

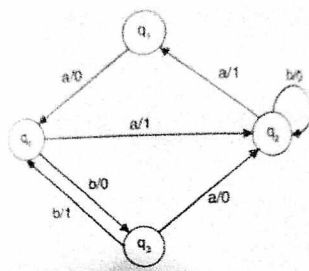
National Institute of Technology, Hamirpur (HP)**End Semester Examination B.Tech & DD Computer Science & Engineering (May 2023)****Branch : Computer Science & Engineering****Semester : 4th****Course Name : Theory of Computation****Course Code : CS-223****Time: 3 Hours****Maximum Marks: 50****NOTE:** (I) Do not write anything on the question paper.

(II) Attempt all questions.

(III) Assume data wherever necessary.

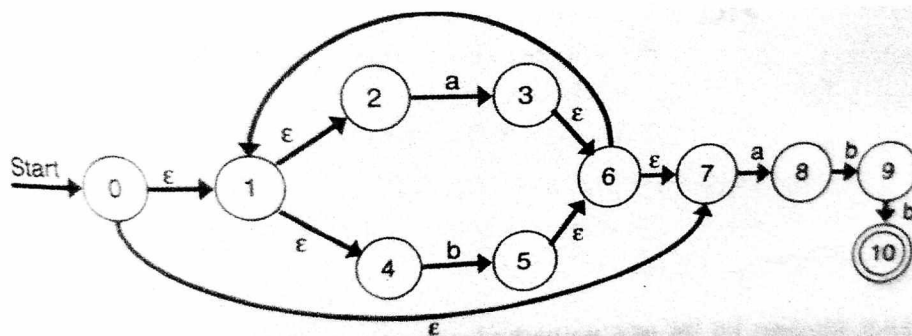
Q.1(a) Design a DFA for newspaper vending machine, input to machine consists of coins of 5 paisa, 10 paisa and 25 paisa. When 30 paisa is inserted, the cover of the machine may be opened & paper is removed. (5)

Q.1(b) Convert the following Mealy machine into an equivalent Moore Machine.



Q.2(a) Where do you see the application of pumping lemma apart from regular set? Jot down the steps involved in proving that given set not regular. Also show that $L = \{a^p \mid P \text{ is prime}\}$ is not regular. (5)

Q.2(b) Convert the following NFA with ϵ -move to an equivalent DFA:



Q.3(a) What is Chomsky Hierarchy all about? Where is the place for recursive enumerable and recursive language in this hierarchy? Prove the following properties of recursive and recursive enumerable language:

(a) The union of two recursive language is recursive.

(b) The Kleene star operation on a recursive enumerable language is recursive enumerable.

(5)

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Q.3(b) When a context free grammar is said to be left recursive? Identify whether the following grammar is left recursive,

$S \rightarrow Aa \mid b$

$A \rightarrow Ac \mid Sc \mid f$

If yes remove it, and if no justify your answer with proper explanation.

(5)

Q.4(a) Consider the following grammar:

$S \rightarrow AB$

$A \rightarrow a$

$B \rightarrow C/b$

$C \rightarrow D$

$D \rightarrow a$

$E \rightarrow a$

Remove the unit productions from the said grammar.

(5)

Q.4(b) Construct a PDA to accept $L = (a,b)^*$ with equal number of "a" and "b". i.e. $n_a(L) = n_b(L)$ by empty stack and the final state.

(5)

Q.5(a) Design a TM to perform the following operation

$f(x,y) = x - y$, where $x > y$

Show an ID FOR $4 - 2 = 2$.

(5)

Q.5(b) Prove the theorem that Halting Problem is unsolvable. Also elaborate the consequences of the Halting Problem.

(5)