PREFACE OF THE COURSE FILE
DEPARTMENT OF MECHANICAL ENGINEERING
TEZPUR UNIVERSITY

Code and Title of the Course	:	**ME530 – Numerical Methods**
L-T-P Structure of the Course	:	**3-0-1-4-5**
Category of the Course	:	**Core**
Course offering Department	:	**Mechanical Engineering**
Name of the Programme	:	**M.Tech. in Mechanical Engineering (*Specialization*: Thermal and Fluid Engineering)**
Academic Year	:	**2024–2025**
Session	:	**Spring Semester, 2025**
Students' Batch	:	**2024–2026**
Semester	:	**Second**
Class Timetable of the Course	:	$\frac{\textbf{Mon}}{\textbf{11.30–12.30}}$, $\frac{\textbf{Wed}}{\textbf{15.30–16.30}}$, $\frac{\textbf{Thu}}{\textbf{15.30–17.30}}$, $\frac{\textbf{Fri}}{\textbf{11.30–12.30}}$
Course Coordinator/Instructor	:	**Prof. Dilip Datta**

1 Objectives

(1) The main objective of the course is to impart knowledge to students on how to solve a mathematical model numerically using the computing power of a computer, which is very tough or even impossible to solve by an exact method.

(2) To teach students both theory and programming of important numerical methods often required in practical computations.

Instructor **HOD**

2 Lesson Plan

SN	Unit	Chronological Sub-Units (CSUs)	L+P	Completion Date		Remarks
				Proposed	Actual	
1	Introduction*	Approximations and error analysis	2+1			
2	Roots of transcendental equations	1. Bracketing methods (bisection and false position methods). 2. Open methods (Newton-Raphson, secant, and fixed-point methods).	3+1			
3	Roots of polynomial equations	Polynomial deflation, Müller method and Bairstow's method.	3+1			
4	System of linear algebraic equations	1. Direct methods (Gauss elimination, Gauss-Jordan elimination, LU decomposition, and matrix inversion methods). 2. Iterative methods (Jacobian, Gauss-Seidel, and successive relaxation methods).	6+2			
5	System of nonlinear algebraic equations	Fixed point iteration and Newton's methods.	3+1			
6	Eigenvalues and eigenvectors	Direct power, inverse power, and shifted power methods.	2+1			
7	Numerical differentiation	Finite difference methods (for first and second order derivatives).	3+1			
8	Numerical integration	1. Newton-Cotes methods (Trapezoidal rule, Simpson's rules, Romberg integration). 2. Gauss quadrature (Two-point and higher-point Gauss-Legendre formulae).	3+1			
9	Ordinary differential equations (ODEs)	1. Initial value problems (Euler, Runge-Kutta, and predictor-corrector methods). 2. Boundary value problems (Shooting and finite difference methods). 3. Eigenvalue problems.	6+2			
10	Partial differential equations (PDEs)	1. Classification and characteristics of PDEs. 2. Elliptical, parabolic and hyperbolic equations.	3+2			
11	Similarity transformation	QR decomposition with Householder transformation	2+1			
		Total contact hours	**36+14**			

3 Course Outcome

SN	Course Outcome (CO)	Units
1	Find roots of single-variable transcendental and polynomial equations	2, 3
2	Solve both linear and nonlinear systems of algebraic equations	4, 5, 6
3	Perform numerical differentiation and integration	7, 8
4	Solve both ordinary and partial differential equations	9, 10
5	Programming various numerical methods and apply them to different relevant real-life problems	1–11

4 Textbooks

1. Gerald, C.F. and Wheatley, P.O. *Applied Numerical Analysis.* 5/e, Addison-Wesley, 1994.
2. Conte, S.D. and de Boor, C. *Elementary Numerical Analysis.* 3/e, Tata McGraw-Hill Education, 2005.
3. Hildebrand, F.B. *Introduction to Numerical Analysis.* 2/e (revised), Courier Dover Publications, 1987.

5 References

1. Kreyszig, E. *Advanced Engineering Mathematics.* 10/e, John Wiley and Sons, 2010.
2. Burden, R.L. and Faires, J. D. *Numerical Analysis.* 9/e, Brooks/Cole, 2011.
3. Chapra, S.C. and Canade, R.P. *Numerical Methods for Engineers.* Tata McGraw-Hill, 2006.
4. Mathews, J.H. *Numerical Methods for Mathematics, Science and Engineering.* Prentice-Hall of India, 2000.

How to record your class notes?

(1) Take a separate notebook for this Course only.

(2) Make numbering of each class on the top-left corner, along with the date on which it was held, as demonstrated below.

(3) Note down the lecture as delivered.

(4) At the end of each class, summarize what you have learned from this lecture, as shown below.

CN-1
22-01-2025

Introduction to Numerical Methods

Summary

Instructor **HOD**