COURSE CODE	**MATH-334**
COURSE NAME	**NUMERICAL ANALYSIS**
CREDIT HOURS	Theory: 02 Practical: 01 Total: 03
CONTACT HOURS	Theory: 32 Practical: 48 Total: 80
PREREQUISITE	Nil

MODE OF TEACHING:

Instruction:	Three hours of lecture per week	75%
Practical:	Three hours of Lab work per week	25%

COURSE DESCRIPTION:

The course demonstrates the use of numerical analysis as a powerful problem-solving tool in engineering. The course encompasses numerical analysis, numerical integration, and solution to ordinary differential equations, with applications to engineering problems through mathematics software MATLAB.

COURSE OBJECTIVES:

1. To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues, and solution of algebraic and differential equations
2. To apply the numerical techniques to different linear and nonlinear engineering problems

RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the PLOs:

1	Engineering Knowledge	✓	7	Environment and Sustainability	☐
2	Problem Analysis	☐	8	Ethics:	☐
3	Design/Development of Solutions	☐	9	Individual and Teamwork	☐
4	Investigation	☐	10	Communication	☐
5	Modern Tool Usage	✓	11	Project Management	☐
6	The Engineer and Society	☐	12	Lifelong Learning	☐

COURSE LEARNING OUTCOMES:

No.	CLO	Domain	Taxonomy Level	PLO
1	Apply the algorithms of algebraic, transcendental, and linear / nonlinear system of equations and estimate the roots of	Cognitive	3	1

	equations			
2	Determine the numerical solution of various numerical, integration and differentiation techniques by using appropriate numerical method	Cognitive	3	1
3	Develop codes of known numerical method by using a modern computer algebra system either in MATLAB, Maple or Mathematica	Cognitive	3	5

TOPICS COVERED:
Theory:

Week	Topic
1	Round off error and Computer arithmetic, Algorithms and Convergence.
2	Bisection, Fixed point, Newton-Raphson methods to find real roots of algebraic and transcendental equations.
3	Solution of simultaneous non-linear equations by Newton-Raphson method.
4	LU Factorization, Iterative methods for Systems of Equations, Jacobi's Method, Gauss-Seidel method.
5	Curve fitting: least square method to fit a polynomial equation.
6-7	Linear and polynomial interpolation. Gregory-Newton Forward Difference methods. Lagrange interpolation techniques.
8	Numerical differentiation using interpolation formula Numerical Partial Differentiation.
9	Numerical integration: Trapezoidal Rule, Simpson's Rules.
10-11	Introduction to numerical solution of differential equations. Euler and Predictor-Corrector methods.
12	Fourth order Runge-Kutta method to solve differential equations.
13	Numerical solution of system of ordinary differential equations. Method of reduction order
13	Solution of Higher order IVPs.
14	Solution of BVPs Using Shooting method, Finite difference methods.
15	Numerical solution of system of PDEs.
16	**ESE**

Practical:

Lab No	Description
1	Introduction to MATLAB. Basics of plotting & graphics.
2	Creation and manipulation of arrays (uni and multi-dimensional). Array addressing; colon notation. Array operations. Basic Syntax of MATLAB

3-5	Relational and Logical Operators, If-else statement, for and while loop. Break and continue statements. User-defined functions and function files. Subfunctions and Nested functions.
6-7	Programming of Bisection and Newton-Raphson methods. Polynomials and their arithmetics. Finding roots of polynomial and transcendental equations.
8-9	Programming of Interpolation and interpolating polynomials, Basic Curve Fitting Interface, Regression Line
10-11	Programming of Numerical derivatives, meanings, limitations, and usage of inbuilt functions.
12	Programming Trapezoidal and Simpson Rules.
13-14	Solving ODEs by inbuilt solvers, Programming of Euler and Runge-Kutta Method. Programming of Euler and Runge-Kutta Method for system of first order ODEs and Higher Order ODEs.
15	Programming of Shooting Method, Finite Difference Methods, Programming of Numerical solution of PDEs
16	**ESE**

TEXT AND MATERIAL:

Textbook (s):

Numerical Methods for Engineers and Scientists: An Introduction with Applications using MATLAB by Amos Gilat, Vish Subramaniam Wiley, 3rd Edition, 2013

References Material:

1. Applied Numerical Methods with MATLAB for Engineers and Scientists by S. C. Chapra
2. Numerical Analysis (8th Ed) By Burden & Faires
3. Numerical methods for scientist and engineers by R.W. Hamming (Latest Edition)
4. Numerical methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition)

ASSESMENT SYSTEM:

1. CLOs Assessment

Cognitive	Psychomotor	Affective
Spreadsheet	-	-

2. Relative Grading

Theoretical/Instruction			67%
	Assignments10%		

	Quizzes10%		
	OHT Exams30%		
	End Semester Exam50%		
Total			67%

Practical Work			33%
Laboratory Work		*70%*	
	Laboratory Attendance20%		
	Laboratory Report20%		
	Laboratory Quiz30%		
Viva/Quiz		*30%*	
Total			100%