

## IE471 – OPERATIONS RESEARCH I

*Designation as a 'Required' or 'Elective' course*

TYPE OF COURSE: Required for BSIE and BSEM Majors

*Course (catalog) description*

COURSE DESCRIPTION: IE471 Operations Research I. 3 undergraduate hours; 4 graduate hours. Introduction to operations research, formulation of linear programming problems, simplex methods, duality theory, sensitivity analysis, network models, and mixed-integer linear programming. No graduate credit for industrial engineering majors.

*Prerequisite(s)*

PREREQUISITE(S): MATH 310, Applied Linear Algebra, 3 Hours

*Textbook(s) and/or other required material*

SAMPLE SOURCES AND RESOURCE MATERIALS:

Introduction to Operations Research, Hillier and Lieberman, 8<sup>th</sup> edition, McGraw Hill, 2005.

*Course objectives*

COURSE OBJECTIVES: The course is designed to provide students with an opportunity to learn the theory and techniques of linear programming and its extensions. Students are expected to learn to formulate real-world problems as linear and mixed-integer programs through illustrations in class, via numerous problems from text and the literature, and also via an optional project opportunity. Students also learn to use Excel and CPLEX to solve linear programs. With the successful completion of the course, students will be equipped with the understanding of a palette of optimization tools: the simplex algorithm for linear programs and various algorithms for simple network models.

*Topics covered*

MAJOR TOPICS:

	Hrs
1. Introduction to operations research and linear programming	(1.5 hrs)
2. Model formulation, graphical interpretation and computer implementation	(6.5 hrs)
3. Simplex method	(9 hrs)
4. Theory of the Simplex method	(3 hrs)
5. Duality theory	(5 hrs)
6. Sensitivity analysis	(3 hrs)
7. Transportation and Assignment problems	(5 hrs)
8. Network models	(5~6** hrs)
9. Integer programming formulation	(4~5** hrs)
10. Project presentation*	(2 hrs)
11. Exams	<u>(3 hrs)</u>
Total	45 hrs

\*: The semester project is required for the course at the discretion of an instructor.

\*\* : If an instructor requires the final project, 5 hours are allocated for network models and 4 for integer programming

*Class/laboratory schedule, i.e., number of sessions each week and duration of each session*

CREDIT HOURS: 3 undergraduate hours; 4 graduate hours.

Type of Instruction	Contact Hours/Week
Lecture-and-discussion	3

*Contribution of course to meeting the professional component*

The course is a gateway to optimization and presents a variety of basic operations research techniques for solving linear programming problems. Foremost, students understand the need for optimization. Through selectively chosen homework problems and the problems from the literature as well as extensive discussions in class and/or the final project opportunity (optional,) students learn to formulate and solve real-world problems as linear programs, network problems and mixed-integer linear programs. Through the optional final project opportunity (if required) or/and an interactive lecture-and-discussion course style, students learn to communicate and present their ideas better orally. Also, through the preparation of the final project report (if required) and homework, students learn to enhance their written communication abilities. Students also learn to use computer software for solving linear programming problems and learn how to seek information outside of class materials.

*Relationship of course to program outcomes*

As shown in the BSIE Course Outcomes Matrix:

- a. Ability to apply knowledge of mathematics, science and engineering
- e. Ability to identify, formulate, and solve engineering problems
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

*Person(s) who prepared this description and date of preparation*

Wei Chen (Associate Professor) & Hong Seo Ryoo (Assistant Professor) of Mechanical & Industrial Engineering, January 31, 2002

Pat Banerjee (Professor) of Industrial Engineering, October 15, 2007

Elodie Adida (Assistant Professor of Industrial Engineering), September 17, 2008

*Comments on outcomes*

- a. Use of linear algebra and calculus to learn the theory and methods for linear optimization problems.
- e. Through homework or/and an optional project.
- k. In addition to developing problem solving capabilities by hand in exam situations, students are required to use computer software and other mathematics applications for homework problems and their optional semester project.