

ME455: DESIGN OPTIMIZATION
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To acquire knowledge of various optimization techniques to apply in physical systems.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory		Practical		
			ESE	CE	ESE	CE		
3	0	2	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	<u>Introduction:</u> General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints -Classification of optimization problems.	10
2	<u>Optimization techniques:</u> Single variable and multivariable optimization Techniques of unconstrained minimization - Golden Section -Random, pattern and gradient search methods -Interpolation methods.	08
3	<u>Optimization with equality and inequality constraints:</u> Direct methods - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming and stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques.	09
4	<u>Structural applications:</u> Design of simple truss members.	03
5	<u>Design application:</u> Design of simple axial, transverse loaded members for minimum cost, maximum weight, - Design of shafts and torsionally loaded members -Design of springs.	06

Unit No.	Topics	Teaching Hours
6	Dynamic Applications: Optimum design of single, two degree freedom system, vibration absorbers. Application in Mechanism - Optimum design of simple linkage mechanism.	06
TOTAL		42

List of References:

1. Onwubiko, C., "*Introduction to Engineering Design Optimization*", Prentice Hall, 2000. ISBN 0-201-47673-8.
2. Vanderplaats, G.N., "*Multidiscipline Design Optimization*", Vanderplaats R&D, 2007. ISBN 0-944956-04-1
3. Johnson Ray, C., "*Optimum design of mechanical elements*", Wiley, John & Sons, 1981.
4. Goldberg, D.E., "*Genetic algorithms in search, optimization and machine*", Barnen, Addison-Wesley, New York, 1989.
5. Kalyanamoy Deb, "*Optimization for Engineering design algorithms and Examples*", PHI India.
6. S.S.Rao, "*Engineering Optimization: Theory and Practice*", John Wiley & Sons
7. Arora, J.S., "*Introduction to Optimum Design*", (4th ed), Elsevier, 2017. ISBN 978-0-12-800806- 5.
8. Singeresu S. Rao, "*Engineering Optimization - Theory and Practice*", New Age Intl. Ltd., Publishers, 2000

Course Outcomes (COs):

At the end of this course students will be able to ...

1. Formulate an optimization problem in terms of its design variables, objective function, and constraints
2. Select an appropriate optimization technique for problems involving single and multivariable unconstrained problems
3. Demonstrate the use of optimization techniques on a variety of engineering problems with equality and inequality constraints
4. Design optimization of simple truss elements
5. Optimize the design of simple mechanical elements
6. Solve dynamic problems requiring optimization