Reg. No. : | | | | | | | | | | | | |

Question Paper Code:R5E02

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Fifth Semester

R21UAD502 – FORMAL LANGUAGES AND COMPUTATION

Artificial Intelligence & Data Science

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

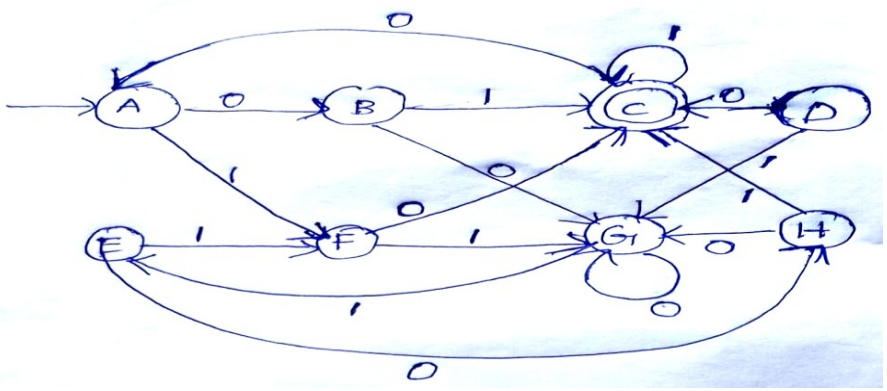
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1.	State any four types of proofs.	CO1- U
2.	Find DFA over ∑=(a,b) which produces not more than 3a's.	CO2- App
3.	Name the four closure properties of RE.	CO1- U
4.	Find out the language generated by the regular expression (0+1)*.	CO2- App
5.	Find derivation tree for the string abaaba for the CFG given by, G where Productions are S -> aSa S->bSb S->a|b| ε	CO2- App
6.	Find the string aaabbabbba for the Grammar G with S→aB|bA A→a|aS|bAA B →b|bS|aBB	CO2- App
7.	Define the language recognized by any Turing Machine	CO1-U
8.	Find a transition diagram for a Turing machine to identify n mod 2.	CO2- App
9.	Describe an example of an undecidable problem	CO1- U
10.	Define a universal language Lu?	CO1- U

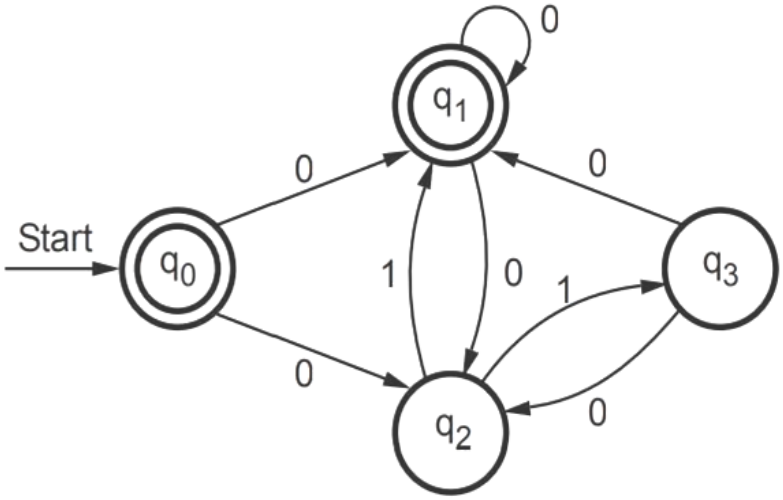
PART – B (5 x 16= 80 Marks)

11. (a) Identify and explain the algorithm for minimization of DFA. Using the above algorithm minimize the following DFA. CO2-App (16)



Or

(b) (i) Convert the following NFA into DFA CO2-App (16)



(ii) Construct a NFA to accepting the set of strings over {a,b} ending in aba. Use it construct a DFA accepting the same set of strings.

12. (a) Prove that regular languages are closed under each of these operations. For your proofs, use the following approach: CO1-U (16)

- **Union**: Given two regular languages L1L_1L1 and L2L_2L2, show that their union L1∪L2L_1 \cup L_2L1∪L2 is also a regular language.
- **Intersection**: Given two regular languages L1L_1L1 and L2L_2L2,
  show that their intersection L1∩L2L_1 \cap L_2L1∩L2 is also a regular language.

Or

(b) Define and Explain the closure properties of regular languages with respect to the following operations: CO1-U (16)

- Union
- Intersection
- Complement
- Concatenation
- Kleene Star

13. (a) Find PDA that recognizes and analyzes the language $\{a^i b^j c^k | i,j,k>0$ and i=j or i=k$\}$. Explain about PDA acceptance CO1-U (16)

- From empty Stack to final state.
- From Final state to Empty Stack.

Or

(b) Define a Context-Free Grammar (CFG) and a Pushdown Automaton (PDA). Differentiate the relationship between CFGs and PDAs — CO1-U — (16)

14. (a) (i) Define pumping lemma for CFL. Show that $L=\{a^i b^j c^k, i<j<k\}$ is not context free. — CO2-App — (16)

(ii) Find a grammar in Chomsky normal form equivalent to $S \rightarrow aAbB$, $A \rightarrow aA|a$, $B \rightarrow bB|b$.

Or

(b) (i) Find a grammar in Chomsky normal form equivalent to $S \rightarrow aAD$, $A \rightarrow aB|bAB$, $B \rightarrow b$, $D \rightarrow d$. — CO2-App — (16)

(ii) Find a grammar in Greibach normal form equivalent to $S \rightarrow AA|0$, $A \rightarrow SS|1$

15. (a) Explain and state RICE theorem — CO1-U — (16)

Or

(b) (i) Define PCP and prove that PCP is undecidable. — CO1-U — (16)

(ii) Explain that "MPCP reduce to PCP".