NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering
Course Code:	3EC901ME24
Course Title:	Optimisation Methods
Course Type:	Departmental Elective
Year of Introduction:	2024-25

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Course Learning Outcomes (CLOs):

At the end of the course, students will be able to

1. appreciate the role of optimisation in engineering. BL-2
2. apply classical optimisation techniques with and without constraints to the given problem. BL-3
3. select an appropriate method and constraints for the given problem BL-4
4. solve linear, nonlinear and geometric optimisation problems with equality constraints and inequality constraints. BL-5

Unit No.	Contents	Teaching hours (Total 45)
I	**Introduction:** Engineering applications of optimisation, optimisation problem statement, classification of optimisation problems based on nature of constraints and variables	06
II	**Classical Optimisation Techniques:** Single variable and multivariable optimisation without constraints, with equality and inequality constraints, Solution by direct substitution, solution by the method of constrained variation, solution by the method of lagrange multipliers, multivariable optimisation with inequality constraints - kuhn–tucker conditions, constraint qualification, convex programming problem	12
III	**Linear Programming:** Standard form and geometry of linear programming, simplex algorithm, duality in linear programming-symmetric primal-dual relations, general primal-dual relations, duality theorem, dual simplex method, decomposition principle, sensitivity or postoptimality analysis, transportation problem, Karmarkar's interior method, quadratic programming	10
IV	**Nonlinear Programming:** Unimodal function, elimination methods, unrestricted search, search with fixed step size and accelerated step size, exhaustive search, dichotomous search, interval halving method, fibonacci method, golden section method, comparison of elimination methods, interpolation methods – quadratic interpolation, cubic interpolation, quasi-newton method, unconstrained optimisation techniques- classification, random search methods, grid search method, univariate method, indirect methods – gradient of function, steepest descent method, newton's method, constrained optimisation – random search methods, complex methods, sequential linear programming	12
V	**Geometric Programming:** Unconstrained minimisation problem, constrained minimisation problem, geometric programming with mixed inequality constraints, applications of geometric programming	05

Self-Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggest List of Tutorials (not restricted to the following):
(Only for information)

Sr. No.	Title of the Tutorial	Hours
1.	Matrix operations	01
2.	Linear algebra operations	01
3.	Differentiation of a vector and matrix	01
4.	Integration of a vector and matrix	01
5.	Simplex algorithm	01
6.	Newton's method	01
7.	Lagrange multiplier method	01
8.	KKT theorem	01
9.	Linear unconstrained problem-1	01
10.	Linear unconstrained problem-2	01
11.	Equality and non-equality constraints-1	01
12.	Equality and non-equality constraints-2	01
13.	Quadratic optimisation problem -1	01
14.	Quadratic optimisation problem -2	01
15.	Nonlinear optimisation problem -1	01
16.	Nonlinear optimisation problem -2	01

Suggested Readings:

1. Stephen G. Nash, A. Sofer, Linear and Non-linear Optimisation, Tata McGraw Hill
2. Rao S.S, Optimisation – Theory and applications, Wiley publication
3. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Engineering Optimisation, Wiley publication