IE 222 Industrial Operations Analysis -1- 3(3,1,0)

Catalog Data	Introduction to mathematical programming and optimization. Characteristics of linear programs. Modeling of various industrial programs as linear programs. Graphical solutions. Introduction to the theory of simplex methods. Big M method, unbounded and infeasible solutions. Sensitivity analysis and introduction to the duality theory. Goal programming method. Transportation and assignment problems and solution techniques. Shortest path, minimum spanning tree, and maximum flow minimum cut problems.			
Prerequisite	None			
Co-requisites	MATH 107			
Level	5			
Textbook	1. Operations Research: An introduction, 9th Ed., H. A. Taha, Prentice Hall, 2011.			
Reference	1- Introduction to Operations Research, 8th Ed., Hiller and Lieberman, McGraw Hill, 2005. 2- Applications of optimization with Xpress-MP, Christelle Guéret, Christian Prins, Marc Sevaux, Editions Eyrolles, 2000.			
Learning Objectives	• To introduce students to basic concepts in modeling and linear programming to enable them to formulate linear models, to solve them by using graphical approach and simplex method • To perform sensitivity analysis, to understand duality theory and relation between primal-dual optimality-feasibility • To utilize the algorithms for special linear programs such as transportation, assignment, and some network problems • To get exposed to an approach of multi-objective optimization, namely goal programming			
Topics (classes)		**Topic**	**Week**	**Contact, hr**
	1.	**Introduction to operations research**	**(1)**	**[4]**
	2.	**Linear programming modeling, and selected engineering and industrial applications**	**(3)**	**[12]**
	3.	**Graphical solutions of linear programs**	**(0.5)**	**[2]**
	4.	**The theory of simplex method**	**(2)**	**[8]**
	5.	**Sensitivity analysis and shadow prices**	**(1)**	**[4]**
	6.	**Duality theory**	**(1)**	**[4]**
	7.	**Goal Programming**	**(2)**	**[8]**
	8.	**Special types of linear programs: Transportation problem and assignment problem**	**(1.5)**	**[6]**
	9.	**Network analysis: Shortest path, minimum spanning tree, and maximum flow and minimum cut problems**	**(2)**	**[8]**
Laboratory Topics		None		
Project work	Selecting a real life problem and solving it by using computer			
Computer Usage	Solve problems and perform sensitivity analysis by using the package LINGO			

Learning outcomes	1) Formulate linear models from the description of the problems ***[a, e, k]*** 2) Plot the linear program with 2 variables and solve it. Locate basic, basic feasible, degenerate and optimal solutions in the graph ***[a]*** 3) Transform problems into standard form. Generate basic feasible solutions ***[a]*** 4) Grasp the fundamentals of simplex method. Perform simplex method in tables and learn when to utilize artificial variables. Verify the feasibility and optimality of a solution. Learn how to identify unbounded and infeasible problems, and single and multiple optimums ***[a]*** 5) Perform sensitivity analysis on cost and right hand side parameters, find and interpret the meaning of shadow prices ***[a, e, h, k]*** 6) Learn how to develop dual of a primal and its economical meaning. Analyze the relationship between primal optimality and dual feasibility, find dual solutions with several methods, and verify the complementary slackness theorem ***[a, e, h, k]*** 7) Expose an approach of multi-objective optimization, namely goal programming ***[a, e, h, k]*** 8) Understand the practical meanings of transportation and assignment problems. Learn how to utilize special algorithms for these problems and to identify multiple optimums ***[a, e, h, k]*** 9) Learn basic problems in graph theory. Understand the special algorithms for these problems and apply them. ***[a, e, h, k]***
Estimated Category Content	Engineering Design: 3 credit hour or 100%.
Prepared by	*Dr. Mohamed Labidi*
Preparation Date	May 2012