National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	**Theory of Automata**	**Course Code:**	
	Degree Program:	**BS(CS)**	**Semester:**	**Fall 2025**
	Section:	**3A,3B,5F**	**Marks:**	**20**
	Assignment	**3**	**Deadline**	**3rd Dec**

Question: Construct a Single Tape Turing Machines for the following questions:

1- Turing Machine that ensures if binary string w follows the even parity. Input can be string of any length, and the output should maintain even parity.
2- Turing Machine to increment a binary number by 1. For example, 1011 should become 1100.
3- Turing Machine to check if a binary string is a palindrome. For example, 101 should be accepted and 1100 rejected.
4- Turing Machine to remove all 0s from a binary string w. For example, 1010011 should become 1111.
5- Turing Machine to divide a unary number n by 2. For example, n=1111 should result in 11.
6- Turing Machine to check if the number of 1s in a unary string is divisible by 3. For example, 111 should accept, but 1111 should reject.
7- Turing Machine to check if the first part of a string (before a delimiter #) is the postfix of the second part. For example, 10#1010 should accept, but 11#1010 should reject.
8- Turing Machine to check if two binary strings (separated by a delimiter #) are equal. For example, 101#101 should accept, but 101#100 should reject.
9- TM whose language is equal to the following language:**L={a^n| n is a Fibonacci number}.**
A Fibonacci number is defined as follows:
$F_0=0$, $F_1=1$,$F_n=F_{n-1}+F_{n-2}$ for n≥2.
For example,

	// because 0 = F_0
a	// because 1 = F_2 = F_1
aa	// because 2 = F_3 = F_2 + F_1 = 1 + 1
aaa	// because 3 = F_4 = F_3 + F_2 = 2 + 1
aaaaa	// because 5 = F_5 = F_4 + F_3 = 3 + 2

10- TM whose language is equal to the following language: **L={$a^{n\wedge 2}$| n≥0}**
For example, the following words are in the language:

	// because 0 = 0^2
a	// because 1 = 1^2
aaaa	// because 4 = 2^2
aaaaaaaaa	// because 9 = 3^2
aaaaaaaaaaaaaaaa	// because 16 = 4^2