

**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:** Two hours of lecture per week 67 %  
 Three hours of lab per week 33 %

**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           | <input checked="" type="checkbox"/> | 7  | Ethics:                                    | <input type="checkbox"/> |
| 2 | Problem Analysis                | <input type="checkbox"/>            | 8  | Individual and Collaborative<br>Team Work: | <input type="checkbox"/> |
| 3 | Design/Development of Solutions | <input type="checkbox"/>            | 9  | Communication                              | <input type="checkbox"/> |
| 4 | Investigation                   | <input type="checkbox"/>            | 10 | Project Management                         | <input type="checkbox"/> |
| 5 | Tool Usage                      | <input checked="" type="checkbox"/> | 11 | Lifelong Learning                          | <input type="checkbox"/> |
| 6 | The Engineer and Society        | <input type="checkbox"/>            |    |  |                          |

**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 equations	Cognitive	3	1
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
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**CONFERENCES/ SEMINARS/ WORKSHOPS**

**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	<b>ESE</b>

**Practical:**

Lab No	Description	CLO	PLO
1	Introduction to MATLAB. Basics of plotting & graphics.	3	5
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	<b>ESE</b>		

### 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)

### ASSESSMENT SYSTEM:

#### 1. CLOs Assessment

Cognitive	Psychomotor	Affective
Spreadsheet	-	-

#### 2. Relative Grading

Theoretical/Instruction			67%
	<i>Assignments</i>	10%	
	<i>Quizzes</i>	10%	
	<i>Mid Semester Exam</i>	30%	
	<i>End Semester Exam</i>	50%	
Total			67%

Practical Work			33%
<i>Laboratory Work</i>		70%	
	<i>Laboratory Attendance</i>	20%	
	<i>Laboratory Report</i>	20%	
	<i>Laboratory Quiz</i>	30%	
<i>Viva/Quiz</i>		30%	
Total			100%