Assignment 05
Second Year BS (Honors) 2023-2024
Course Title: Math Lab II, Course Code: AMTH 250
Department of Applied Mathematics, University of Dhaka

Name: **Roll No.:**   **Group:**

*[Write a Fortran Program to solve each of the following problems. Use files for input/output unless specified otherwise. Name the files and the code according to the assignment and problem no., e.g., for problem no. **Y** of assignment **X**, input and output file names must be 'inXqY.txt' and 'outXqY.txt' respectively.]*

1. The *Mersenne* numbers are defined by $M_n = 2^n - 1$ where $n = 0, 1, 2, 3, ...$ Generate the first 70 *Mersenne* numbers and print them in the following tabular form:

n	0	1	2	3
M_n	0	1	3	7

   Also determine the Mersenne primes in the list. You may need to take *logarithm* of the numbers to find the primacy if the number is large enough.

   [NB: Don't forget to consider the accurate version of integers.]

2. Let H_n denote the number of moves needed to solve the Tower of Hanoi problem with n disks. The recurrence relation with the initial condition is given for the problem is

   $$H_n = 2H_{n-1} + 1; H_1 = 1$$

   Use recursive function as a subprogram to determine the number of moves required if $n = 1, 4, 9, 16, ..., 64$. If each move takes 5 seconds, how many days needed to solve the tower of Hanoi problem. Show your findings as follows:

N	H_n	Days
1	1	1
2	7	1
N	...	...

   Now generate the relation between the H_n and M_n (from Problem 1) by showing the numbers in tabular form.

3. Use **function** and **recursive function** to find first 20 Fibonacci numbers. Comment on the convergence of each process.

4. Generate all the possible bit strings of length $n = 8$. Print these strings in ascending and descending orders. Remove all the strings which have the element 101 and 100 at any position. Now print the number of such bit strings possible and show the resulting bit strings in the terminal.

5. Use recursive function as a subprogram to find the factorial value and hence use the function to determine n_{C_r} & n_{P_r}. Hence calculate $^{10}P_6$, $^{10}C_4$ and $^{10}C_6$.

6. Write a Fortran program to construct a truth table for $(p \wedge q) \vee r$ and $(p \vee r) \wedge (q \vee r)$ and decide if it is a tautology.

7. Consider the recurrence relation $a_n = 2a_{n-1} - a_{n-2} + 3$ with the initial condition $a_0 = 1, a_1 = 5$. Find a_n for $n = 1, 2, \ldots, 50$. Compare the results with the exact solution $a_n = \frac{3}{2}n^2 + \frac{5}{2}n + 1$. Show your results with suitable descriptor making a suitable table.