	Course Code	Name of Course	L	T	P	Credit
DE	NMCD550	Foundation of Convex Optimization	3	0	0	3

Course Objective

The objective of this course is to introduce the fundamental concepts of convex analysis with emphasis on generalized convexity, and to develop a comprehensive understanding of their applications in nonlinear programming problems. It aims to equip students with the theoretical and analytical tools necessary to model, analyze, and solve optimization problems, and to prepare them for advanced study and research in optimization theory and related areas.

Learning Outcomes

Upon successful completion of this course, students will:

- will develop a strong foundation in the fundamental principles of generalized convexity.
- acquire the ability to analyze and characterize different classes of generalized convex functions.
- gain the theoretical concepts to analyze nonlinear programming problems and their solutions.
- understand the role of generalized invexity and monotonicity, and their significance in optimization theory.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Convex sets and topological properties of convex sets; Convex functions; Jensen's Inequality; Convexity and homogeneity; Minima of convex functions; Quasiconvexity; Strict quasiconvexity, Semi-strict quasiconvexity.	10	Understanding the fundamental concept of the convex sets, convex functions, and generalized convexity concepts.
2.	Differentiable convex functions and its properties; Differentiable quasi-convex and pseudo-convex functions; Pseudolinear functions: their properties and relationships.	8	This unit helps to differentiable among different classes of differentiable generalized convex functions, and apply their properties in optimization theory.
3.	Nonlinear programming problems: Optimality conditions and duality theory; Constraint qualifications; Generalized convexity of some homogenuous nonlinear functions: The Cobb-Douglas, Leontif, and Constant Elasticity of Substitution (CES) production functions.	10	Students will be able to analyze nonlinear programming problems by integrating generalized convexity with optimality conditions and duality theory.
4.	Generalized invexity: Preinvex functions; Invex functions; Semi-strictly preinvex functions; Pre-quasiinvexity: their properties and relationships.	7	Students will be able to examine invexity and its variants, and recognize their role in generalized convexity.
5.	Concept of generalized monotonicity; Differentiable generalized monotone maps; relationship between generalized monotonicity and generalized convexity.	7	Students will be able to examine the generalized monotonicity mappings and relate their role in characterizing generalized convex functions and optimization models.
	Total	**42**	

Text Books:

1. Alberto Cambini and Laura Martein, Generalized Convexity and Optimization, Lecture Notes in Economics and Mathematical Systems Vol. 616, Springer-Verlag Berlin Heidelberg, 2009.
2. M. S. Bazaraa, J. J. Jarvis and H. D. Sherali, "Linear Programming and Network Flows", 4th Ed., Wiley, 2011.

Reference Books:

1. S. Chandra, Jayadeva and A. Mehra, Numerical Optimization with Applications, Narosa, 2009.
2. B. D. Craven, Fractional Programming, Berlin; Helderman Verlag, 1988.