**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**
**INSTRUCTION DIVISION**
**SECOND SEMESTER 2020-2021**
**Course Handout Part II**

Date: 15th Jan 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. : ME F344/MF F344
Course Title : ENGINEERING OPTIMIZATION
Instructor-in-charge : RAJESH P MISHRA
Instructor : Aakash C Rai
Tutorial Instructors : Rajesh P Mishra, Aakash C Rai, Sachin U Belgamwar and Murali Palla

## 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 to familiarize the students with standard methods of solving optimization problems.

This course deals with details of various aspects associated with optimization. These include description of optimization techniques, namely, linear programming and non-linear 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.

## 2. Text Book:

**T1** HA Taha, *Operations Research: An Introduction*, Pearson Education/PHI, 10/E, 2018.

## Reference Books:

**R1** A. Ravindran, DT Philips and JJ Solberg, *Operations Research: Principles and Practice*, John Wiley & Sons, Singapore, Second Ed., 1987

**R2** S.S Rao, *Engineering Optimization: Theory and Practice*, New Age International (P) Limited, Third Edition, 1996

**R3** F.S Hillier and GJ Lieberman, *Introduction to Operations Research*, TMH, 10th Ed., 2013.

**R4** J.C Pant, *Introduction to Optimization: Operations Research***,** Jain Brothers, New , 6th Ed., 2004.

## 3. Course Plan:

| Learning Objectives | Topics to be Covered | Lecture No. | Ref. To Text book |
|---|---|---|---|
| To understand the meaning of optimization and formulation of LPP models and NLPP models. | Introduction to optimization | 1-2 | T1 (1.1 to 1.4) |
| Discussion on how to solve two variables LP models by the graphical solution procedure. | Two variable LP model, graphical LP solution, selected LP applications, convex set. | 3-4 | T1 (2.1, 2,2, 2.4, 7.1) |
| To obtain an understanding of why and how the simplex calculations are made and know how to recognize the special situations. | LP model in equation form, transition from graphical to algebraic solution. | 5 | T1 (3.1, 3.2) |
| | The Simplex method, generalized Simplex tableau in matrix form, Revised Simplex method. | 6-8 | T1 (3.3, 7.1.1, 7.1.2, 7.2.1 7.2.2) |
| | Artificial starting solution, special cases in the simplex method. | 9-11 | T1 (3.4, 3.5) |
| To understand the concept of duality, how to read and interpret the solution of dual problem and relate the dual solution to the primal solution and to explain how post optimal analysis can be used by a decision maker. | Definition of dual problem, duality, primal-dual relationships. | 12-13 | T1 (4.1, 4.2) |
| | Economic interpretation of duality, additional Simplex algorithms (Dual Simplex and Generalized Simplex). | 14 | T1 (4.3, 4.4) |
| | Post optimal analysis. | 15 | T1 (4.5) |
| To formulate transportation and assignment problems as LPP and how to solve these problems. | Definition of transportation problem, the transportation algorithm. | 16-17 | T1 (5.1, 5.3) |
| | The assignment model. | 18 | T1 (5.4) |
| To understand multiples objectives optimization and how to solve multi objective optimization. | Goal programming formulation. | 19 | T1 (8.1) |
| | Goal Programming algorithms: the weights method and the preemptive method. | 20 | T1 (8.2) |
| To understand the integer programming (IP) problem and its efficacy. | Formulation of IP problems, B&B and Cutting-plane method for solving IP problems. | 21-22 | T1 (9.1, 9.2) |
| To solve nonlinear programming problems. | Unconstrained problems, convex and concave functions. | 23-24 | T1 (20.1, Appendix D.4) |
| | Unconstrained algorithms: Direct-search and gradient methods. | 25-26 | T1 (21.1) |
| | Constrained problems. | 27-28 | T1 (20.2) |
| | Constrained algorithms: quadratic programming. | 29-30 | T1 (21.2.2, Appendix D.3) |
| | Genetic algorithm. | 31-32 | |

**4. Evaluation Scheme:**

| Component | Duration | Marks | Weightage (%) | Date & Time | Remarks |
|---|---|---|---|---|---|
| Mid-semester | 1.5 hours | 105 | 35 | | OB |
| Evaluative tutorials (best 3 out of 4) | Common hour | 60 | 20 | | OB |
| Comprehensive | 2 hours | 135 | 45 | | OB |

**OB – Open Book**

**5. Make-Up Policy:** Only genuine cases will be entertained (Prior permission will be needed for make up, usually make-up will be held within a week after the regular test). No make-up will be given for evaluative tutorials. Best three evaluative tutorials out of four will be considered.

**6. Problems:** Students are strongly advised to work out all the problems in the text-book and do similar problems from the reference books. It is also strongly recommended that the students should try out the algorithms on computers to get a better understanding of the subject.

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

**8. Notice: All notices regarding the course will be put up on NALANDA only.**

**9. NC will be given to students obtaining overall marks less than 15% of the total (less than 45 out of 300).**

**INSTRUCTOR-IN-CHARGE**
**(ME F344/MF F344)**