Course Type	CourseCode	Nameof the Course	L	T	P	Credits
DE	NCSD502	Computational Optimization	3	0	0	3

CourseObjective
• To provide a comprehensive understanding of classical optimization techniques. • To explore the application of metaheuristics, reinforcement learning, and online optimization methods in solving complex real-world problems.
LearningOutcomes
Students will be able to effectively implement and apply advanced optimization techniques, including metaheuristics and reinforcement learning, to solve complex problems in various domains.

Unit No.	Topicsto beCovered	Lecture Hours	LearningOutcome
1	**Introduction:**Overview of Convex, Non-convex,ConstraintOptimization Problem Classes.	3	The students will be introduced in this field
2	**Classical Optimization**: Constraint Programing, Linear Programming, Integer Linear Programing, Mixed Integer Linear Programming, Mixed Integer Quadratic Constraint Programing, KKT Conditions and Lagrangians, Linearization: Taylor Series Approximation and Piecewise Linear Approximation, Handling Non-Linear Constraints, Relaxation and Rounding.	10	Students will learn about Dynamical System Models for Classical Optimization, linearization, multi-objective Optimization
3	**Metaheuristics:** Introduction to Meta-Heuristic Simulated Annealing,Monte Carlo methods, Hybrid, Metaheuristics and Applications	6	Students will acquire a solid understanding of metaheuristic algorithms
4	**Real-time and Online Optimization Methods:**Basics of dynamic programming for solving sequential decision-making problems. Descent methods, Momentum-based methods, Bandit Algorithms	9	Students will be able to apply real-time optimization in dynamic systems
5	**Reinforcement Learning for Optimization:** Introduction to RL**,** Value based and Policy Gradient MethodsQ-Learning, Actor-Critic Model. Applications of RL in Optimization	9	Students will be able to apply reinforcement learning models, such as Actor-Critic, to real-world optimization scenarios
6	**Case studies:** Case Studies and applications in different domainsincluding agriculture, electrical energy, transportation, etc.	5	Students will learn how design solutions using optimization techniques to address real life problems
Total		**42**	

Text Books:

1. Optimization Theory and Applications by S. S. Rao
2. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto
3. Metaheuristics: From Design to Implementation" by El-Ghazali Talbi

Reference Books:

1. Convex Optimization Algorithms" by Dimitri P. Bertsekas
2. Introduction to Optimization by Pablo Pedregal
3. Practical Deep Reinforcement Learning: A Guide to Develop Advanced Deep RL Algorithms Using Python