IE472 – OPERATIONS RESEARCH II

Designation as a 'Required' or 'Elective' course
TYPE OF COURSE: Required for BSIE and BSEM Majors

Course (catalog) description
COURSE DESCRIPTION: IE472 Operations Research II. 3 undergraduate hours; 4 graduate hours. Nonlinear programming problems, unconstrained optimization search techniques, Kuhn-Tucker theorems, quadratic programming, separable programming, dynamic programming, Markov chain, and queuing theory

Prerequisite(s)
PREREQUISITE(S): IE 471 – Operation Research I (3 Hours)

Textbook(s) and/or other required material

Course objectives
COURSE OBJECTIVES: The course will continue to introduce the methods of operations research for improving design and operations of engineering system. The learning will emphasize the mathematical procedures of nonlinear programming search techniques, probabilistic models in operations research (e.g., Markov Chains and Queuing Theory), and dynamic programming. Students successfully completing this course are expected to be able to apply a variety of operations research techniques for solving nonlinear programming problems; to have a good command of probabilistic operations research methods and dynamic programming techniques; and to be familiar with computer software for solving nonlinear programming problems.

Topics covered
MAJOR TOPICS: 
1. Introduction to Nonlinear Programming (3 hrs)
2. Unconstrained Single Variable Problem (3 hrs)
3. Unconstrained Multiple Variable Problem (3 hrs)
4. Constrained Multiple Variable Problem (6 hrs)
5. Quadratic Programming (4.5 hrs)
6. Markov Chains (6 hrs)
7. Queuing Theory (6 hrs)
8. Dynamic Programming (4.5 hrs)
9. Computer Lab (3 hrs)
10. Review and Examinations (3 tests) (6 hrs)

Total 45 hrs
Class/laboratory schedule, i.e., number of sessions each week and duration of each session

CREDIT HOURS: 3 undergraduate hours; 4 graduate hours.

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<tr>
<th>Type of Instruction</th>
<th>Contact Hours/Week</th>
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<tr>
<td>Lecture-and-discussion</td>
<td>3</td>
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**Contribution of course to meeting the professional component**

The course extends OR I and presents more advanced topics of operations research, including nonlinear programming problems and probabilistic models. 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 the trade-off between realistic formulations of real-world problems and their solvability, learn to seek information outside of class materials, and realize the need for more sophisticated optimization tools and life-long learning for more accurate treatment of nonlinear problems and probabilistic models. If required, 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 problem solving.

**Relationship of course to program outcomes**

As shown in the BSIE Course Outcomes Matrix:

a. Ability to apply knowledge of mathematics, science and engineering
d. Function on multi-disciplinary teams
e. Ability to identify, formulate, and solve engineering problems
i. Recognition of the need for, and an ability to engage in life-long learning
j. A knowledge of contemporary issues
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**

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

Pat Banerjee (Professor) of Industrial Engineering, February 12, 2008

**Comments on outcomes**

a. Use of fundamental knowledge of mathematics such as linear algebra and calculus to learn the methods in Nonlinear Programming. Use the knowledge of statistics and probability to study the probabilistic models (Markov Chains and Queuing Theory) in operations research.
e. Through homework and computer project assignments, students are required to demonstrate their understanding of the course material by implementing optimization algorithms for solving engineering problems.

k. In addition to developing problem solving capabilities by hand in exam situations, students are required to use nonlinear programming software for homework problems and the optional semester project. The optional semester project provides students an opportunity to learn how to seek information outside of class materials. Through illustrative examples, students are exposed
to the shortcomings of linear programming approach to real-world problems and the trade-off between realistic formulations of problems vs. their solvability and understand the need for more sophisticated optimization tools and life-long learning.

These outcomes are what students are expected to gain from this course.