END TERM EXAMINATION

FOURTH SEMESTER [B.TECH] JUNE 2025

Paper Code: CIC-206 **Subject: Theory of Computation**

Time: 3 Hours **Maximum Marks:60**

Note: Attempt any five questions including Q.No.1 which is compulsory. Select one question from each unit.

Q1 Attempt all **[4x5=20]**

a) Describe the Chomsky Classification of language with example.

b) Draw the DFA equivalent to the CFG with productions P = {S→0S/1A, A→1A/0B, B→1B/∧}. Here ∧ is used for null.

c) Prove that if there is a polynomial time reduction from P_1 to P_2 and if P_2 is in P then P_1 will be in P.

d) Prove that every language accepted by a multi tape TM is acceptable by some single-tape TM.

e) Define the classes PSPACE and NSPACE complexity classes. Give example problems for both.

UNIT-I

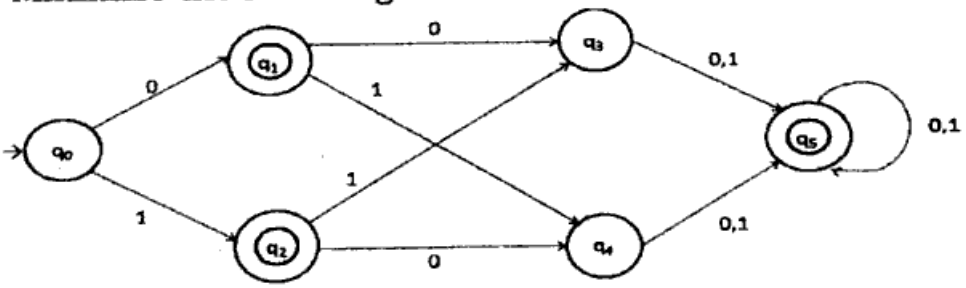
Q2 a) Construct a Mealy machine equivalent to the Moore machine given in the table. **[3]**

Present State	Next State a= 0	Next State b=1	Output
→q_0	q_1	q_2	0
q_1	q_3	q_2	1
q_2	q_2	q_1	0
q_3	q_0	q_3	1

b) Construct a DFA to accept all strings over {0,1} which contains three consecutive Zeros. **[3]**

c) Define NFA with the help of an example. **[4]**

Q3 a) Minimize the following DFA. **[3]**



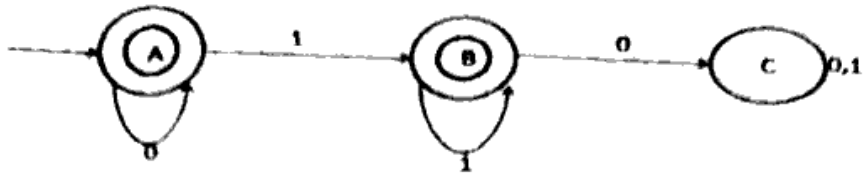
b) i) Find the regular expression for the set $\{a^n b^m : (n+m) \text{ is odd}\}$. **[1]**

ii) Find a regular expression over {a,b} for all the strings that start and end with the same symbol. **[2]**

c) Using Pumping Lemma prove that the language $A=\{ a^n b^n \mid n \geq 0\}$ is not regular. **[4]**

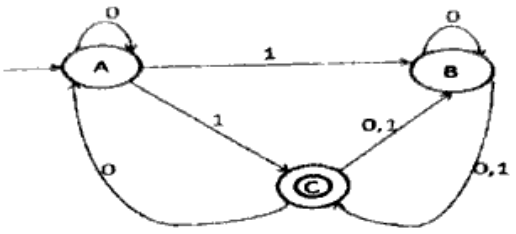
P.T.O

Q3 a) Write down the regular expression for the following diagram. [4]



b) Design a FA that accepts all binary strings where 0's and 1's are alternate. [3]

c) Convert the following NFA (Figure given below) into an equivalent DFA. [3]



UNIT-II

Q4 a) i) What is Context Free Grammar? How it is useful to generate Context Free Language using Push Down Automata? [4]

ii) Differentiate between DPDA and NDPDA. [1]

b) Explain the language accepted by Pushdown Automata using final state and empty stack with suitable examples. [2.5]

c) Draw a pushdown automata for the CFG given below [2.5]
S→aSb ; S→a/b/Є

Q5 a) Define Parsing and Ambiguity. Also explain the Left and Right Derivation tree with the help of an example. [4]

b) Convert the following Context Free Grammar to Chomsky Normal Form [3]
P: S→ASA/aB, A→B/S, B→b/Є

c) Explain Closure properties of Context Free Grammar. [3]

UNIT-III

Q6 a) Give the Formal definition of Turing Machine. [3]

b) Explain the representation of Turing Machine by instantaneous Description using diagram. [3]

c) Consider the Turing machine given by the following table and Draw the transition diagram of the Turing machine, where tape symbols are (1,b) and L,R are R/w head moves. [4]

Present State	Input Type 1	Symbols b
→q_0	1 R q_0	1 R q_1
q_1	1 R q_1	b L q_2
q_2	b L q_3	—
q_3	1 L q_3	b R q_4
q_4	—	—

P.T.O.

Q7 a) Explain Reducibility and undecidability. How can we use Reducibility to prove undecidability? **[4]**

b) Explain Universal Turing Machine. Design a Turing Machine that accepts the language denoted by regular expression 11^*. **[3]**

c) Explain Rices Theorem and Recursion Theorem. **[3]**

UNIT- IV

Q8 a) In context to Computational Complexity Theory, define **[4]**

i) Solvable and Unsolvable problems

ii) Decidable and Undecidable problems.

b) Explain P and NP problems. When can we call a problem NP-hard and NP-complete? **[3]**

c) State and prove Cook's Theorem. **[3]**

Q9 a) In context to Complexity theory explain PSPACE and NSPACE complexity classes. **[4]**

b) State and Prove Savitch Theorem. **[3]**

c) What do you mean by Interactive proof systems and IP class. **[3]**

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