

Syllabus template

Semester: III				
Programme: Mathematics				
Course: Linear Algebra and Multi-Variate Calculus [Chem+ Microbio+Biotech]				
Paper code: B2MT230311T			Credits: 4	
Hours/week: 4				
Category: Core/MDC/SEC/VAC: Minor				
Theory / Practical / Composite: Theory				
No of Modules: NA				
<p>Course Overview: This course provides a comprehensive foundation in Linear Algebra and Multivariate Calculus, focusing on concepts that support higher mathematical thinking and real-world problem solving. Students develop an understanding of vector spaces, linear transformations, and matrix diagonalization as tools for simplifying complex systems. The course also introduces functions of several variables, partial derivatives, and optimisation techniques, including Lagrange multipliers. Further, learners gain practical skills in evaluating double integrals and applying the change of variables. With an emphasis on clarity, reasoning, and structured methods, the course strengthens analytical ability and prepares students for advanced studies and applications across various disciplines.</p>				
<p>Course Outcome: On successful completion of this course, the student will be able to:</p>				
<p>1. Describe real vector spaces and explain the concepts of linear span, linear dependence, independence, and basis.</p>				
<p>2. Apply the properties of linear transformations and interpret their matrix representations.</p>				
<p>3. Compute eigenvalues and eigenvectors and use them to diagonalise matrices where applicable.</p>				
<p>4. Evaluate partial derivatives and apply the chain rule, Euler's theorem, and Taylor's theorem for functions of several variables.</p>				
<p>5. Determine maxima and minima of multivariable functions using Lagrange's method of multipliers.</p>				
<p>6. Evaluate double integrals over rectangular and non-rectangular regions and apply change of variables where appropriate.</p>				
<p>Prerequisites: <i>Basic understanding of Higher Secondary level algebra, matrices, coordinate geometry, and elementary calculus (limits and derivatives).</i></p>				
SYLLABUS				
UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I. Linear Spaces and Linear Operators	<p>Definition of vector space over \mathbb{R}: Examples and properties [4].</p> <p>Concepts of linear span, linear dependence and independence of a finite set of vectors, subspace [4].</p> <p>Idea of the basis of a finite-dimensional real vector space. Statement of addition, deletion and replacement</p>	18 hours	CO1, CO2	K2, K3

	theorems: examples [5]. Linear operators on real linear spaces, Rank-Nullity theorem and its applications only [5].			
II. Eigenvalues & Diagonalisation of Matrices	Eigenvalues and eigenvectors and related problems [4]. Diagonalisation of Matrices [3].	7 hours	CO3	K3, K4
III. Multivariate Calculus	Partial Derivative, knowledge and use of Chain Rule, Exact differentials and its applications to problems [6]. Euler's Theorem on homogeneous functions, Taylor's theorem for functions of two variables [5]. Maxima and minima of functions of more than one variable, Lagrange's method of undetermined multiplier and related problems. [6]	17 hours	CO4, CO5	K3, K4
IV. Double integrals	Evaluation of Double Integrals over rectangular regions and non-rectangular regions [5]. Change of Variable in Double Integrals [5].	10 hours	CO6	K3, K4
Text Books				
1. Higher Algebra (Linear & Abstract): S.K.Mapa				
2. Linear Algebra- A Geometric Approach: S. Kumaresan.				
3. Linear Algebra- Concepts and Applications: P.K.Nayak.				
4. Matrix and Linear Algebra: Kanti Bhushan Datta.				
5. Mathematical Analysis: S.C. Malik.				
6. An Introduction to Analysis: Differential Calculus (Part-1): Maity and Ghosh.				
7. Basic Multivariable Calculus: Marsden, Tromba and Weinstein.				
Suggested readings				
1. Calculus: T.M.Apostol, Vol-II.				
Web Resources				
1.				
2.				
3.				
4.				
Evaluation: Theory CIA: 20+5+5=30; Semester Exam: 70.				
Paper Structure for Theory Semester Exam Module: 7 questions each carrying 10 marks need to be answered out of 12/13 questions.				

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	Describe real vector spaces and explain the concepts of linear span, linear dependence, independence, and basis.	K2
CO2	Apply the properties of linear transformations and interpret their matrix representations.	K3
CO3	Compute eigenvalues and eigenvectors and use them to diagonalise matrices where applicable.	K3, K4
CO4	Evaluate partial derivatives and apply the chain rule, Euler's theorem, and Taylor's theorem for functions of several variables.	K3
CO5	Determine maxima and minima of multivariable functions using Lagrange's method of multipliers.	K4
CO6	Evaluate double integrals over rectangular and non-rectangular regions and apply change of variables where appropriate.	K3, K4