



Lahore University of Management Sciences

MATH 3010 – Advanced Calculus

(Tentative)
Spring 2023-2024

Instructor	Waqas Ali Azhar
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Course URL (if any)	TBA

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 min
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	For Math Major
Elective	
Open for Student Category	All students
Close for Student Category	None

COURSE DESCRIPTION
In this course we will study Real-valued functions of several variables, Vector-valued functions of several variables, Linear Transformations and Matrices; Continuity and Differentiability of Transformations; Inverse function theorem and Implicit function theorem, differential forms, integration of forms and Stokes' theorem.

COURSE PREREQUISITE(S)
MATH 102 OR MATH 205

COURSE OBJECTIVES
The objective of this course is to understand the basic facts about \mathbb{R}^n , vector valued function with several variables, their limits, continuous functions and differentiation. It shows the utility of abstract concepts and teaches an understanding and construction of proofs what they have studied in calculus II.

Learning Outcomes
The students would be able to apply the theory they have learnt in this course to the relevant subsequent advance courses they will pursue during their further studies.

Grading Breakup and Policy(tentative)
Assignment(s): 10% Quiz(s): 20% (every alternate week) Midterm Examination: 30% Final Examination: 40 %



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Examination Detail	
Midterm Exam	Yes/No: Yes
Final Exam	Yes/No: Yes Exam Specifications:

Week/ Lecture/ Module	Topics	Readings	Objectives/Applications
1-3	Function on Euclidean Space R^n	[S] Chapter 1	Norms, properties of subsets of R^n , functions on R^n and continuity
	Norm and Inner products, subset of Euclidean space and Function of continuity		
4-8	Partial Derivatives and the Differential	[S] Chapter 2	Partial derivatives, directional derivatives of function in n variables, implicit functions and explicit functions
	Derivatives, Inverse functions and Implicit function Theorems		
9-12	Differential forms on the Euclidean Space R^n	[Sj] Chapter 2 and 3	Differential forms and pull backs
	Tangent Spaces, Vector Fields, Elementary Properties, Exterior derivatives, closed and exact form, div, curl and grad; Pulling back forms		
13-16	Integration of 1-forms	[Sj] Chapter 4	Integration
	Definition and elementary properties of Integration Integration of Exact 1-form, The global angle function and the winding number		
17-20	Integration and Stokes' theorem	[Sj] Chapter 5	Integration
	Integration of forms over chains, The boundary of a chain, Cycles and boundaries, Stokes' theorem		
21-22	Manifolds	[Sj] Chapter 6	Manifolds
	The definition, The regular value theorem		
23-24	Differential Forms on Manifolds	[Sj] Chapter 7	Multilinear Algebra
	Definition and review of multilinear algebra		
25-26	Volume forms	[Sj] Chapter 8	Differential forms and integration
	n -Dimensional volume in R^n Orientations		
27-28	Integration and Stokes' theorem for manifolds	[Sj] Chapter 9	Integration and stokes theorem
	Manifolds with boundary, Integration over orientable manifolds, Gauss and Stokes		

Textbook(s)/Supplementary Readings
<p>[S] Calculus on Manifolds by M. Spivak and Benjamin Cummings (1965).</p> <p>[Sj] Manifolds and Differential forms by Sjamaar, Reyer " Lecture Notes, Cornell University, (http://www.math.cornell.edu/sjamaar/) (2001).</p> <p>[Ed] Advanced Calculus: a differential forms approach by Harold M. Edwards, Springer Science & Business Media, 2013.</p>