National Institute of Technology Mizoram

End-Semester Examination, Even Semester – (2022-2023)

Theory of Computation (CSL 1403)

B.Tech 4th Semester **Full Marks: 50** **Duration: 2.30 hours**

All questions are Compulsory All Questions Carry the Same Marks
(5 × 10 = 50 Marks)

1. (a) State the below languages L_1, L_2, L_3, L_4 and L_5 are CFG or not with reason [5]

   $L_1 = \{a^n b^m c^m d^{n+1} | n, m \geq 1\}$

   $L_2 = \{a^n b^m c^m d^n | n, m \geq 1\}$

   $L_3 = \{a^n b^m c^n d^m | n, m \geq 1\}$

   $L_4 = \{a^n b^n c^m | n, m \geq 1 \text{ and } n > m\}$

   $L_5 = \{a^n b^n c^n d^n | n \leq 10^{10}\}$

   (b) Let us consider the following grammar G_3 and G_4 [5]

   $G_3 = (S \rightarrow S + S/S * S/a/b)$

   $G_4 = (S \rightarrow a/abSb/aAb, A \rightarrow bS/aAAb)$

   Find the grammar G_3 and G_4 are ambiguous or not

2. (a) What is PDA [5]

   $L_1 = \{a^n b^n | n \geq 1\}$

   Construct a PDA for L_1.

   (b) What is TM [5]

   $L_2 = \{a^n b^n c^n | n \geq 1\}$

   Construct a TM for L_2

3. (a) Construct a PDA for L_3 [5]

   $L_3 = \{ww^R | w \in (a, b)^*\}$

   (b) Write a set of rules to construct a PDA from a CFG [5]

   $G_1 = (S \rightarrow 0BB, B \rightarrow 0S/1S/0)$

   Find a PDA for G_1.

4. (a) Construct a TM as a Copier and Comparator Give an example of Non-halting TM [7]

   (b) Consider the following grammar G_2 [3]

   $G_2 = (S \rightarrow 0B/1A, \quad A \rightarrow 0/0S/1AA, \quad B \rightarrow 1/1S/0BB)$

   For the string 00110101, find the LMD, RMD, and DT using G_2

5. (a) Reduce the following grammar G_3 [4]

   $G_3 = (S \rightarrow aAa, A \rightarrow Sb/bCC/DaA, C \rightarrow abb/DD, D \rightarrow aDA, E \rightarrow aC)$

   (b) Covert the following grammar G_6 into CNF [6]

   $G_6 = (S \rightarrow abAB, A \rightarrow bAB, B \rightarrow BAa/A/\lambda)$

Answer all questions

Q.1) Consider the regular expression r−0*(10*10*) *10*
Which of the following are not valid strings? Explain your answer.
   (1) 0101010011 (2) 1111001111001 (3) 0011001100111
(a)Cannot be determined (b) Only 1 (c) Only 2 (d) None of these

[2]

Q.2) The string 1101 does not belongs to the set represented by
(a) 110*(0+1) (b) 1(0+1) * 101   (c)(10) * (01) *(00+11) *   (d) (00 +(11) *0) *
    Explain your answer.   [2]

Q.3) Construct a DFA for the binary string in which every 0 is followed by 11.   [3]

Q.4) Construct a non-deterministic finite automaton accepting the set of strings over {a, b}
ending in aba. Use it to construct a DFA accepting the same set of strings.

[2+3]

Q.5) Construct Regular Expression for the following languages:
        a. The set of all strings over {0, 1} ending with 00 and beginning with 1
        b. The set of all string over {a, b} that contain at most two 'a'.

[2x1.5=3]

***** Best Wishes*****