|| 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:	I	**Course Type:**	ASC		
Course Title: Calculus and Linear Algebra					
Course Code:	25MAT11A			**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 introduce functions of several variables and develop the ability to compute partial derivatives, directional derivatives, and gradients.
1. Familiarize the importance of ordinary differential equations in engineering problems.
2. 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: Applied Calculus	10 Hours

Partial differentiation: Definition , Total derivative - differentiation of composite functions, Jacobian, Statement of Maclaurin's series expansion for two variables. Maxima and minima for the function of two variables. Implementation using MATLAB.

Self Study: Taylor's series expansion for two variables.

RBT Levels: L1, L2 and L3

Module-2: Vector Calculus	10 Hours

Scalar and vector fields, Gradient, directional derivatives, divergence and curl - physical interpretation, solenoidal vector fields, irrotational vector fields and scalar potential. Curvilinear coordinates: Scale factors, base vectors, Cylindrical polar coordinates. Implementation using MATLAB.

Self Study: Curvilinear coordinates: Spherical polar coordinates.

RBT Levels: L1, L2 and L3

Module-3: Differential Equations of First order and Higher order	10 Hours
Bernoulli`s differential equations. Exact and reducible to exact differential equations with integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{-1}{M}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$. Homogeneous differential equations and non-homogeneous differential equations (second order only) with constant coefficients. Inverse differential operators $e^{ax}, sin(ax+b), cos(ax+b), x^n$. Implementation using MATLAB.	
Self Study: Method of Variation of Parameters.	
RBT Levels: L1, L2 and L3	
Module-4: System of Linear Equations, Eigenvalues and Eigenvectors.	10 Hours
Elementary row transformation of a matrix, Echelon form, rank of a matrix. Consistency and solution of system of linear equations, Gauss Jordan method. Applications: Traffic flow. Eigenvalues and Eigenvectors, modal matrix. Implementation using MATLAB.	
Self Study: Gauss elimination method.	
RBT Levels: L1, L2 and L3	
Module -5 : Numerical solutions for system of linear equations	10 Hours
Norms: Vector norms and Matrix norms-L1, L2 and L∞, Ill conditioned linear system, condition number. Solution of system of linear equations: Gauss Seidel method and LU-decomposition method. Eigenvalues and Eigen vectors: Rayleigh power method. Implementation using MATLAB.	
Self Study: Jacobi's method	
RBT Levels: L1, L2 and L3	

IV. COURSE OUTCOMES

CO1	Apply the concepts of multivariable and vector calculus to compute derivatives and their applications in Computer Science and Engineering
CO2	Analyze analytical methods to ordinary differential equations in solving mathematical models.
CO3	Solve system of linear equations and determine eigenvalues and eigenvectors using direct and iterative methods
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	Engineering Mathematics	Srimanta Pal & Subodh C.Bhunia	Oxford University Press	3rd Ed., 2016.
3	Numerical Methods for Scientific and Engineering Computation	M.K. Jain, S.R.K. Iyengar and R.K. Jain	New Age International Publishers	8th Ed., 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	Linear Algebra and its Applications	David C Lay	Pearson Publishers	4th Ed., 2018.
5	A Textbook of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	10th Ed., 2022

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

VIII: Activity Based Learning

Assignments, quiz and presentation.