DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER VI [COMPUTER ENGINEERING]
SUBJECT: (CE623) NAME: THEORY OF AUTOMATA AND FORMAL LANGUAGES

Examination : Regular — **Seat No** :
Date : 23/04/2025 — **Day** : Wednesday
Time : 10.00 to 1.00 pm — **Max. Marks** : 60

INSTRUCTIONS:

1. Answer each section in a separate answer book.
2. Figures to the right indicate maximum marks for that question.
3. The symbols used carry their usual meanings.
4. Assume suitable data, if required & mention them.
5. Draw neat sketches wherever necessary.

SECTION – I

Q.1 **Do as directed.** **[10]**

CO2 A (a) Convert the Regular Expression into Finite Automata. **R.E. = $(a^*ba)^*$** [2]

CO3 A (b) Perform Left-Factoring on the given grammar [2]

$A \rightarrow abd \mid abde \mid abdAB \mid f \mid g$ $B \rightarrow e \mid \varepsilon$

CO2 R (c) Define: Regular Grammar [2]

CO2 R (d) Explain Greibach Normal Form (GNF) with a suitable example. [2]

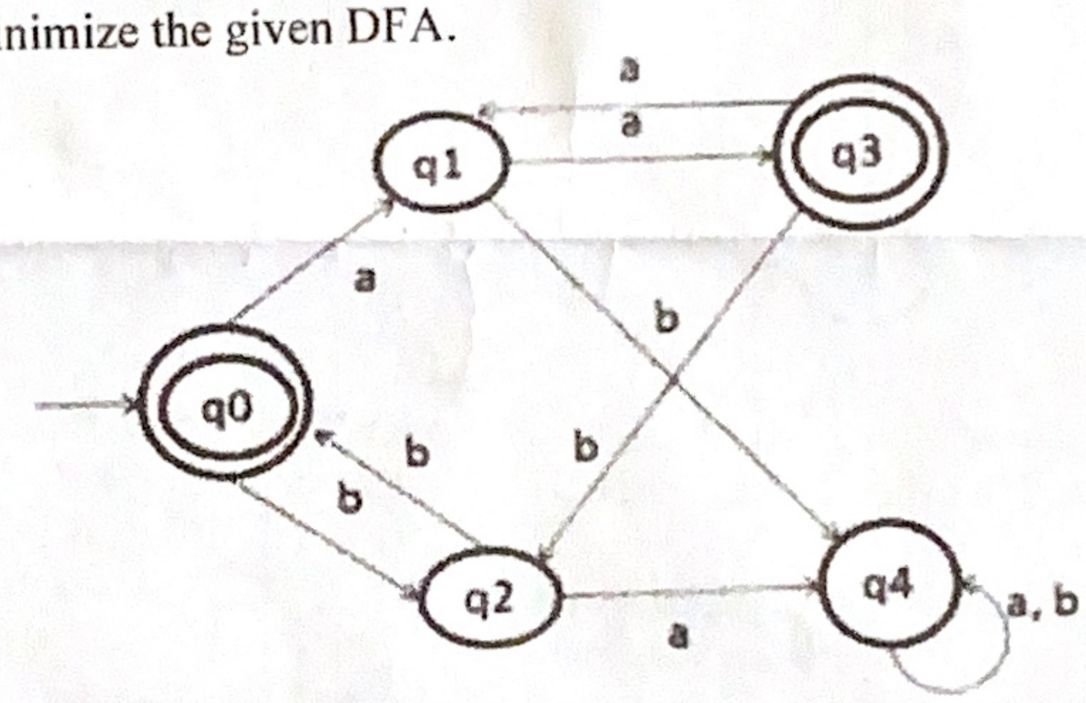
CO2 U (e) Find the Regular Expression for the following language. [2]

L={w | w ∈ {0,1}* and w does not contain two consecutive 0's or 1's}

Q.2 **Attempt *Any TWO* from the following questions.** **[10]**

CO2 C (a) Construct a minimal DFA that accepts the strings with input symbols {0, 1, 2} [5]
where 2nd last symbol in 1

CO2 C (b) Minimize the given DFA. [5]



CO2 A (c) Using Pumping Lemma prove **$L = \{a^{3^n} \mid n >= 1\}$** can't be accepted by FA. [5]

Q.3 **Attempt the following questions.** **[10]**

CO4 C (a) Consider the following languages: [5]

$L_1 = \{wcw^R \mid w \in \{0,1\}^*$ and c is a symbol not equal to 0 or 1$\}$

$L_2 = \{wxw^R \mid w, x \in$ to $\{0,1\}^*\}$

Which of the above language(s) is/are DCFL? Construct a DPDA for any one language only if the language is DCFL.

