Course Code	Course Title	L	T	P	C
BMEE215L	Engineering Optimization	3	1	0	4
Pre-requisite	BMAT101L, BMAT101P, BMAT201L	Syllabus Version			
		2.0			

Course Objectives

1. To gain knowledge on linear, non-linear optimization tools and techniques.
2. To apply the knowledge gained in solving engineering problems.
3. To gain knowledge and apply modern heuristic algorithms to solve engineering optimization problems.

Course Outcomes

1. Formulate and solve Linear Programming Problems
2. Understand and apply suitable approach for solving transportation and assignment problems.
3. Demonstrate the usage of network optimization algorithms for traditional applications.
4. Apply goal programming and dynamic programming approach for solving problems of appropriate applications.
5. Apply classification optimization technique and suitable algorithms for non-linear programming problems.
6. Justify and apply evolutionary algorithm for solving optimization problems.

Module:1	Linear Programming Problem	9 hours

Two-variable linear programming model-Graphical linear programming solution-Linear programming applications-Linear programming model in equation form-Transition from graphical to algebraic solution-Artificial starting solution-Special cases in the simplex method-Sensitivity analysis.

Module:2	Transportation and Assignment Models	8 hours

Definition of the transportation model-Non-traditional transportation models-The transportation algorithm-The assignment model-The transhipment model.

Module:3	Network Models	9 hours

Scope and definition of network models-Minimal spanning tree algorithm-Shortest route problem-Maximal flow model-CPM and PERT.

Module:4	Goal and Dynamic Programming	8 hours

Goal Programming: A goal programming formulation-Goal programming algorithms.

Deterministic dynamic programming: Recursive nature of computations in dynamic programming-Forward and backward recursion-Selected dynamic programming applications.

Module:5	Classical Optimization Techniques	8 hours

Introduction, engineering applications of optimization-Classification of optimization problems-Single variable optimization-Multivariable optimization with no constraints-Multi variable optimization with equality and in equality constraints: Lagrange multipliers method, Kuhn-Tucker conditions.

Module:6	Unconstrained and Constrained Nonlinear Optimization	8 hours

Unconstrained nonlinear optimization: Univariate method-Gradient of a function-Cauchy method-Fletcher-Reeves method.

Constrained nonlinear optimization: Characteristics of a constrained optimization problem-Cutting plane method-Interior and exterior penalty function methods.		
Module:7	**Evolutionary Algorithms**	**8 hours**
Genetic Algorithm: Introduction-Representation of design variables-Representation of objective function and constraints- Genetic operators- Algorithm-Multi-objective optimization using NSGA-II.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**60 hours**

Text Book(s)	
1.	Hamdy A. Taha, Operations Research: An Introduction, 2017, 10th Edition, Pearson Education, Inc.
2.	Rao, S.S., Engineering optimization: theory and practice, 2019, 5th Edition, John Wiley & Sons, Inc.
Reference Books Authors, book title, year of publication, edition number, press, place	
1.	Arora, R.K., Optimization: algorithms and applications, 2015, 1st Edition, Chapman and Hall/CRC.
2.	Deb, K., Optimization for engineering design: Algorithms and examples, 2012, 2nd Edition, PHI Learning Pvt. Ltd.
Mode of Evaluation: CAT / written assignment / Quiz / FAT	

Recommended by Board of Studies	30-11-2022		
Approved by Academic Council	No. 68	Date	19-12-2022