BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE,Pilani
Pilani Campus

SECOND SEMESTER 2023-2024

Course Handout (Part II)

Date:9/01/2024

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 Number : ME F320
Course Title : Engineering Optimization
Instructor In-charge : C P KIRAN, Anirudh U, Abhishek Sarkar, Pardha Sardahi G, V. Muralidhar, Vashista K

Course Description : 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. The objective of the course is 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 Books:

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

3. References:

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:

Lect. No.	Topic to be Covered	Learning Objectives	Chapter in the 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	T1 (3.1-6)

		to algebraic solution, Simplex method, Generalized simplex 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	Demand forecasting in supply chain, Aggregate planning in the supply chain, Planning supply and demand in the supply chain: Managing predictable variability; Coordination in Supply Chain	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 System	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 capacitie	T1 (15.1-6)
35-38	Classical and Nonlinear Optimization	Unconstrained problems, Constrained problems: Equality constraints – Lagrangean 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 Component

S. No.	Evaluation Component	Duration	Max. Marks	Date & Time	Nature
1	Mid-Semester Examination	90 Min	25%	13/03 - 2.00 - 3.30PM	CB
2	Surprise Quizzes +Software based assignment		(5+5)10%		OB
3	Class/Tutorial		25%		OB

	assignments				
4	Comprehensive Examination	180min	40%	11/05 AN	CB

6. **Chamber Consultation**: To be announced in the class.
7. **Notices:** All notices concerning this course will be displayed on the CMS only.
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. **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