SPRING MID SEMESTER EXAMINATION-2023

School of Computer Engineering
Kalinga Institute of Industrial Technology, Deemed to be University
Subject Name: Automata and Formal Languages
[CS-2010]

Time: 1.5 Hours **Full Marks: 20**

Answer any four Questions including Q.No.1 which is Compulsory.
The figures in the margin indicate full marks. Candidates are required to give theiranswers in their own words as far as practicable and all parts of a question should beanswered at one place only.

1. Answer all the questions. [1 x 5]

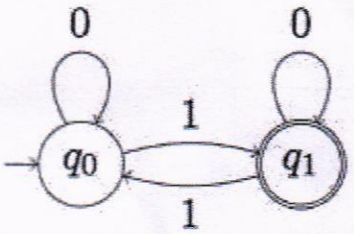
(a) Design an NFAover $\sum$ = {a,b}without λ-transitions and with a single final state that accepts the set :

{a} ∪ {b^n : n ≥ 2}.

(b) Let L1 and L2 be two languages over the same alphabet Σ. Given that L1 and L1.L2 both are regular. Prove or disprove L2 must be regular.

(c) What is the length of the shortest string not in the language denoted by the regular expression (ba+a)*(b+ba)*

(d) Find a regular expression for the following DFA :



(e) Two regular expressions over the same alphabet are called equivalent if they generate the same language. Find out whether the followingtwo regular expressions are equivalent:

$(ab^*a+ba^*b)^*$ and $(ab^*a)^* + (ba^*b)^*$.

2. (a) Design a DFA for the following regular language over Σ= {0, 1}.

L={The set of all strings, interpretated as binary representation of integers, are divisible by 2 but not divisible by 3}. [4 Marks]

(b) Write down the statement of Pumping Lemma for regular languages. [1 Mark]

3.(a) Design a DFA for the language L={w ϵ $(a+b)^*$ | w contains equal number of occurrences of the substrings 'ab' and 'ba'}. For example, the string 'ababa' is in the language, whereas 'bbaba' is not in the language. [3 Marks]

(b) Write down regular expressions for the following languages: [2 Marks]

i) L = {w ∈ {a, b}* : w starts with 'ab' but does not end with 'ab'}

ii) L={ w ∈ {a, b}*: $n_b(w)$ mod 5 > 0}

i) L={ w ∈ {a, b}* : every 'a' in w is immediately preceded and followed by 'b'}

iv) L={ w ∈ {a, b}* : |w| mod 3 ≠ 0}

4. (a) Consider the DFA {{q0, q1, q2, q3, q4, q5, q6, q7, q8}, {a,b}, δ, q0, {q4, q5, q8}} [3 Marks]

δ	a	b
q0	q1	q2
q1	q3	q8
q2	q4	q3
q3	q5	q3
q4	q4	q6
q5	q8	q6
q6	q7	q4
q7	q6	q5
q8	q8	q7

Minimize the above DFA and show the indistinguishable states.

(b) Convert the NFA defined by:[2 Marks]

δ(q0, a) = {q0, q1}

δ(q1, b) = {q1, q2}

δ(q2, a) = {q2}

δ(q0, λ) = {q2}

with initial state {q0} and final state {q2} into an equivalent DFA.

5. (a) Prove that L = {ww^R | w ∈ Σ^*} is not regular. [3 Marks]

(b) Show that regular languages are closed under intersection. [2 Marks]

*** Best of Luck ***