CO2 A (b) Convert the following CFG into Chomsky Normal Form. [5]

$S \rightarrow AbA \mid Ab \mid bA \mid b$

$A \rightarrow Aa \mid a$

OR

Q.3 **Attempt the following questions.** **[10]**

CO4 C (a) Construct a NPDA for the language **$L = \{a^i b^j c^k \mid i < j$ or $j > k$ and $i, j, k > 0\}$** [5]

CO2 A (b) Write a Context-Free Grammar for the following Language. [5]

$L = \{w \mid w \in \{a,b\}^*$ and $|w_a| = 2\,|w_b|\}$

SECTION – II

Q.4 **Do as directed.** **[10]**

CO3 R (a) In what way the working of Turning Machines is different from FAs and PDAs? [2]

CO3 N (b) "Every recursive language is recursively enumerable". Prove the statement. [2]

CO3 A (c) Does every Turing Machine compute a Partial Function? Justify your answer. [2]

CO4 U (d) Mention advantages and disadvantages, if any, of non-determinism in models of computation. [2]

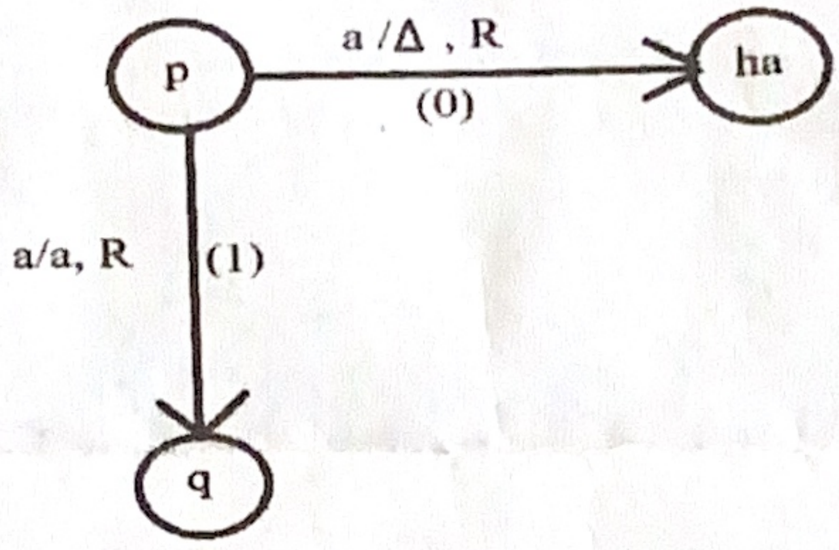
CO1 U (e) Is Minimal Counter Example Principle related to any other proof technique(s)? Justify your answer. [2]

Q.5 **Attempt *Any TWO* from the following questions.** **[10]**

CO3 C (a) Construct a Turing Machine for reversing the input string. Perform execution Trace for the input " abb". [5]

CO3 C (b) Draw a transition diagram for a Turing Machine for accepting [5]
$\{x \in \{a, b, c\}^* \mid n_a(x) = n_b(x) = n_c(x)\}$.
Here, $n_i(x)$ **means no. of i's in the input string x.**

CO3 C (c) Construct Transition Diagram of Execute Sub-Turing Machine (Deterministic Turing Machine) for a given below non-deterministic Turing Machine, [5]



Assume that NDTM (T_1) has alphabet 'a' other than 'Δ'. Make and clearly specify necessary assumptions.

Q.6 **Attempt the following questions.** **[10]**

CO3 U (a) Prove the following statement: [8]
If $L \subseteq \sum^*$, is a language that is accepted by the NFA-Λ $M = (Q, \sum, q_0, A, \delta)$, then there is an NFA $M_1 = (Q_1, \sum, q_1, A_1, \delta_1)$ that also accepts L.

CO1 U (b) Write a recursive definition for a subset of $\{a, b\}^*$ having the set of all strings containing at least one 'a' and all the a's precede all the b's. [2]

OR

Q.6 **Attempt the following questions.** **[10]**

CO3 U (a) State and prove Kleene's Theorem – Part I. [8]

CO1 U (b) Write a recursive definition for a subset of $\{a, b\}^*$ having the set of all strings that start with 'a' and do not contain the substring "aa". [2]

Bloom's Taxonomy levels: R-Remembering, U- Understanding, A-Applying, N-Analyzing, E- Evaluating, C-Creating