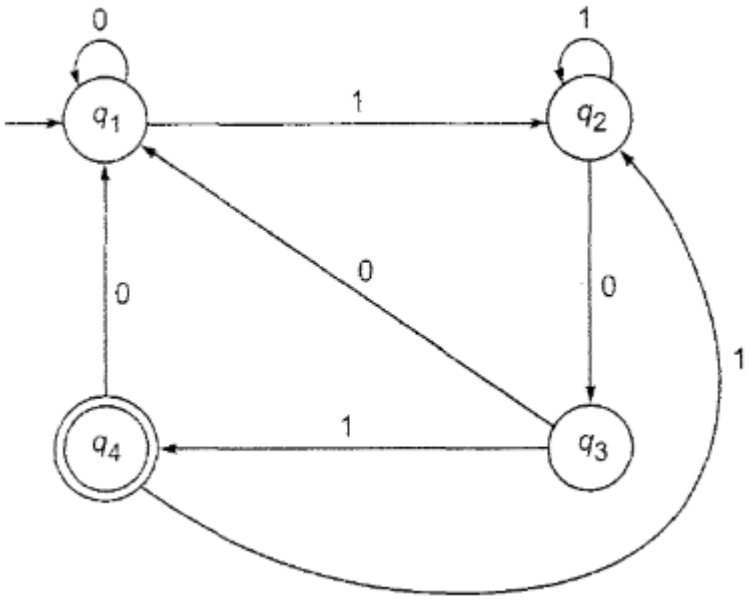
4-b. For the following DFA, determine the classes of equivalent states, and use them to provide the equivalent minimum-state DFA. (CO1) 10



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

5-a. Write down the statement of Pumping Lemma for Regular Languages. also Describe the Closure Properties of Regular Languages. (CO2) 10

5-b. Prove Ardens's Theorem. Find the regular expression corresponding to Fig. (CO2) 10



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

6-a. 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

6-b. Describe the following : (CO3) 10

(i) Eliminating the Use Less Symbols in CFG

(ii) Removal of Unit Production in CFG

(iii) Removal of Null - Production in CFG

Find the Reduced Grammar that is equivalent to the CFG given below :

S ---> AB

A ---> a

B ---> C / b

C ---> D

D ----> E

E -----> a

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 = { $a^{m+n}b^{m}c^{n}$ / m, n > 1} (CO4) 10

7-b. Design a PDA for the following CFG : (CO4) 10

S ----> ε

S ----> SS

S ----> (S)

Show the transition relation on string ( ) ( ) for constructed PDA.

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

8-a. Explain Instantaneous description of Turing Machine. Design the Turing Machine for : (CO5) 10

(i) 1's Complement of any string

(ii) 2's Complement of any string

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

(i) Universal Turing Machine

(ii) Recursively Enumerable Language

(iii) Halting Problem

(iv) Post's Correspondence Problem