NIRMA UNIVERSITY

Institute of Technology

Semester End Examination(IR/RPR), May 2022

B.Tech in Computer Science Engineering – Sem VI

2CS601-Theory Of Computation

Roll / Exam No. 19BCE245 | Supervisor's Initial with Date

Time: 3 Hours | Max Marks: 100

Instructions:
1. Attempt all questions
2. Figures to right indicate full marks
3. Assume necessary data.
4. Use section-wise separate answer book.
5. Draw neat sketches wherever necessary.

SECTION-I

Q:1 **Answer the following questions** **[18]**

[CLO3]

A BL-2 (i) Give recursive definition for the language 0^i1^j with i>=2j. [06]

(ii) Find the language from the recursive definition:
a. a ∈ L ;
b. For any x ∈ L, xb, xa and bx are in L.

B BL-4 Prove that for every n ≥ 0, using PMI [06]

$$\sum_{i=1}^{n} (1/i(i+1)) = \frac{n}{n+1}$$

OR

B BL-4 Prove that for any n>= 4, $n! > 2^n$ [06]

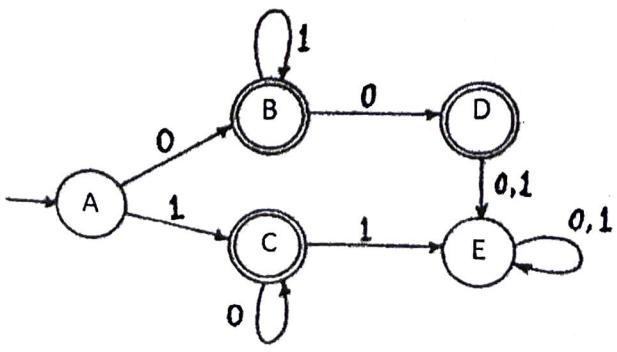
C BL-4 Find the regular expression for following regular language [06]
a. The language of strings with even number of 0's and odd number of 1's.
b. The language of strings that do not end with 01.

Q:2 **Answer the following questions** **[18]**

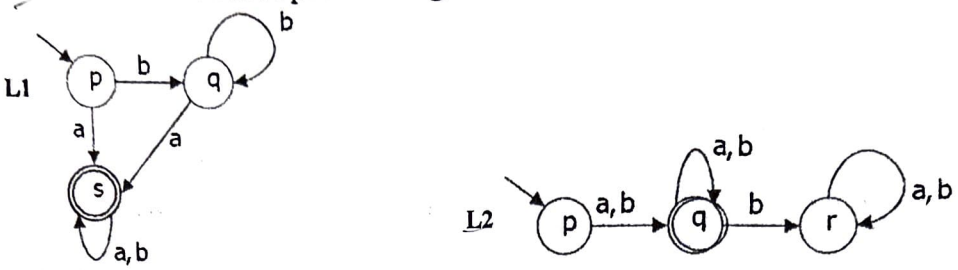
[CLO1]

A BL-6 (i) Design a DFA to accept the valid C programming language identifiers. Assume L= [a–z, A--Z], D= [0 – 9] [06]

(ii) Find the generated language from following DFA.



B BL-5 Let L_1 and L_2 be language represented by the following automata. Construct DFA representing L2 U L1 [06]

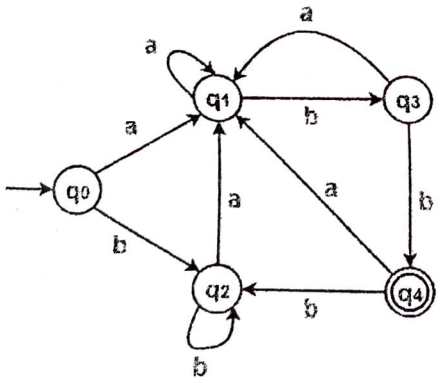


C BL-4 Define ∧- closure of a set for NFA-∧. Consider the following transition table and find ∧ ({3,4}) [06]

