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**SECOND SEMESTER 2020-2021**

# Course Handout Part II

Date: 16-01-2021

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

## Course Title : Engineering Optimization

## Instructor-in-Charge : **DHEERAJ AGARWAL**

## other-instructors : AMIT KUMAR GUPTA

Deepak Nabapure, V Venkateswara Rao, V Muralidhar, K Lakshman Rao

**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 with the standard methods of solving optimization problems. This course deals with details of various aspects associated with optimization, including Linear programming methods, simplex method, transportation model and its variants, PERT/CPM, inventory models, queuing systems, nonlinear optimization algorithms and evolutionary algorithms

**Textbooks:**

1. *Operations Research: An Introduction*, 10th Edition, by Taha, Hamdy A., Pearson Education, 2018.

**Reference books**

1. SS Rao, *Engineering Optimization: Theory and Practice*, New Age International (P) Limited, Third Edition, 1996
2. FS Hillier and GJ Lieberman, *Introduction to Operations Research*, TMH, 8/E, 2006.
3. WL Winston, *Operations Research: Applications and Algorithms*, Thomson Learning, 4th Ed., 2004.
4. A Ravindran, DT Philips and JJ Solberg, *Operations Research: Principles and Practice*, John Wiley & Sons, Singapore, Second Edition, 1987.
5. GC Onwubolu and BV Babu, *New Optimization Techniques in Engineering*, Springer-Verlag, Heidelberg, Germany, First Edition, 2004.

**Course Plan:**

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| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction | Introduction to optimization |  |
| 2-3 | Modeling with Linear Programming | Two variable LP model, Graphical LP solution (Problem solving: Selected LP applications) | T1 (2.1-3) |
| 4-8 | Simplex Method | LP model in equation form, Transition from graphical to algebraic solution; The Simplex Method, Generalized simplex tableau in matrix form, artificial starting solution  (Problem solving: Simplex, Big-M, 2-phase, TORA) | T1 (3.1-2, 3.3-5) |
| 9-11 | Transportation Model and its Variants | Definition of transportation problem, The transportation Algorithm, The Assignment Model  (Problem solving: transportation, assignment, TORA) | T1 (5.1, 5.3-4) |
| 12-14 | Network Models | Definition, Minimal Spanning Tree Algorithm, Shortest route Problem, CPM and PERT  (Problem solving: Network, CPM, PERT, TORA) | T1 (6.1-3, 6.5) |
| 15-17 | Inventory Models | Deterministic Inventory Models  (Problem solving: inventory) | T1 (11.1-3) |
| 18 | Review of Basic Probability | Random variables, Poisson, Exponential and Normal Distribution | T1 (12.2-4) |
| 19-22 | Queuing Systems | Definition, Birth and Death process, Role of Exponential Distribution, Generalized Poisson Queuing Models, Specialized Poisson Queues.  (Problem solving: M/M/1 and M/M/c with infinite and finite system capacities, TORA) | T1 (15.1-6) |
| 23-26 | Nonlinear Programming Algorithms | Unconstrained problems, Unconstrained Algorithms  Karush-Kuhn-Tucker (KKT) Conditions, Quadratic Programming | T1 (18.1, 19.1, 18.2.2, 19.2.2) |
| 27-28 | Evolutionary Algorithms | Introduction to Nontraditional Optimization Techniques (Genetic Algorithms, Simulated Annealing, etc.) |  |

**Evaluation Scheme:**

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| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid-Sem. Test | 1.5 hours | 30% | 03/03 9.00 - 10.30AM | Open Book |
| Tutorial assignments |  | 20% |  | Open Book |
| Surprise Quizzes |  | 10% |  | Open Book |
| Comprehensive Exam | 2 hours | 40% | 06/05 FN | Open Book |

**Chamber Consultation Hour:** To be announced during the class.

**Notices:** Notices will be displayed on CMS**.**

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

**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 F344)**