|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)

SJB Institute of Technology

BGS Health and Education City, Dr. Vishnuvardhana Road, Kengeri, Bengaluru-560060
Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Semester:	II	**Course Type:**	ASC		
Course Title: Vector Calculus and Numerical Methods					
Course Code:	25MAT21D			**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 differential calculus.
2. Develop the knowledge of Linear Algebra referring to matrices.
3. Apply the knowledge of Numerical methods to develop computer algorithms.

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 and 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	10 Hours
Multiple Integrals: Evaluation of double and triple integrals, changing into polar coordinates. Applications to find Area and volume by double integral. Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Implementation using MAT LAB.	
Self study: Evaluation of double integrals by change of order of integration,	
RBT Levels: L1, L2 and L3	

Module-2: Ordinary Differential Equations of Higher Order	10 Hours
Higher-order ordinary differential equations with constant coefficients, homogeneous and non-homogeneous equations- e^{ax}, sin(ax+b), cos(ax+b), x^n (Secand order only), Cauchy's and Legendre's homogeneous differential equations. Applications: mass spring model. Implementation using MAT LAB.	
Self-Study: Method of variation of parameters	
RBT Levels: L1, L2 and L3	

Module-3: Vector Calculus	10 Hours

Scalar and vector fields. Gradient, directional derivative, divergence and curl - physical interpretation, solenoidal vector fields, irrotational vector fields and scalar potential. Vector Integration: Line integrals, work done by a force and flux, Statements of Green's theorem problems without verification. Implementation using MAT LAB.

Self-study: Statements of Stoke's theorem

RBT Levels: L1, L2 and L3

Module-4: Numerical Methods - 1	10 Hours

Solution of algebraic and transcendental equations: Newton-Raphson methods, problems. Interpolation: Finite differences, Interpolation using Newton's forward and backward difference formulae and Lagrange's interpolation formula. Numerical integration: Simpson's 1/3rd and 3/8th rules. Implementation using MAT LAB.

Self-study: Regula-Falsi method and Weddle's Rule, Newton's divided difference formula

RBT Levels: L1, L2 and L3

Module-5: 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, Milne's predictor and corrector method. Implementation using MAT LAB.

Self-study: Adams-Bashforth predictor-corrector method

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 methods to solve ordinary differential equations of first and higher order arising in engineering problems.
CO3	Analyze vector fields and understand their properties such as conservative fields and potential functions.
CO4	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.

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., 2018.
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:

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	Higher Engineering Mathematics	B.V. Ramana	McGraw-Hill Education	11th Ed., 2017
2	Engineering Mathematics	Srimanta Pal & Subodh C.Bhunia	Oxford University	3rd Ed., 2016
3	A Textbook of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	10th Ed., 2022.
4	Higher Engineering Mathematics	H. K. Dass and Er. Rajnish Verma	S. Chand Publication	3rd Ed., 2014
5	Linear Algebra and its Applications	David C Lay	Pearson Publishers	4th Ed., 2018

VII(c): Web links and Video Lectures (e-Resources):

- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://nptel.ac.in/courses/111105160
- https://nptel.ac.in/courses/127106019
- https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/
- https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring 2012/pages/syllabus/

VIII: Activity Based Learning

Assignments, quiz and presentation.