**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

GEHU/O

# Term Evaluation (Even) Semester Examination March 2025

Roll no. 2301...........

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 $\Sigma = \{a, b\}$ such that it does not accept the strings ending with either "aab" or "aba".

**OR**

**b.** Design a DFA over the input alphabet $\Sigma = \{0, 1\}$ 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 |
|---|---|---|
| → $q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_3$ | $q_5$ |
| $q_2$ | $q_5$ | $q_4$ |
| * $q_3$ | $q_3$ | $q_3$ |
| * $q_4$ | $q_4$ | $q_4$ |
| $q_5$ | $q_5$ | $q_5$ |

**OR**

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

| State/ symbol | ε | 0 | 1 | 2 |
|---|---|---|---|---|
| → 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 $\Sigma = \{a, b\}$. 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.

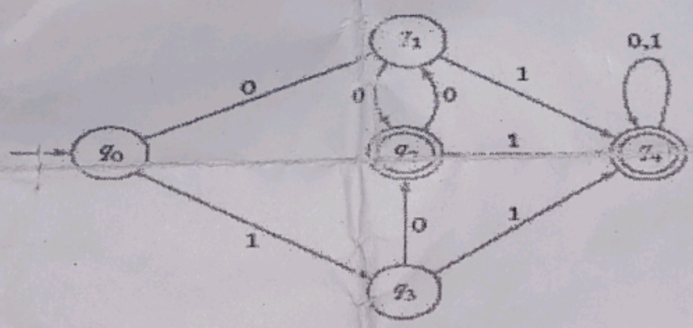
| Present State | Input = 0 | | Input = 1 | |
|---|---|---|---|---|
| | Next State | Output | Next State | Output |
| →$q_1$ | $q_3$ | A | $q_2$ | A |
| $q_2$ | $q_1$ | A | $q_4$ | B |
| $q_3$ | $q_2$ | B | $q_1$ | A |
| $q_4$ | $q_4$ | A | $q_3$ | B |

**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.

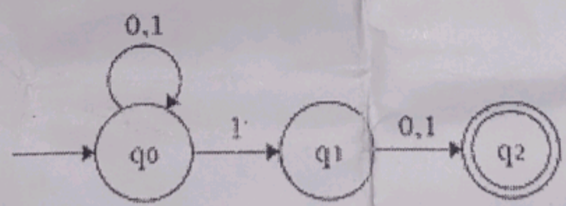
**OR**

**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:

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