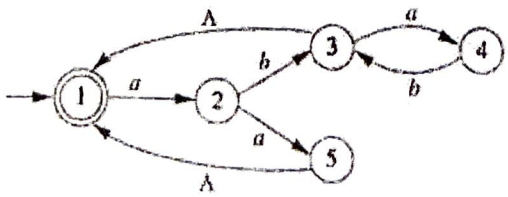
q	δ (q,a)	δ (q,b)	δ (q, ∧)
1	Φ	Φ	{2}
2	{3}	Φ	{5}
3	Φ	{4}	Φ
4	{4}	Φ	{1}
5	Φ	{6,7}	Φ
6	{5}	Φ	Φ
7	Φ	Φ	{1}

Q:3 [CLO2] Answer the following questions **[14]**

A BL-5 Minimize the following DFA. [07]



B BL-5 Convert following NFA-∧ to DFA. [07]



OR

What is an equivalence class in a regular language? What is significance of it to prove whether the language is regular or not? Explain with suitable example. [07]

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SECTION-II

Answer the following questions **[18]**

Q:4 **[CLO4]**

A BL-4 Find the equivalent CFG for following languages. [06]

(i) $\{a^i b^j c^k \mid i< j \text{ or } i < k\}$

(ii) Set of all (positive or negative) even integer. e.g. +174, -936

(Assume terminals = {+,-,0,1,2,3,4,5,6,7,8,9)

B BL-4 Convert following CFG to CNF (Chomsky Normal Form). [06]

$S \rightarrow AACD$

$A \rightarrow aAb \mid \wedge$

$C \rightarrow aC \mid a$

$D \rightarrow aDa \mid bDb \mid \wedge$

OR

B BL-4 Define Following terms: [06]

(i) Regular Grammar

(ii) Context Free Grammar

(iii) Language accepted by PDA

C BL-4 Do as Directed

(i) Describe the language generated by following grammar

$S \rightarrow aA \mid bC \mid b$

$A \rightarrow aS \mid bB$

$B \rightarrow bA \mid aC \mid a$

$C \rightarrow aB \mid bS$

(ii) Define an unambiguous grammar. Is following grammar unambiguous? Justify your answer.

$S \rightarrow aSb \mid aaSb \mid \wedge$

Q:5 **[CLO1,3]** **Answer the following questions** **[18]**

A BL-5 Following table shows the DPDA. Find out the language accepted by DPDA where starting state={q0} and accepting state = {qa,qb} [06]

Move No	State	Input	Stack Symbol	Move(s)
1	q0	a	Z0	(qa,Z0)
2	q0	b	Z0	(qb,Z0)
3	qa	a	Z0	(qa,aZ0)
4	qa	a	a	(qa,aa)
5	qa	b	a	(qa, ∧)
6	qa	b	Z0	(q0,Z0)
7	qb	b	Z0	(qb,bZ0)
8	qb	b	b	(qb,bb)
9	qb	a	b	(qb, ∧)
10	qb	a	Z0	(q0,Z0)

B BL-6	Design the DPDA for $\{a^i b^j c^k \mid i, j, k >= 0, j=i \text{ or } j=k\}$	[06]
C BL-6	Design a Top down PDA for the following CFG also trace the string a*a+a $S \rightarrow S + T \mid T$ $T \rightarrow T * a \mid a$	[06]
Q:6 [CLO2, CLO4]	**Answer the following questions**	**[14]**
A BL-6	Design the Turing Machine (TM) for calculating following function f for the string x where $x \in \{a,b\}^*$, F(x) = 0 if x is palindrome F(x) = 1 if x is nonpalindrome	[07]
B BL-6	Design the TM for deleting the particular symbol initially represented by pointer. (eg : i/p string = aaba o/p string=aaa)	[07]
	OR	
B BL-4	Define PDA and TM with all the elements. State the difference between both the automata and discuss the real time application of PDA and TM.	[07]