BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B.TECH
BRANCH: CSE

SEMESTER : V/ADD
SESSION : MO/2025

SUBJECT: CS331 FORMAL LANGUAGE AND AUTOMATA THEORY

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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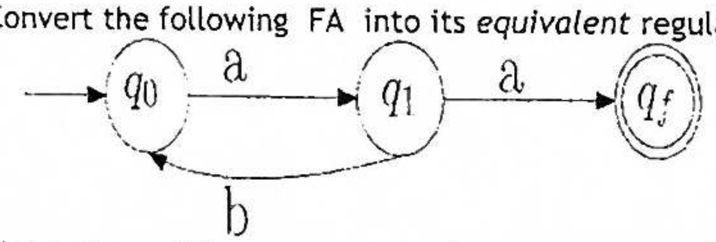
	Question	Marks	CO
Q.1(a)	"If 'n' is the number of states in NFA, the maximum possible states in the corresponding DFA is $n!$". Justify if the statement is *correct*. Otherwise correct it.	[2]	CO2
Q.1(b)	Consider the following transition table of NFA with alphabet: $\Sigma = \{a, b\}$, states: $Q = \{q0, q1, q2, q3\}$, start state: q0 and the accepting state: q3.	[3]	CO1

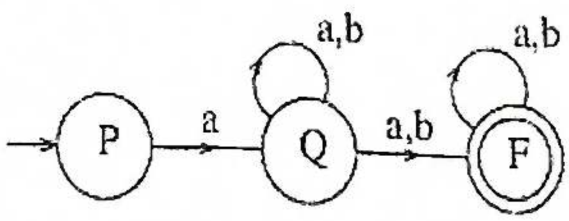
Current state	On Input symbol: 'a'	On Input symbol: 'b'
q0	q0, q1	q0
q1	q2	--
q2	q2, q3	q2
q3	q2	q1

Convert it to equivalent DFA and show the transition table of the equivalent DFA. Mark the *initial state* and *final state*(s) of the equivalent DFA.

Q.2(a) Convert the following FA into its *equivalent* regular expression. [2] CO3



Q.2(b) Show all possible *sequences* (paths) of *state* and the *input-symbol* to process the string: "*aba*" from P. *For example*, for w=*aab*, one path is: P-a-Q-a-Q-b-Q. Among the paths for "*aba*", identify the *valid paths* for accepting the string. What is the probability that the automata successfully accepts the string "*aba*"? [3] CO1



Q.3(a) Consider the language $L = \{a^n b^n \mid 0 \le n \le 10 \text{ and } n \ne 5\}$. Justify your answer whether the language L is *regular* or not. [2] CO3

Q.3(b) Formally define Mealy machine and Moore machine. Construct a Moore Machine that recognizes the string "**ON**" over an input sequence of characters : $\Sigma = \{O, N\}$, giving output "*Luck*". The machine should output "*Bad Luck*" otherwise. [3] CO1

Q.4(a) The statement of the *Pumping Lemma* for regular language is stated as follows: [2] CO3

Let $M = (Q, \Sigma, \delta, q_0, F)$ be a finite automaton with n states. Let L be a language accepted by M (L is regular) and a string $w \in L$, where $|w| \ge m$. If $m \ge n$, we can break w into substrings: x, y, z such that $w = xyz$, where $|y| \ge 0$ and $x(y)^i z$ is in L for $i > 0$.

Identify the *errors* (if any) in the Lemma and correct those.

Q.4(b) Design regular expression to recognize the following languages over {0,1}. [3] CO3

(i) L = {w | w consists of *at most* two 0s }.

(ii) L = {w | w consists of *even* number of 0s and *odd* number of 1s}.

Q.5(a) Define grammar formally with examples. What is the *limitation* of Formal grammar? [2] CO1

Q.5(b) Construct a minimized DFA over {0, 1} that accepts all strings *ending* with "0" and the *length* of the string is even. [3] CO2