JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS-2023

B.Tech-V Semester (ECM)

COURSE CODE (CREDITS): 23B11EM512 (3) MAX. MARKS: 35

COURSE NAME: Theory of Computation

COURSE INSTRUCTORS: Dr. Shweta Pandit MAX. TIME: 2 Hour

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. a) Convert the given NFA in Figure 1 to DFA. **[3][CO-1]**

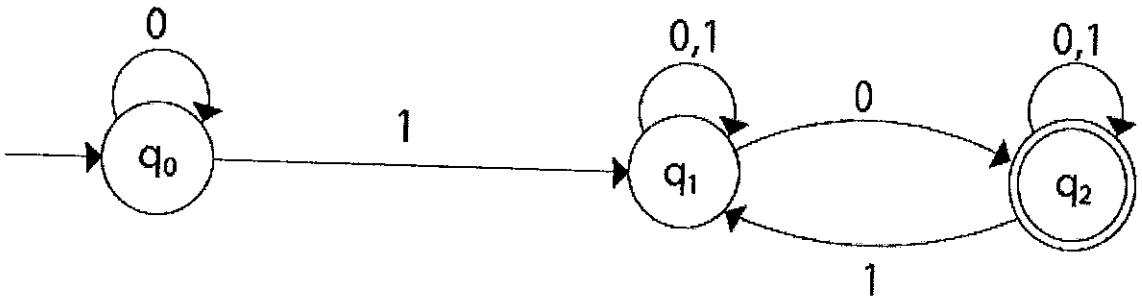


Figure 1

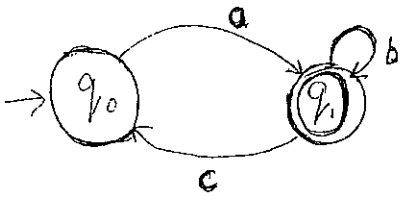
b) How to find the space and time complexity of an algorithm? Define with examples P, NP, NP-hard and NP complete problems. **[3][CO3]**

Q2. a) For the given Regular Languages, provide the Regular Expressions: **[2][CO-1]**

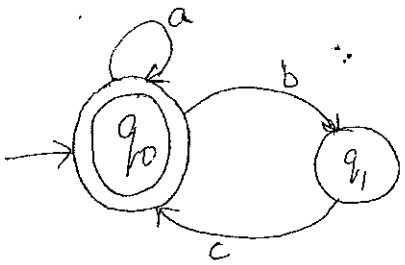
(i) starts and ends with symbol a (ii) $|w| \leq 3$ (iii) $|w| = 2 \pmod 3$ (iv) $|w_b| = 0 \pmod 3$

b) Define the importance of regular expressions in automata designing. What is the role of different operators used in regular expression of automata? Find the regular expressions for the following automata: **[2+2][CO-1][CO-4]**

(i)



(ii)



Q3 Define grammer of a language in theory of computation through quadruple set. **[1.5+4.5][CO-1][CO-4]**

(i) Design a Finite Automata for the following grammer productions and show how many minimum states are required to construct FA from this grammer?
$S \rightarrow Xa/Ya \quad X \rightarrow Za \quad Z \rightarrow Sa/\lambda \quad Y \rightarrow Wa \quad W \rightarrow Sa$

(ii) For the language L_1 defined by grammer $S_1 \rightarrow aS_1b/\lambda$ and language L_2 defined by grammer $S_2 \rightarrow abS_2/\lambda$, show which one language is regular and why?

(iii) Convert following regular grammer to regular expression: $S \rightarrow 011A/101B \quad A \rightarrow 110A/00 \quad B \rightarrow 11B/S.$

Q4 a) What is solvable and unsolvable problem? What is role of decidability in it? Provide different decision properties which are decidable with steps which shows the problem is decidable or not? **[5][CO-2]**

Q5. Give different componets of Push Down Automata (PDA). For the following context free languages (CFL), design PDA: **[1.5+4.5][CO-2][CO-4]**

(i) $L = \{wcw^r \mid w\epsilon(a,b)^*\}$

(ii) $L = \{|w|_{a=b} \mid w\epsilon(a,b)^*\}$

(iii) $L = \{a^n b^{2n} \mid n \geqslant 1\}$

Q6. What is Turing Machine (TM) and how it is different from PDA? Design the TM for following: **[1.5+4.5][CO-2][CO-4]**

(i) which accepts language $L = \{a^n b^n c^n \mid n \geqslant 1\}$

(ii) which accepts language $L = \{a^n b^n \mid n \geqslant 1\}$

(iii) which work as an adder