Course Code	Multivariable Calculus and Differential Equations	L	T	P	C
BAMAT101		3	0	2	4
Pre-requisite		Syllabus Version			

Course Objectives

1. To provide essential foundational knowledge in engineering mathematics, supporting engineers and scientists in mastering advanced mathematical concepts relevant to their field
2. To enhance problem-solving skills for engineers and scientists by mastering vector calculus principles, including gradient, divergence, curl, and fundamental theorems, for real-world engineering applications.
3. To develop expertise in solving differential equations through various techniques, enabling engineers and scientists to address complex challenges in system modeling and simulations.

Course Outcomes

At the end of the course, the student is able to:

1. evaluate partial derivatives and solve optimization problems involving several variables with or without constraints.
2. solve multiple integrals in cartesian, polar, cylindrical and spherical coordinates.
3. understand gradient, directional derivatives, divergence, curl, Green's, Stokes and Gauss Divergence theorems.
4. utilize different solution methods to obtain the solution for second-order ordinary differential equations.
5. demonstrate proficiency in solving linear and nonlinear first-order partial differential equations.

Module:1	Functions of Several Variables	8 hours

Functions of two variables- Partial derivatives –total differential -Jacobian and its properties. Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module:2	Multiple Integrals	9 hours

Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals - change of variables between Cartesian and cylindrical and spherical co-ordinates.

Module:3	Vector Differentiation and Integration	10 hours

Scalar and vector valued functions – gradient, directional derivative, divergence, and curl – scalar and vector potentials. Line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems - Verification and evaluation of vector integrals using them.

Module:4	Ordinary Differential Equations	8 hours

Linear second-order ordinary differential equations with constant coefficients – Solutions of ODE by Method of undetermined coefficients – Method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendre differential equations – Applications of linear second-order differential equations.

Module:5	Partial Differential Equations	8 hours

Formation of PDE- solution of first order partial differential equation of the forms: $F(p,q)=0$, $F(z,p,q)=0$, $F(x,p)=G(y,q)$ and Clairaut's form - Lagrange's equation: $Pp+Qq = R$. Solution of a linear first order partial differential equation by separation of variables.

Module:6	Contemporary Topics	2 hours
	Total Lecture hours:	45 hours

Text Books	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2015.
2	B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2020
Reference Books	
1.	George B. Thomas, D. Weir and J. Hass, Thomas' Calculus, 15th edition, Pearson, 2023.
2.	Dennis G. Zill, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett Publishers, 2018.
Mode of Evaluation: Quizzes, Assignments, CATs and FAT	
List of Experiments (Indicative)	
1.	Introduction to Calculus through MATLAB – Symbolic Computations
2.	Plotting and visualizing curves and surfaces
3.	Evaluating maxima and minima of functions of several variables
4.	Applying Lagrange multiplier optimization method
5.	Evaluation of volume under a surface by double Integral
6.	Evaluating triple integrals
7	Demonstration of gradient, divergence and curl
8	Evaluating line integrals in vectors
9	Solution of Linear differential equations
10	Solution of Partial differential equations
Total Lab hours:	**30 hours**
Text Book	
1	Ronald L. Lipsman , Jonathan M. Rosenberg, Multivariable Calculus with MATLAB with applications to Geometry and Physics, Springe, 2017.
Reference Book	
1	Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press, 2022.
Mode of Evaluation: Assignments and FAT	

Recommended by Board of Studies	14-May-2025		
Approved by Academic Council	**No.**	**Date**	