

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

CLASS: BTECH  
BRANCH: CSE

SEMESTER : V  
SESSION : MO/2025

**SUBJECT: CS331 FORMAL LANGUAGE AND AUTOMATA THEORY**

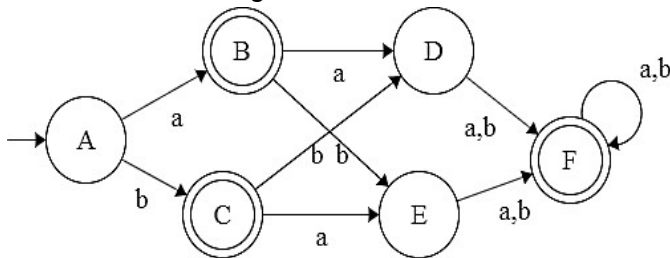
TIME: 3 Hours

FULL MARKS: 50

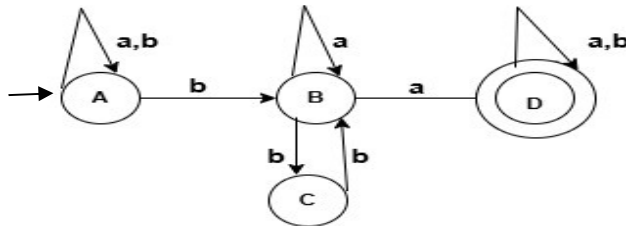
**INSTRUCTIONS:**

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.

- Q.1(a) Let  $\Sigma = \{a, b\}$ . Design a DFA to accept strings that do not *begin* and *end* with same symbol. Is the *complement* of the language  $L = \{a^n b^n \mid 0 \leq n \leq 3\}$  regular? Justify your answer. [5] CO-1 BL
- 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 NDFSA (without using *null-move*) to recognize the language generated by the RE =  $(a+b)^* b (a+b)$ . 5 CO-3
- Q.2(a) 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  $L = \{(ab)^n \mid n \geq 1\}$  over  $\{a, b\}$ . Let the language  $L_1 = \{a^i b^j \mid i, j \geq 1 \text{ and } i=j\}$  over  $\Sigma = \{a, b\}$ . Is the complement of  $L_1$  CFL? Justify your answer. [5] CO-3, CO-4
- Q.4(a) Let  $R = \{S \rightarrow aBc, B \rightarrow b\}$  be the rule set of a grammar (G), where  $V_N = \{S, B\}$  and  $\Sigma = \{a, b, c\}$ . 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  $L = \{a^m b^n c^n d^m \mid m, n \geq 1\}$  [5]  
Can the language:  $L = \{a^m b^n c^m d^n \mid 0 \leq m \leq 2, 0 \leq n \leq 3\}$  be recognized by a PDA? Justify your answer.

- 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

::::::19/11/2025::::::M