Graphic Era
HILL UNIVERSITY

End Term (Even) Semester Examination May-June 2025

Roll no.....

Name of the Program and semester: B.Tech (CSE) 4th Semester
Name of the Course: Finite Automata and Formal Languages
Course Code: TCS-402
Time: 3 hours

Maximum Marks: 100

Note:

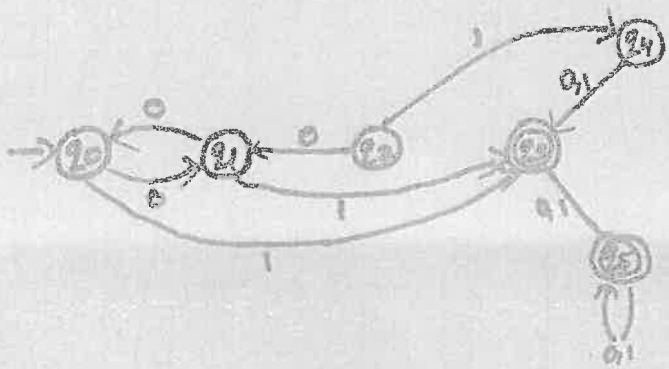
(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

a. Design a DFA that accepts all the strings over the alphabet $\sum = \{0, 1, 2\}$ such that the **"number of 1's in the accepted string is a multiple of 4"**. **[CO-2]**

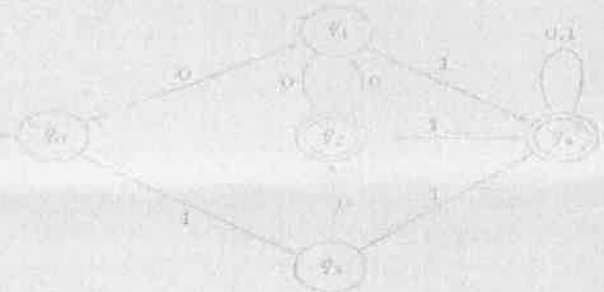
b. Design a DFA that accepts all the strings over the alphabet $\sum = \{a, b\}$ such that the accepted string does not contains "aab" or "abb" as a substring. **[CO-2]**

c. Apply Myhill-Nerode theorem to minimize the given DFA: **[CO-2]**



Q2. (2X10=20 Marks)

a. Apply Arden's theorem to find the equivalent regular expression for the given finite automata: **[CO-2]**



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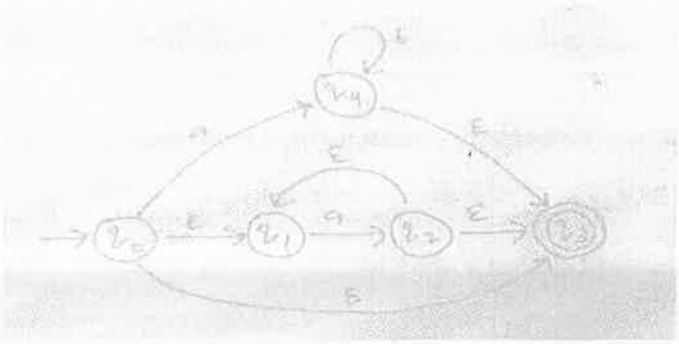
b. Design a Mealy Machine that takes a binary number over the $\Sigma = \{0, 1\}$ as the input and finds the 2's complement as the output. Further, convert the resultant Mealy machine to Moore machine. [CO-6]

c. Define ε-closure. Convert the given ε-NFA to equivalent DFA: [CO-2]



Q3. (2X10=20 Marks)

a. Convert the given CFG to CNF, where V= {S, A, B} and T= {a, b}: [CO-3]

S → abAB
A → bAB | ε
B → BAa | A | ε

b. Simplify the following CFG: [CO-3]

S → aA | aBB
A → aaA | ε
P → bB | bbC
C → B

What language does the simplified grammar generates?

c. Apply pumping lemma for CFL to prove that the given language L is not a context-free language:
$L = \{a^m b^n c^n \mid m = 2n\}$ [CO-3]

Q4. (2X10=20 Marks)

a. Convert the following CFG to PDA: [CO-4]

S → aAB | bBA
A → bS | a
B → aS | b

Also, test whether the string "**abbaaabbbbab**" would be accepted/ rejected by the resultant PDA?

b. Construct a PDA that recognizes strings from the given language: [CO-4]
$L = \{0^m 1^n 2^i 3^n \mid m>=1 \text{ and } n>=0\}$

c. Design a PDA that recognizes the following language by final state or by empty stack: [CO-4]
$L = \{w\, a^n\, w^R \mid w \in (a,b)^*$ and $n>=0$; w^R is the reverse of $w\}$

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Q5. (2X10=20 Marks)

a. Write short notes on any two:* **[CO-6]**

(i) Turing-Church Thesis

(ii) Variants of Turing machine

(iii) Post correspondence problem (PCP)

b. Construct a Turing Machine for the given language over the $\Sigma = \{0, 1\}$: **[CO-5]**

$L = \{WW \mid \text{where, } W \text{ is } (0 + 1)^*\}$

c. Construct a Turing Machine that works as a copier. It takes a string W as the input and generates **WcW** as the output, where W is $(a, b)^*$ **[CO-5]**

Note For the question paper setters:

- Question paper should cover all the COs of the course.
- Please specify COs against each question.