Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

Term Evaluation (Even) Semester Examination March 2025

Roll no.............................

Name of the Course and semester: **B. Tech CSE IV Core, Int., AI/DS, CS | 4th**
Name of the Paper: **Finite Automata and Formal Languages**
Paper Code: **TCS-402**
Time: 1.5 hour

Maximum Marks: 50

Note:
- *(i)* Answer all the questions by choosing any one of the sub questions
- *(ii)* Each question carries 10 marks.
- *(iii)* Please specify COs against each question.

Q1. **(10 Marks) [CO-2]**

a. Design a DFA over the input alphabet $\sum = \{a, b\}$ such that it does not accept the strings ending with either "aab" or "aba".

OR

b. Design a DFA over the input alphabet $\sum = \{0, 1\}$ such that it accepts only the binary strings whose decimal equivalent is divisible by 5.
[For Example, 101, 0101, 1010, 1111, etc. are divisible by 5 so all these inputs should be accepted while, 100, 1100, 0111, etc. are not divisible by 5 so should be rejected]

Q2. **(10 Marks) [CO-1]**

a. Apply Myhill-Nerode theorem to minimize the given DFA:

Q / Σ	**0**	**1**
$\rightarrow q_0$	q_1	q_2
q_1	q_3	q_5
q_2	q_5	q_4
$*q_3$	q_3	q_3
$*q_4$	q_4	q_4
q_5	q_5	q_5

OR

b. Convert the given ε-NFA into an equivalent DFA where $\sum = \{0, 1, 2\}$:

State/ symbol	**ε**	**0**	**1**	**2**
$\rightarrow p$	{q, r}	-	{q}	{r}
q	-	{p}	{r}	{p, q}
*r	-	-	-	-

Q3. **(10 Marks) [CO-2]**

a. Design a Moore machine as a sequence detector over the input alphabet $\sum = \{a, b\}$. The Moore machine should generate a "1" whenever there is "abb" in the input sequence otherwise nothing.

[Samples are: Input: abbaabbaa, Output: 11
Input: abbbabbbabb, Output: 111]

OR

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b. Convert the given Mealy machine to an equivalent Moore machine. Also, Test the output of Mealy and Moore machine for the input "101101" to prove the equivalence.

Present State	Input = 0		Input = 1	
	Next State	Output	Next State	Output
→q_1	q_3	A	q_2	A
q_2	q_1	A	q_4	B
q_3	q_2	B	q_1	A
q_4	q_4	A	q_3	B

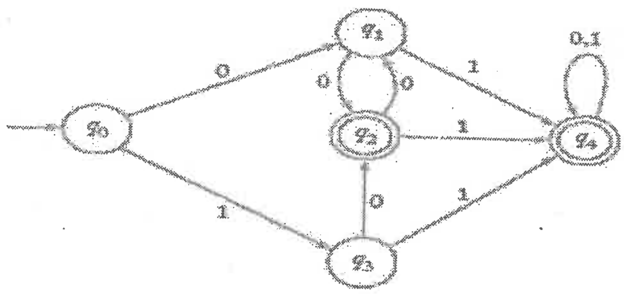
Q4.

(10 Marks) [CO-2]

a. Define ε-closure (Epsilon-closure). State and prove Kleene's Theorem for showing the equivalence between Regular Expression and Finite Automata.

OR

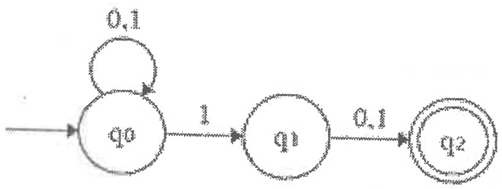
b. Find the regular expression for the given finite automata using Arden's theorem:



Q5.

(10 Marks) [CO-1]

a. Define NFA (Non-Deterministic Finite Automata). Convert the given NFA to equivalent DFA:



OR

b. State pumping lemma for regular languages. Prove that the given language L is non-regular:

$L = \{a^i b^j c^k \mid k > i+j\}$