Semester:	II	**Course Type:**	ASC		
Course Title: Numerical Methods and Advanced Linear Algebra					
Course Code:	25MAT21A			**Credits:**	4
Teaching Hours/Week (L:T:P:S)			3:2:0:1	**Total Hours:**	50 (40L+10T)
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives

1. To understand the Importance of error analysis and their propagation.
2. The concepts of determinants, matrices, basis vectors, and their characteristics.
3. To interpret and visualize mathematical solutions through MATLAB

II. Teaching-Learning Process (General Instructions)

1. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Grading assignments, presentations, practical implementation of the problem, quizzes and documenting students' progress.
4. Encourage the students for group learning to improve their creative and analytical skills.

Pre-requisites

1. Trigonometric formulae.
2. Differentiation, Integration and properties.

III. COURSE CONTENT

Module-1: Introduction to Numerical Methods	10 Hours

Errors and their computation: Round off error, Truncation error, Absolute error, Relative error and Percentage error.

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods. Implementation using MATLAB.

Self Study: Solution of algebraic and transcendental equations: Secant and b Bisection methods

RBT Levels: L1,L2 and L3

Module-2: Numerical Interpolation and Integration	10 Hours

Finite differences, interpolation using Newton Gregory forward and Newton Gregory backward difference formulae, Lagrange interpolation formulae, piecewise interpolation-linear .

Numerical integration: Simpson's $1/3^{rd}$, Simpson's $3/8^{th}$ rule. Implementation using MATLAB.

Self Study: Newton's divided difference, weddle's Rule, piecewise interpolation -quadratic.

RBT Levels: L1, L2 and L3

Module-3: Numerical Solution of Differential Equations	10 Hours
Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector method. Implementation using MATLAB.	
Self Study: Adam's Bashforth predictor-corrector method	
RBT Levels: L1, L2 and L3	
Module-4: Vector space	10 Hours
Vector spaces: definition and examples, subspace: definition and examples. linear Combinations, linear span, linearly independent and dependent sets, basis and dimension. Inner products and orthogonality. Implementation using MATLAB.	
Self Study: Row space and column space of a matrix, Coordinates,	
RBT Levels: L1, L2 and L3	
Module -5 : Linear Transformation	10 Hours
Definition and examples, algebra of linear transformations, matrix of a linear transformation. singular, non-singular linear transformations and invertible linear transformations. rank and nullity of linear transformations, rank-nullity theorem. Implementation using MATLAB.	
Self Study: Quadratic form.	
RBT Levels: L1, L2 and L3	

IV. COURSE OUTCOMES

CO1	Apply the relationship between step size, method order, and error in various numerical methods.
CO2	Analyse numerical methods to transcendental equations, interpolation, numerical integration, and ordinary differential equations.
CO3	Interpret the properties of vector spaces and linear transformations in the context of engineering applications.
CO4	Demonstrate the applications of computer science and allied engineering science using modern ICT tools.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	S1	S2	S3	S4
CO1	3	2			1				1		1				
CO2	3	2			1				1		1				
CO3	3	2			1				1		1				
CO4	3	2			1				1		1				

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources				
VII(a): Textbooks:				
Sl. No.	**Title of the Book**	**Name of the author**	**Name of the publisher**	**Edition and Year**
1	Higher Engineering Mathematics	B.S.Grewal	Khanna Publishers	44thEd., 2018.
2	M.K. Jain, S.R.K. Iyengar and R.K. Jain	Numerical Methods for Scientific and Engineering Computation	New Age International Publishers	8th Ed., 2022.
3	Linear Algebra and its Applications	Gilbert Strang	Cengage Publications	4th Ed., 2022.
VII(b): Reference Books:				
1	Engineering Mathematics	Srimanta Pal & Subodh C.Bhunia	Oxford University Press	3rd Ed., 2016.
2	Advanced Engineering Mathematics	E.Kreyszig	John Wiley& Sons	10th Ed.,2016
3	Introductory Methods of Numerical Analysis	S.S.Sastry	Tata McGraw-Hill	11thEdition
4	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill	11thEd.,2017
5	Engineering Mathematics	N.P Bali and Manish Goyal	Laxmi Publications	10thEd., 2022
6	Linear Algebra and its Applications	D. C. Lay	Pearson Publishers	4th Ed., 2018
VII (c): Web links and Video Lectures (e-Resources):				
1. http://academicearth.org/ 2. VTU e-Shikshana Program 3. VTU EDUSAT Program 4. https://nptel.ac.in/courses/127106019 https://nptel.ac.in/courses/111106135				
VIII: Activity Based Learning				
Assignments, quiz and presentation.				