



**Birla Institute of Technology & Science, Pilani**  
Hyderabad Campus

**FIRST SEMESTER 2021-2022**

**Course Handout Part II**

Date: August 20, 2021

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.** : MATH F212  
**Course Name** : Optimization  
**Instructor-in-charge** : P.T.V. Praveen Kumar,  
**Instructor** : D. K. Satpathi, K. Venkataratnam, Sumit Kumar Vishwakarma

**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. The objective of the course is set to familiarize students with standard methods of solving optimization problems.

This course deals with details of various aspects associated with Optimization. These include a description of optimization techniques, namely, Linear Programming and Nonlinear Programming, and their applications to various engineering and science disciplines, including economics and finance. Multi-objective Optimization, which handles optimization aspects of more than one objective, is also discussed. A brief and informative description of Nontraditional optimization techniques such as Genetic Algorithms, Differential Evolution, Memetic Algorithms, Ant Colony Optimization, Particle Swarm Optimization, etc. is also provided.

**2. Text Book:**

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

**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, 4<sup>th</sup> Edition, 2004
- R4 JC Pant, *Introduction to Optimization: Operations Research*, Jain Brothers, New, 6/E, 2004.
- R5 A Ravindran, DT Philips and JJ Solberg, *Operations Research: Principles and Practice*, John Wiley & Sons, Singapore, Second Edition, 1987
- R6 GC Onwubolu and BV Babu, *New Optimization Techniques in Engineering*, Springer-Verlag, Heidelberg, Germany, First Edition, 2004.



### 3. Course Plan:

Lecture Nos.	Learning Objectives	Topics to be Covered	Chapter in the Text Book
1	Understand the concepts of Optimization. Learn basic optimization techniques	Introduction to Optimization	
2-4	Understand and develop Linear Programming models for mathematical problems	Two variable LP model, Graphical LP solution, Selected LP applications, Convex Set	T1 (2.1, 2.2, 2.4, 7.1)
5-6	Understand different techniques available for solving two, multivariate LP problems.	LP model in equation form, Transition from graphical to algebraic solution	T1 (3.1, 7.1.1 , 3.2)
7-9		The Simplex Method Generalized simplex tableau in matrix form, Revised Simplex Method.	T1(3.3., 7.1.2, 7.2)
10-12		Artificial starting solution Special cases in the simplex method	T1(3.4, 3.5)
13-14	Understand and solve special cases in the LP problems, introduce sensitivity analysis to re-evaluate a solution. Practical application of LP for solving real time problems	Definition of Dual Problem, Duality, Primal-Dual Relationships.	T1 (4.1, 7.4,4.2)
15-16		Economic Interpretation of Duality, Additional simplex algorithms (Dual Simplex Method, Generalized Simplex Algorithm),	T1(4.3, 4.4)
17-19		Post optimal Analysis	T1(4.5)
20-22	Understand special cases of simplex problems and its procedures.	Definition of transportation problem, The transportation Algorithm,	T1 (5.1, 5.3)
23		The Assignment Model	T1(5.4)
24-25	Understand multiple objective optimization problems and develop models for solving them	Goal Programming Formulation	T1 (8.1, 8.2)
26-28	Understand Integer Programming Problems and different techniques for solving IPP	Formulation of IP problem Branch and Bound method for solving IPP Cutting Plane method	T1 (9.1, 9.2)



29	Understand the difference between LPP and Nonlinear Programming Problems. Solve Nonlinear Programming Problems	Unconstrained problems, Convex and concave functions,	T1 (20.1)
30-31		Elimination Methods: Fibonacci Method and Golden Section Method,	R1 (5.7)
32-33		Gradient of a Function, Descent Methods: Steepest Descent Method and Conjugate Gradient Method,	T1 (21.1.1) T1(21.1.2) R1( 6.11,6.12)
34-35		Karush-Kuhn-Tucker (KKT) Conditions,	T1 (20.2.2)
36-38		Quadratic Programming,	T1(21.2.2)
39-40	Introduce Evolutionary Computation Techniques	Drawbacks of the Classical Techniques, Introduction to Nontraditional Optimization Techniques (Genetic Algorithms, Differential Evolution, etc.)	R6

#### 5. Evaluation Scheme:

Evaluation Component	Duration	Weightage	Date & Time	Nature of Component
Quiz 1	30 Minutes	15%	To be announced	Open book
Mid Semester	90 Minutes	30%	16/10/2021 1.30 - 3.00PM	Open book
Quiz 2	30 Minutes	15%	To be announced	Open book
End Semester	120 Minutes	40%	23/12 AN	Open book

\* The total marks of all the components taken together will be 200.

**6. Notices:** All notices about the course will be put on CMS.

**7. Consultation Hour:** To be announced in the class by the respective Instructors.

**8. Make-up:** Make up for the tests will normally be held in the following week. Make up will be Granted only in genuine cases. Permission must be taken in advance except in extreme cases.

**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.

