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End Term (Even) Semester Examination May-June 2025

Roll no. 2319669

Name of the Program and semester: B.Tech CSE IV Core, Int., AI/ML, AI/DS, CS
Name of the Course: Finite Automata and Formal Languages.
Course Code: TCS402
Time: 3 hour

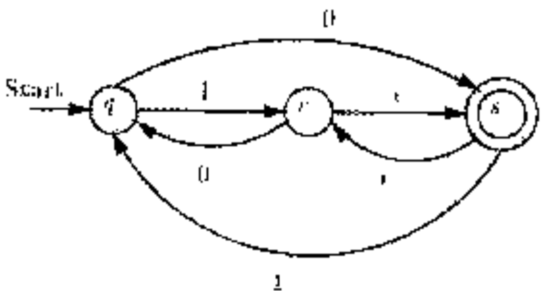
Maximum Marks: 100

Note:
- (i) All the questions are compulsory.
- (ii) Answer any two sub questions from a, b and c in each main question.
- (iii) Total marks for each question is 20 (twenty).
- (iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

a. Design a TM to recognize all strings consisting of even no. of 1's.

b. Find the regular expression for the following FA



c. (i) Construct DFA accepting odd number of 0s and odd number of 1s

(ii) Design a Moore Machine for residue of mod 4. And also show the remainder of 19.

Q2. (2X10=20 Marks)

a. Construct PDA for the following CFG G=({S,T}, {a,b, ε},P,S} where P consists of following productions:

$S \rightarrow aTb|b$,

$T \rightarrow Ta|\varepsilon$. **CO6**

Check for the acceptance of w=aaaab

b. Design DFA for the following R.E. **CO2**

010*+0(01+10)*11 over {0,1}

Design Transition Table, Transition Graph and also check that the given string (010110100) belongs to above DFA

c. Convert CFG to GNF **CO3**

$S \rightarrow XA|BB$

$B \rightarrow b|SB$

$X \rightarrow b$

$A \rightarrow a$

Q3. (2X10=20 Marks)

a. Convert the following CFG into CNF $S \rightarrow XY \mid Xn \mid p$; $X \rightarrow mX \mid m$; $Y \rightarrow Xn \mid o$ **CO3**

b. C = { w ∈ Σ*| $n_a(w)$ mod 4 = 1 }, where Σ = {a, b} and $n_a(w)$ is the number of a's in string w. For example, n_a(babaabb) = 3. Also, recall j mod k returns the remainder after dividing j

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by k, e.g., 3 mod 4 = 3, and 9 mod 4 = 1.
Recognize the type of language and design the required machine with language. **CO2**

c. Let L1, L2, and L3 be languages defined over the alphabet $\Sigma = \{a, b\}$, where

- L1 consists of all possible strings over Σ except the strings w1, w2, . . . , w100; i.e., start with all possible strings over the alphabet, take out 100 particular strings, and the remaining strings form the language L1;
- L2 is recognized by an NFA; and
- L3 is recognized by a PDA.

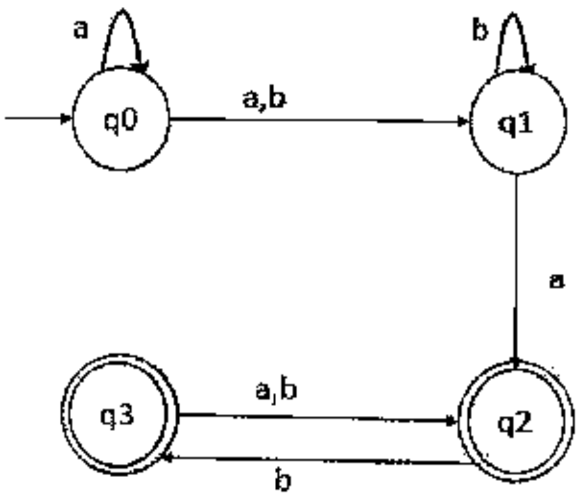
Prove that $(L1 \cap L2)L3$ is a context-free language or not. **CO4**

Q4. (2X10=20 Marks)

a. Construct a PDA from the following CFG. G = ({S, A}, {a, b}, P, S) where the productions are: $S \rightarrow AS \mid \varepsilon$, $A \rightarrow aAb \mid Ab \mid ab$ **CO4**

b. Does the Turing machine finish computing of the string w in a finite number of steps? **CO6**

c. Convert the following Non-Deterministic Finite Automata (NFA) to Deterministic Finite Automata (DFA). **CO2**



Q5. (2X10=20 Marks)

a. Design a Turing machine which accepts the language which contains equal number of a's followed by equal number of b's followed by equal number of c's over input alphabet {a,b,c} . Also check the decidability of that turing machine. **CO5**

b. Give the transition functions δ (i.e., specify the domains and ranges) of a DFA, NFA, PDA, Turing machine and nondeterministic Turing machine. Show the evolution of machines and differences. **CO1**

c. O = { $b^n a^n b^k c^k$ | $n \geq 0, k \geq 0$ }. Design PDA for given CFL. **CO4**