22MEHO201	NUMERICAL METHODS IN MECHANICAL ENGINEERING					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
		PE	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

1.	Upon completion of this course, the students will understand and systematize numerical solution techniques for the partial differential equations governing the physics of mechanical engineering problems.
2.	Numerical Methods use computers to solve problems by step-wise, repeated and iterative solution methods, which would otherwise be tedious or unsolvable by hand-calculations.
3.	This course is designed to give an overview of numerical methods of interest to scientists and mechanical engineers.

UNIT I	**ERRORS**	**9**	**0**	**0**	**9**

Errors: Introduction, Types of errors, Rules for estimate errors, Error propagation, Error in the approximation of function. Roots of Equation - Bracketing Method: Bisection Method, False position method - Open method: Newton- Raphson’s method for Single root, multiple root, Iterative method for Non-linear equations - Roots of polynomial: Muller’s Method, limited to TWO Iterations.

UNIT II	**LINEAR ALGEBRAIC EQUATION**	**9**	**0**	**0**	**9**

Linear Algebraic Equation - Gauss Elimination Method. Pitfalls and improving techniques - LU decomposition method, Gauss-Jacobi and Gauss-Seidel Iteration method. Curve Fitting & Interpolation- Least Square Regression – Linear regression, Parabolic regression - Interpolation–Interpolating polynomial, Lagrange’s interpolating polynomial, Divided Difference Formula

UNIT III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**	**0**	**0**	**9**

Numerical Differentiation and Integration - Newton-Cote’s Integration of equation: Trapezoidal rule, Simpson’s rules - Integration of Equation: Gauss Quadrature methods. - Numerical differentiation: For Equally spaced Data: Forward difference Formula, Central difference Formula, Backward difference Formula, - For unequally spaced Data: Divided difference Formula.

UNIT IV	**ORDINARY DIFFERENTIAL EQUATION**	**9**	**0**	**0**	**9**

Ordinary Differential Equation - Taylor’s series method, Picard’s Method, Euler’s Method, Runge-Kutta 4th Order method - Boundary value Problem-Finite Difference Method -- Eigen value problem: Eigen value problem based on Power method.

UNIT V	**PARTIAL DIFFERENTIAL EQUATION**	**9**	**0**	**0**	**9**

Partial Differential Equation - Finite Difference–Elliptical equation, Liebmann’s method to Solve Laplace’s and Poisson’s Equations - Finite Difference- Parabolic Equation - Implicit Method- Crank-Nicolson method (Derivation Only)

TOTAL(45L) : 45 PERIODS

TEXT BOOKS:

1.	B. S. Grewal and J. S. Grewal, “Numerical methods in Engineering and Science,” 6 th Edition, Khanna Publishers, New Delhi, 2004.
2.	D. G. Luenberger, “Linear and Nonlinear Programming,” Springer, 3rd Edition, 2008.

REFERENCES:

1.	K. E. Atkinson, “An Introduction to Numerical Analysis,” Wiley, 2nd Edition, 1989.
2.	S. D. Conte and C. de Boor, Elementary Numerical Analysis, Third Edition, Tata McGraw-Hill Education, 2005.

3.	F.B. Hildebrand, Introduction to Numerical Analysis, Second (Revised) Edition, Courier Dover Publications, 1987.
4.	E. Kreyszig, Advanced Engineering Mathematics, Tenth Ed., John Wiley and Sons, 2010
5.	R. L. Burden and J. D. Faires, Numerical Analysis, 9th Edition (second Indian Reprint 2012), Brooks/Cole, 2011.
6.	L.N. Trefethen, David Bau III, Numerical Linear Algebra, SIAM, 1997.
7.	A.Quarteroni, R. Sacco, and F. Saleri. Numerical Mathematics, Springer-Verlag, New York, 2000.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Apply various methods to find roots of equations.	Apply
CO2	Implement different methods to solve simultaneous equations.	Apply
CO3	Apply the methods of Regression and interpolation.	Apply
CO4	Implement various numerical methods for differentiation and Integration.	Apply
CO5	Apply various methods to solve engineering problems with Ordinary differential equations.	Apply
CO6	Solve Partial differential equations involved in Engineering Problems.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1	0	0	0	0	0	0	0	2	1	0
CO2	3	3	1	2	1	0	0	0	0	0	0	0	2	1	0
CO3	3	3	1	2	1	0	0	0	0	0	0	0	2	1	0
CO4	3	3	1	2	1	0	0	0	0	0	0	0	2	1	0
CO5	3	3	1	2	1	0	0	0	0	0	0	0	2	1	0
Avg	**3**	**3**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**

3/2/1 – indicates strength of correlation (3 – high, 2- medium, 1- low)