DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER VI [COMPUTER ENGINEERIG]
SUBJECT: (CE-623) THEORY OF AUTOMATA AND FORMAL LANGUAGES

Examination	**: First Sessional**	**Seat No.**	**: 103**
Date	**: 01/01/2025**	**Day**	**: Wednesday**
Time	**: 2:30 PM to 3:45 PM**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed. **[12]**

CO1 A (a) Write non-recursive definition for the language of Palindrome. You may use some known recursive function in the definition, if required. [2]

CO1 U (b) Is there any proof technique, which can be considered "An inductive proof by contradiction"? Justify your answer. [2]

CO1 A (c) Write recursive definition for the set **w** of all strings of the form $\mathbf{0^i1^j}$ where $\mathbf{i \geq 2j}$. [2]

CO1 N (d) Find an infinite language over {a,b} for which $L \neq L^*$. [2]

CO1 U (e) Which of the following regular expression(s) is/are equivalent to the below given regular expression: $\mathbf{r = (a^*b)^* + (b^*a)^*}$. Justify your answer. [2]

1. $(a + b)^*$
2. $(a + b)^* (ab)^+ + (a + b)^* (ba)^+$
3. $(a + b)^* a + (a + b)^* b$
4. None of the above

CO1 N (f) Suppose A and B are finite sets, A has ***n*** elements, and ***f: A → B***. What can you say about the number of elements in B when, (1) ***f*** is **one-to-one** (2) ***f*** is **onto.** [2]

Q.2 Attempt *Any TWO* from the following questions. **[12]**

CO1 U (a) Define recursively the reverse function for reversing the input string. Using your definition, prove the following statement: [6]
Rev(xy) = Rev(y) Rev(x) for x,y $\in \Sigma^*$.

CO1 U (b) Prove using P.M.I./ other proof technique, every positive integer N is the product of power of 2 and an odd integer. [6]

CO1 U (c) Define the language of fully parenthesized algebraic expression. Assume that **Σ = { i + -) (}**. Prove using structural induction that no prefix of any string in the language contains more right parenthesis than left. [6]

Q.3 Attempt the following questions. **[12]**

CO2 N (a) Find a regular expression for the following languages. [4]

1. L = { w belongs to {a, b, c}* | all strings contain at least 1 occurrence of each symbol }
2. L = { w belongs to {a, b, c}* | length(w) mod 3 = 0 }

CO2 C (b) Construct a DFA using cross product of FA for the below given language L over Σ = {a, b}. Show each step of the process. [8]

L = { w | n_a (w) ≥ 2 and n_b (w) ≥ 2 }

OR

Q.3 Attempt the following questions. **[12]**

CO2 C (a) Identify the language and construct a minimal DFA for a regular expression: [4]
r = (aaa + aaaaa)*

CO2 N (b) Minimize the given DFA and demonstrate each step of the process. [8]