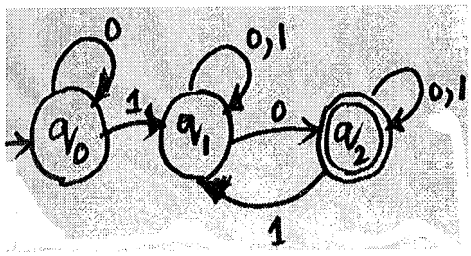
B.E COMPUTER SCIENCE AND ENGINEERING 3rd YEAR 1st SEMESTER
SUPPLEMENTARY EXAMINATION 2024
Formal Languages and Automata Theory

Time: 3 hours | Full Marks: 100

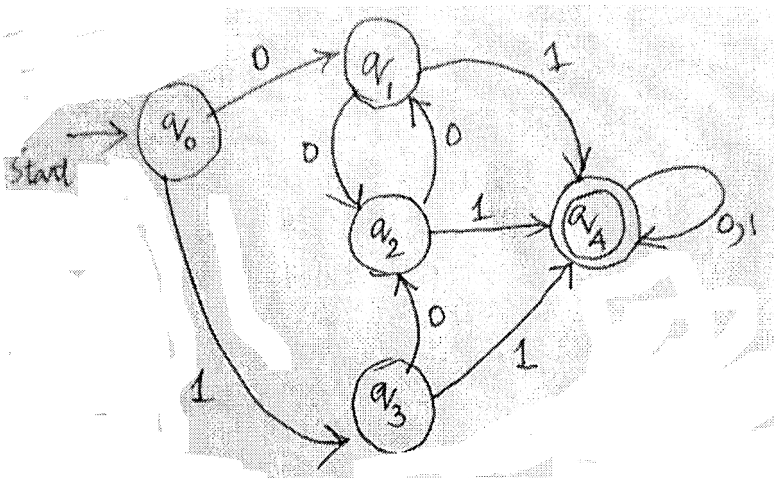
Answer any *five* questions

1(a) Give a DFA for ∑={a,b,c} that accepts any string with aab as a substring.
(b) Convert the following NFA to DFA.



10+10

2(a) Find the minimum-state DFA for the following:



(b) State the pumping lemma for regular languages. Explain its significance. Show that $\{0^n 10^n \mid n \geq 1\}$ is not regular.

10+10

3. a) State the pumping lemma for Context-Free languages.
b) Using the pumping lemma, show that the language $\{a^n b^n c^n \mid n>=1\}$ is not context free.

8+12

4.a) Give a Context Free Grammar (CFG) to generate $\{0^n1^n \mid n>0\}$

b) Prove that the class of Context Free Languages is closed under Union.

c) Construct a Non Deterministic Push Down Automata (NPDA) that recognizes the following Context Free Language:

$$L=\{w\in\{0,1\}^+ \mid \text{no. of 0's in w=no of 1's in w }\}.$$

Give the state transition diagram of the NPDA.

4+8+8

5. Given two positive integers x and y, design a Turing Machine to compute x+y. Give the transition diagram of the machine.

Hints: Assume unary representation in which an integer is represented by a string of as many 0's as the decimal value of the integer is. For example, 5 is represented as 00000. Also assume that a 1 is used as a separator between two integers on the tape. For example, if x=5 and y=3 then a string 000001000 is initially placed over the tape prior to computation of
x+y. After completion of the computation a string 000000001is left over the tape.

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6. Write short notes on (*any three*)

Halting Problem, Universal Turing Machine, Recursive and Recursively Enumerable languages, Chomsky hierarchy of languages, P and NP classes of problems.

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