Cluster Innovation Centre, University of Delhi, Delhi-110007

Examination	: End Semester Examination – MAY 2023
Name of the Course	: B. Tech (Information Technology and Mathematical Innovations)
Name of the Paper	: Decoding Computation Structure and Logic
Paper Code	: 32861602
Semester	: VI
Duration	: 2 Hours
Maximum Marks	: 50

Instructions:

- Question 1 is Compulsory
- Attempt any 4 out of Q2-Q6

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1. Attempt the following questions : **(2x5=10 Marks)**

   a. Construct a DFA which accepts a language of all strings not starting with 'a' or not ending with 'b'.

   b. Write a regular expression for not more than 2 a's and 1 b's of a string w = {a, b}*

   c. Write CFG to accept the language defined by, $L = \{a^i b^j c^k \mid i,j, k>= 0$ and $i=j+ k\}$.

   d. Write a regular expression for even number of a's and even number of b's of a string w = {a, b}*.

   e. When do you say a CFG is ambiguous?

2. Differentiate between **any two** of the following: **(5x2=10 Marks)**

   a. DFA and NDFA.

   b. Mealy Machine and Moore Machine.

   c. CNF and GNF

3. Attempt the following questions : **(5x2=10 Marks)**

   a. Design an ε – NFA (Nondeterministic Finite Automaton) to recognize the language L, containing only binary strings of non-zero length whose bits sum to a multiple of 3. Convert ε – NFA into an equivalent minimized

deterministic finite automaton. Illustrate the computation of your model on any sample input.

b. Prove that regular expressions are closed under union and Kleene closure.

4. Attempt the following questions : **(5x2=10 Marks)**

a. What language over {0, 1} does the CFG with productions

$S \rightarrow 00S|11S|S00|S11|01S01|01S10|10S10|10S01|\in$ will generate? Justify your answer.

b. Convert the following grammar to Chomsky Normal form.

$S \rightarrow A|AB0|A1A$

$A \rightarrow A0|\in$

$B \rightarrow B1|BC$

$C \rightarrow CB|CA|1B$.

5. Attempt the following questions : **(5x2=10 Marks)**

a. Construct an appropriate model to recognize the language L defined by, L = $\{a^n b^m c^m d^n \mid n,m >= 0\}$.

b. Find whether L = $\{a^n b^n c^n \mid n >= 1\}$ is context free or not.

6. Attempt the following questions : **(2.5 x 4=10 Marks)**

a. What is a Turing Machine?

b. Define Chomsky Hierarchy of Languages.

c. State Post's correspondence problem.

d. State and explain Pumping Lemma for Regular Languages.