SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2021-2022

(Master of Science) (Mathematics)
(M.Sc.) (Mathematics) Semester (I)

Course Code	PS01CMTH53	Title of the Course	Functions of Several Real Variables
Total Credits of the Course	04	Hours per Week	04 hours

Course Objectives:	1. This is also called a course on multivariable calculus. 2. Students will learn calculus of R^m-valued, several real variable functions. 3. They will learn limits, continuity, three types of derivatives, Mean Value Theorem, different types of boundary points, etc.

Course Content

Unit	Description	Weightage* (%)
1.	**Limits and Continuity** Euclidean space R^n and its basic properties; Limits and continuity of functions $f : R^n \to R^m$; Examples and basic results on limit and continuity; Continuity and oscillation; Continuity and convexity; Continuity and Intermediate Value Property; Implicit Function Theorem (without proof); Linear maps $T : R^n \to R^m$; Matrix representation of linear maps; Dual space of R^n and its standard basis.	25%
2.	**Total Derivation** New definition of derivation of $f : R \to R$ at a point a; (Total or Full) derivation Df(a) of $f : R^n \to R^m$ at a point a; Uniqueness of derivation and the Chain rule; Examples and basic results on total derivation; Increment Lemma and its applications; Classical version of Implicit Function Theorem (only statement); Inverse Function Theorem.	25%
3.	**Partial and Directional Derivatives** Partial derivatives $D_i f(a)$ of $f : R^n \to R$ at a point a; The Gradient $\nabla f(x_0, y_0)$; Higher ordered partial derivatives; Mixed partial derivatives; Rectangular Rolle's Theorem; Rectangular Mean Value Theorem; Jacobian matrix f'(a) of $f : R^n \to R^m$ at a point a; Sufficient condition for differentiability. Directional derivative, its examples and basic properties; Relation among continuity and three types of derivatives;	25%

4.	**Applications** Classical Bivariate Mean Value Theorem; Classical Bivariate Taylor Theorem; Monotonicity and convexity; Lagrange Multiplier Theorem; Boundary points and critical points; Local extrema and saddle points; Discriminant test.	25%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Supply of information about online resources

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Quizzes, Assignments, and Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, student will be able to	
1.	learn several classical theorems of calculus for multivariable functions.
2.	apply the theory of multivariable functions arising in several branches of mathematical sciences.

Suggested References:	
Sr. No.	References
1.	Ghorpade Sudhir R., and Limaye Balmohan V., A Course in Multivariable Calculus and Analysis, Springer, 2010.
2.	Rudin W., Principles of Mathematical Analysis, (Third Edition), Tata McGraw-Hill Publ., New Delhi, 1983.
3.	Kantorovitz S., Several Real Variables, Springer, 2016
On-line resources to be used if available as reference material	
On-line Resources	

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