Semester:	II	**Course Type:**	ASC		
Course Title: Calculus, Numerical Techniques & Laplace Transforms					
Course Code:	25MAT21B			**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 facilitate the students with a foundation of Integral and vector calculus
2. Apply the knowledge of Numerical methods to develop computer algorithms.
3. Develop knowledge of solving problems in engineering application using Laplace transforms.
4. 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: Integral Calculus and its Applications	10 Hours

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals over the region, changing to polar coordinates. Area and volume using double integrals.
Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Implementation using MATLAB

Self- study: Evaluation of double integrals by changing the order of integration

RBT Levels: L1, L2 and L3

Module-2: Vector Calculus and its Applications	10 Hours

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivatives, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector, physical interpretation of gradient, divergence and curl and scalar potential.
Vector Integration: Line integrals, Statement of Green's theorem and problems (without verification). Implementation using MATLAB

Self-Study: work done by a force and flux, Statements of Stoke's theorem and problems

RBT Levels: L1, L2 and L3

Module-3: Numerical Methods-1	10 Hours
Solution of algebraic and transcendental equations: Newton-Raphson method. **Finite Differences and Interpolation**: Forward and backward differences, Interpolation, Newton forward and backward interpolation formulae, and Lagrange's interpolation formula. **Numerical Integration**: Simpson's 1/3rd rule and Simpson's 3/8th rule. Implementation using MATLAB	
Self-Study: Regula-Falsi method, Newton's divided difference interpolation formula, Weddle's rule	
RBT Levels: L1, L2 and L3	
Module-4: Numerical Methods-2	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-Bashforth predictor-corrector method	
RBT Levels: L1, L2 and L3	
Module-5: Laplace Transform	10 Hours
Existence and Uniqueness of Laplace transform, transforms of elementary functions , Properties of Laplace transforms, Problems on Laplace's Transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of Periodic functions-problems. **Inverse Laplace Transforms**: Definition, properties, evaluation of inverse Laplace transform (using only partial fraction), and applications to solve ordinary differential equations. Implementation using MATLAB	
Self-study: Heaviside function, evaluation of inverse Laplace transform by completing square	
RBT Levels: L1, L2 and L3	

IV. COURSE OUTCOMES

CO1	Apply the concepts of integral calculus and vector calculus to model and solve problems in engineering applications such as area, volume.
CO2	Apply appropriate numerical methods to find approximate solutions of algebraic, transcendental, and ordinary differential equations and to perform interpolation and numerical integration in engineering contexts
CO3	Apply Laplace transform techniques for time domain, wave forms, periodic functions and solving differential equations.
CO4	Employ MATLAB techniques for analytical solutions of calculus, Numerical techniques and Laplace Transforms concepts in engineering.

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	44th Ed., 2021
2	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Ed., 2018
3	Numerical Methods for Scientific and Engineering Computation	M.K. Jain, S.R.K. Iyengar and R.K. Jain	New Age International Publishers	8thEd., 2022.

VII(b): Reference Books:

1	Higher Engineering Mathematics	B.V.Ramana	Tata Mc Graw-Hill	11th Ed., 2017
2	Higher Engineering Mathematics	H. K. Dass and Er. Rajnish Verma	S. Chand Publication,	3rd Ed., 2014.
3	Engineering Mathematics	Srimantha Pal & Subodh C Bhunia	Oxford Publication	3rd Ed., 2016.
4	Applied Numerical Methods with Matlab for Engineers and Scientists	Steven V. Chapra and Raymond P. Canale	McGraw-Hill	3rd Ed., 2011.
5	A Textbook of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	10th Ed., 2022
6	Introductory Methods of Numerical Analysis	S.S. Sastry	PHI Learning Private Limited	5th Ed., 2012.

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/111105160
5. https://nptel.ac.in/courses/127106019
6. https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/
7. https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2012/pages/syllabus/

VIII: Activity Based Learning

Assignments, quiz and presentation.