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

CLASS: BTECH/IMSC
BRANCH: CSE/MATHS

SEMESTER : V/ADD
SESSION : MO/2025

SUBJECT: CS331 / CS310 FORMAL LANGUAGE AND AUTOMATA THEORY

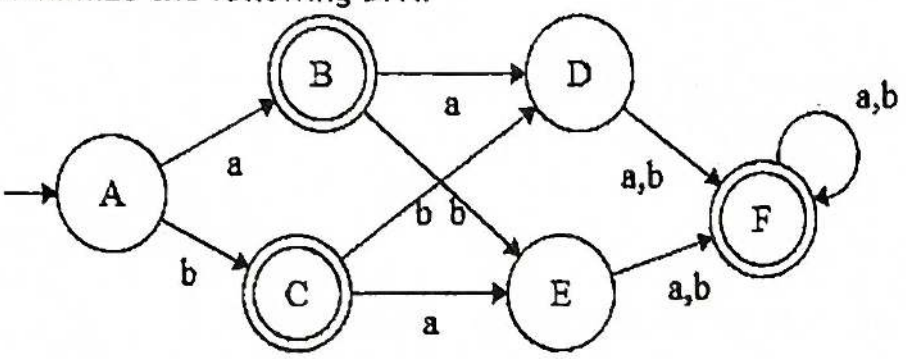
TIME: 3 Hours

FULL MARKS: 50

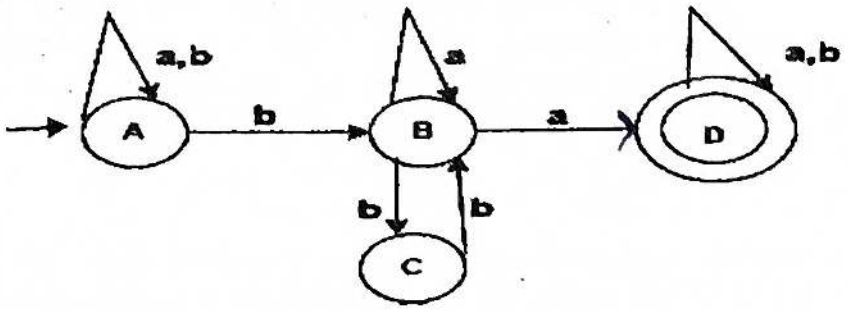
INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Let Σ={a, b}. Design a DFA to accept strings that do not *begin* and *end* with same symbol. Is the *complement* of the language $L = \{a^n b^n \mid 0 \le n \le 3\}$ regular? Justify your answer.	[5]	CO-1	
Q.1(b)	Minimize the following DFA.	[5]	CO-2	



Q.2(a)	Design a RE for the language: $L=\{a^m \# b^n \mid m, n>0\}$. Design an NDFA (without using *null*-move) to recognize the language generated by the RE= $(a+b)^*b(a+b)$.	5	CO-3	
Q.2(b)	State the Arden's *lemma* and find the regular expression of the given finite automata using Arden's lemma.	[5]	CO-3	



Q.3(a)	Find the language(L) generated by the grammar: $G = (V_N, \Sigma, P, S)$, where $V_N = \{S\}$, $\Sigma = \{a, b\}$ and P consists of the rules: (i) $S \rightarrow aS$ (ii) $S \rightarrow bS$ (iii) $S \rightarrow a$ (iv) $S \rightarrow b$. S is the start symbol of G. Is this grammar CFG? Justify. Draw a parse tree for any valid string(w) of length at least 3 in L(G).	[5]	CO-3	
Q.3(b)	Design a grammar for the language $L = \{(ab)^n \mid n \ge 1\}$ over {a, b}. Let the language $L_1=\{ a^i b^j \mid i, j \ge 1$ and $i=j\}$ over Σ={a, b}. Is the complement of L_1 CFL? Justify your answer.	[5]	CO-3, CO-4	
Q.4(a)	Let R={S→ aBc , B→b} be the rule set of a grammar (G), where V_N={S, B} and Σ={a, b, c}. Is this rule set in GNF? If not, convert it into GNF. Define formally PDA. Under what conditions, a PDA is to be considered as deterministic?	[5]	CO-3, CO-4	
Q.4(b)	Design a PDA for $L = \{a^m b^n c^n d^m \mid m, n \ge 1\}$? Can the language: $L = \{a^m b^n c^m d^n \mid 0 \le m \le 2, 0 \le n \le 3\}$ be recognized by a PDA? Justify your answer.	[5]		

PTO

Q.5(a) Consider a RE=((a + b)*a). Design a single tape Turing Machine with no more than three states to accept the language(L) generated by the RE. [5] CO-5

Q.5(b) Design a single tape Turing machine to add *two* positive integers, and show the output of (4+3) on the tape. [5] CO-5

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