Thapar Institute of Engineering and Technology, Patiala
Electrical and Instrumentation Engineering (EIED)

**UCS701**

# Theory of Computation

## MID-SEMESTER TEST (MST)

**BE-Electrical and Computer, VII Semester, 2023-24**

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| **October 7, 2023** | Saturday, 3PM |
| **Duration: 2 Hrs** | Max. Marks: **35** |
| Name of Faculty : | Dr. Ashish Gupta |

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**General Instructions**: Attempt all questions with proper Justification. **Without Justification Zero marks will be awarded.**
**Notation:** $n_a(w)$ represents the number of occurrences of the symbol 'a' in the string 'w'.

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1. (a) Use Thompson's construction to draw the NFA (No DFA required) for the language $L$=10*(01+0)* over $\Sigma$={0,1}. **[3]**

   (b) **Design** an **NFA** over $\Sigma$ ={a,b} to accept $L = \{a^m b^n |\ m+n$ is odd$\}$. Convert the NFA into DFA using **subset construction.** Use of Thompson's construction is optional. **[4]**

2. Consider the language $L = \{w \in \Sigma^* |\ n_a(w) mod\ 3 \neq 0$ or $n_b(w) mod\ 2 = 0\}$. Systematically design a DFA accepting $L$ by using the closure properties of regular languages. Also, demonstrate the steps for constructing a regular grammar (capable of generating the string in $L$) from a DFA for $L$. **[5+2]**

3. (a) Use properties of regular languages to prove that the following languages are **not regular.** **[1.5 × 2]**

   i) $L_1$={$w \in \{a,b\}^* \mid n_a(w) \neq n_b(w)$}

   ii) $L_2 = \{a^n b^k c^{n+k} : n \geq 0,\ k \geq 0\}$

   (b) Using Pumping Lemma, prove that $L_{pal} = \{w \in \{a,b\}^* | w$ is palindrome$\}$ is not a regular language. **[4]**