Course Type	Course Code	Name of Course	L	T	P	Credit
DP	NMEC518	Computing Lab	0	0	3	1.5

Course Objective
This course aims to enhance coding skills in using various numerical methods
Learning Outcomes
On successful completion of this course, students will learn: • To code numerical schemes using MATLAB programming • To numerically integrate a function and solve ODEs and PDEs • To solve a system of algebraic equations by self-developed and inbuilt routines. • To solve nonlinear equations using self-developed and inbuilt numerical methods. • To solve curve-fitting problems using computer codes.

Unit No.	Topics to be Covered	Contact hours	Learning Outcomes
1	Introduction to Matlab/a programming language to be used in the course.	3	Students will become familiar with the coding platform to be used for teaching various numerical techniques.
2	Loops and conditional statements	3	Students will learn the working principle of different loops and conditional statements by writing small codes.
3	To find roots of a single nonlinear equation usingself-developed codes and inbuiltfunctions.	3	Students will learn the coding techniques and algorithms of root finding techniques, such as bisection, Newton-Raphson, secant method, etc, for a single nonlinear equation. They will also learn how to call and use different inbuilt functions like *fzero*, *fsolve*, etc.
4	To find roots of a coupled system of nonlinear equations using self-developed codes and inbuilt functions.	3	Students will learn the coding techniques and algorithms of root finding techniques, such as bisection, Newton-Raphson, secant method, etc, for a coupled system of nonlinear equations. They will also learn how to call and use different inbuilt functions like *fzero*, *fsolve*, etc.
5	Numerical integration techniques, such as the Trapezoidal method, Simpson's method, and the Newton-Cotes method (including higher order).	3	Students will be able to code different numerical integration techniques.
6	Learning numerical integration techniques, such as evaluation of multiple integrals, integration with unequal segments, and open methods; Romberg integration, Gauss and adaptive quadrature.	3	Students will be able to code different numerical integration techniquesthat are more efficient than the above ones in case of various complex research problems
7	To solve ordinary differential equations (ODEs) using Euler's method, modified Euler's method, Runge-Kutta method, adaptive Runge-Kutta method, explicit Adams-Bashforth method, implicit Adams-Bashforth method, etc.	3	Students will learn different coding techniques for solving ODEs.

8	To solve boundary value problems (BVPs) using the shooting method, finite difference method, and MATLAB/other platform-specific commands/libraries.	3	Students will learn different coding techniques for solving BVPs.
9	To solve a system of linear algebraic equations using Gauss elimination method, LU decomposition using Crout's method; calculating the inverse with the LU decomposition method, calculating the inverse using the Gauss-Jordan method.	3	Students will learn different coding techniques for solving linear algebraic equations, such as Gauss elimination method, LU decomposition using Crout's method; calculating the inverse with the LU decomposition method, etc.
10	To solve a system of linear algebraic equations using the Jacobi iterative method, and Gauss-Seidel iterative method; learning the usage of MATLAB/ other platform's built-in functions for solving a system of linear equations.	3	Students will learn different coding techniques for solving linear algebraic equations, such as Jacobi iterative method, and Gauss-Seidel iterative method; learning the usage of MATLAB/ other platform's built-in functions, etc.
11	To solve a system of linear algebraic equations with CG, GMRES, Bi-CGSTAB, etc. methods (Poisson, Laplace, or Helmholtz equations) in Cartesian or Cylindrical-Polar coordinates.	3	Students will learn how to solve a system of linear algebraic equations with CG, GMRES, Bi-CGSTAB, etc. methods.
12	To learn curve fitting and interpolation using linear regression, non-linear regression, Lagrange polynomials, cubic splines, and the use of MATLAB for curve fitting and interpolation.	3	Students will learn to code different numerical techniques of curve fitting and interpolation.
13	To compute eigenvalues and eigenvectors using the basic power, inverse power, shifted power, QR factorization, and iteration methods, and MATLAB built-in functions for determining 1eigenvalues and eigenvectors.	3	Students will learn to code different numerical techniques to evaluate eigenvalues and eigenvectors.
14	To numerically determine the extremum of a function using the Golden Section optimization method.	3	Students will learn to develop a code to determine the extremum of a function using the Golden Section optimization method.

Total = 14 x 3 = 42 hrs

Text Books

1. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, 7th Edition, McGraw Hill Education

Reference books

1. Introduction to Numerical and Analytical Methods with Matlab for Engineers And Scientists, William Bober, 2013.