Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2020-2021
Course Handout Part II

Date: 17-08-2020

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

Course No.   : **CE F411**
Course Title   : **Operations Research for Engineers**
Instructor-in-charge : **A VASAN**
Chamber No.   : **D-117**

1. Scope & Objective of the course:

Operation Research deals with the application of advanced analytical methods for proper decision making process. The course has wide application potential in many branches of Engineering, Science and Management. This course starts from traditional techniques and proceed towards non-traditional techniques focusing on engineering based application. Discussion on basic concepts like Linear Programming, Transportation model etc will make a strong foundation that will help to learn more about the advanced concepts such as Evolutionary algorithms. The main objective of the course is to familiarize the students with basic and advanced concepts of operation research through case studies related to Engineering discipline.

Course Outcomes: At the end of this course, the students will be able to:

CO1. Formulate engineering design problems as mathematical optimization model
CO2. Choose the best suited optimization technique as well as software tool for solving the formulated optimization mathematical model
CO3. Solve real world application problems using nontraditional optimization algorithms
CO4. Develop a report that describes the formulated optimization model and the solving methodology, analyse the results and propose recommendations in language understandable to the decision-making process

Student Learning Outcomes (SLOs) assessed in this course – **(a), (b), (c), (d), (e), (f), (h), (j),** and **(k).**

Student Learning Outcomes (SLOs):
SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

2. **Text Book:**
> **T1** HA Taha*, Operations Research: An Introduction,* Pearson Education/PHI, 9/E, 2014.

Reference Books:
> **R1** Singiresu S. Rao, *"Engineering Optimization: Theory and Practice",* New Age International Publishers, Third Edition, 2013.
> **R2** FS Hillier and GJ Lieberman, *Introduction to Operations Research*, TMH, 9th Edition, 2011.
> **R3** K Deb, *Multiobjective Optimization Using Evolutionary Algorithms*, John Wiley & Sons Limited, 2010.
> **R4** Yang, Xin-She. *Nature-inspired metaheuristic algorithms*. Luniver Press, 2010.

3. **Course Plan:**

Lecture No.	Topics to be covered	Learning Objectives	Reference	SLO
1	Introduction to Operations Research and Optimization	To understand Operation Research and Optimization	T1	-
2-3	Two variable LP model, Graphical LP solution, Selected LP applications, Convex Set	To develop Linear Programming models and solve two variables LP models by the graphical solution procedure	T1	a, c, e
4-6	LP model in equation form, Transition from graphical to algebraic solution The Simplex Method, Generalized simplex tableau in matrix form, Artificial starting solution, Special cases in the simplex method	To obtain an understanding of why and how the simplex calculations are made and know how to recognize the special situations	T1	a, c, e

7-9	Definition of Dual Problem, Duality, Primal-Dual Relationships, Economic Interpretation of Duality, Additional simplex algorithms (Dual Simplex Method, Generalized Simplex Algorithm), Post optimal Analysis	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	T1	a, c, e
10-12	Definition of transportation problem, The transportation Algorithm, The Assignment Model	To formulate transportation and assignment problems as LPP and how to solve these problems	T1	a, b, c, e
13-14	Goal Programming Formulation, Goal Programming Algorithms: The Weights Method and The Preemptive Method	To understand multiples objectives optimization and how to solve multi objective optimization	T1	a, c, e
15-16	Formulation of IP problem Branch and Bound method for solving IPP Cutting Plane method	To understand Integer Programming problem and its efficacy	T1	a, c, e
17-23	Unconstrained problems, Convex and concave functions, Elimination Methods: Fibonacci Method and Golden Section Method, Gradient of a Function, Descent Methods: Steepest Descent Method and Conjugate Gradient Method, Karush-Kuhn-Tucker (KKT) Conditions, Quadratic Programming, Penalty Function Method	To solve nonlinear programming problems using various techniques	T1, R1	a, c, e
24-26	Deterministic and Probabilistic Inventory Models, static economic order quantity (EOQ) models, dynamic EOQ models	To understand various inventory models and solve using different variations of the economic order quantity model	T1	a, c, e
27-30	Decision making under Certainty, Risk and Uncertainty, Game Theory	To understand decision making under certainty as well as uncertainty and also using game theory	T1	a, c, e
31-36	Definition, Birth and Death process, Role of Exponential Distribution, Generalized Poisson Queueing Models, Specialized Poisson Queues.	To introduce queues, various models, birth and death models	T1	a, c, e
37-38	Introduction to Multiobjective Optimization	To understand the difference between single objective and Multiobjective optimization problems and few classical methods to solve them	R3	a, c, h, j

S. No.	Evaluation Component	Duration (min)	Weightage (%)	Date & Time	Remarks
				Drawbacks of the classical techniques, introduction to evolutionary computation	

	Content	Objective			
39-42	Drawbacks of the classical techniques, introduction to evolutionary computation techniques (Genetic Algorithms, Differential Evolution, Particle Swam Optimization, Firefly Algorithm etc.)	To introduce evolutionary computation techniques and solve few real life application problems	R4	a, c, d, e, f, h, k	

4. Evaluation Scheme

S. No.	Evaluation Component	Duration (min)	Weightage (%)	Date & Time	Remarks
1	Test I	30	15	September 10 – September 20 (During scheduled class hour)	OB
2	Test II	30	15	October 09 –October 20 (During scheduled class hour)	OB
3	Test III	30	15	November 10 – November 20 (During scheduled class hour)	OB
2	Seminar & Report Writing (2 Nos)	-	25	-	OB
4	Compre Exam	120	30	TBA	OB

5. Chamber Consultation Hour: Friday 04.30 PM – 05.00 PM

6. Notices: Notices concerning this course will be displayed on Google Classroom Course page.

7. Make-up Policy: Prior permission for all make ups are a must.

8. 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
CE F411