BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, HYDERABAD CAMPUS
SECOND SEMESTER, 2024-2025
COURSE HANDOUT PART-II

Date: 30-12-2024

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **ME F320 / ME F344**
Course Name : **Engineering Optimization**
Instructor In-charge : **K. RAM CHANDRA MURTHY**
Instructors : **C P Kiran, Piyush C Varma, Aritra Chatterjee, Vishista Kaushik**

1. Scope and Objective of the Course:

Engineers, scientists, analysts and managers are often faced with the challenge of making trade-offs between different factors in order to achieve desirable outcomes. Optimization is the process of choosing these trade-offs in the best way. Optimization problems, having reached a degree of maturity over the past several years, are encountered in physical sciences, engineering, economics, industry, planning, and many other areas of human activity. Objective of the course is set to familiarize the students with standard methods of solving optimization problems.

This course deals with the following topics: Formulation of optimization problems, classical optimization techniques, nonlinear optimization methods for problems with and without constraints, simplex method, duality and sensitivity concepts, revised simplex methods, transportation models, travelling-salesman models, assignment models, network models, integer programming, genetic algorithm and other evolutionary optimization techniques, goal programming and multi-objective optimization. Use of application software in solving optimization problems.

2. Text Book:

T1 HA Taha, *Operations Research: An Introduction*, Pearson Education, 10/E, 2019.

3. Reference Books:

R1 SS Rao, *Engineering Optimization: Theory and Practice*, New Age International (P) Limited, Third Edition, 1996

R2 FS Hillier and GJ Lieberman, *Introduction to Operations Research*, TMH, 8/E, 2006.

R3 WL Winston, *Operations Research: Applications and Algorithms*, Thomson Learning, 4th Ed., 2004

R4 A Ravindran, DT Philips and JJ Solberg, *Operations Research: Principles and Practice*, John Wiley & Sons, Singapore, Second Edition, 1987

R5 GC Onwubolu and BV Babu, *New Optimization Techniques in Engineering*, Springer-Verlag, Heidelberg, Germany, First Edition, 2004.

R6 Kalyanmoy Deb, optimization for engineering design: algorithms and examples, PHI, Second edition, 2012.

4. Course Plan:

Lec. Nos.	Learning Objectives	Topics to be Covered	Ref. To Text book
1	Introduction	Introduction to optimization	T1 (1)
2-3	Modeling with Linear Programming	Two variable LP model, Graphical LP solution	T1 (2.1-3)
4-10	Simplex Method	LP model in equation form, Transition from graphical to algebraic solution, Simplex method, Generalized simplex	T1 (3.1-6)

		tableau in matrix form, Artificial starting solution, Special cases, Sensitivity analysis	
11-14	Duality and Post-optimal Analysis	Dual problem, Primal-Dual relationships, Economic interpretation of duality, Dual simplex algorithm, Post-optimal analysis	T1 (4.1-5)
15-17	Transportation Model and its Variants	Definition of the transportation problem, The Transportation Algorithm, The Assignment Model	T1 (5.1, 5.3-4)
18-20	Network Models	Definition, CPM and PERT	T1 (6.1, 6.5)
21-23	Goal Programming	Goal programing formulation, Goal programming algorithms	T1 (8.1-2)
24-26	Integer Linear Programming	Applications, Branch-and-bound algorithm, Cutting-plane algorithm	T1 (9.1-2)
27-29	Inventory Models	Deterministic Inventory Models, Static Economic Order Quantity (EOQ) mod	T1 (11.1,11.3)
30	Review of Basic Probability	Random variables, Poisson, Exponential and Normal Distribution	T1 (12.2-4)
31-34	Queuing Systems	Definition, Birth and Death process, Role of Exponential Distribution, Generalized Poisson Queuing Models, Specialized Poisson Queues: M/M/1 and M/M/c with infinite and finite system capacities	T1 (15.1-6)
35-38	Classical and Nonlinear Optimization	Unconstrained problems, Constrained problems: Equality constraints – Lagrangian method, Ineauality constraints – Karush-Kuhn-Tucker (KKT) Conditions, Quadratic Programming	T1 (18.1-2, 19.2.2)
39-42	Evolutionary Optimization	Introduction to Evolutionary Optimization Techniques (Genetic Algorithms, Simulated Annealing, etc.)	R6 (Ch 6)

5. Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Nature
Mid-Sem. Test	90 min	25 %	06/03 11.30 - 01.00PM	Closed Book
Lecture class participation		15 %		Open Book
Tutorial class participation		20 %		Open Book
Comprehensive Exam.	180 min	40 %	08/05AN	Closed Book

6. Chamber Consultation Hour: to be announced in class

7. Notices: All notices concerning this course will be displayed on the LMS.

8. Make up Policy: Make-up will be granted only to the genuine cases with prior permission from the IC. For cases related to illness, proper documentary evidence is essential. No makeup is allowed for quizzes, assignments, etc.

9. Minimum performance requirement for clearing the course: A student should obtain 30% of the lower bound of the highest grade or 40% of the median marks of the class, whichever is lower to clear the course. Otherwise, he/she may be awarded NC.

10. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-In-Charge
(ME F320)