Chemical Engineering 356
Optimization: Theory and Practice

ELECTIVE

Course Description:
2004-06 Techniques of optimization, including formulation of optimization problems, one-dimensional search techniques, analytical methods, and n-dimensional search techniques; application of methods to process-industry problems.

Prerequisite(s) and Knowledge, Abilities, and Skills Student Should Have Entering This Course:
Prerequisites: Chemical Engineering 348 (or 448) or 353.
KAS: 1. Be familiar with basic equations for fluid flow, heat transfer, mass transfer, thermodynamics, and material and energy balances (ChE 353, 322, 317).
2. Be familiar with numerical techniques for linear and nonlinear equation solving and matrix techniques (ChE 348).

Textbook(s) and/or other required materials:

Course Objective:
This course is intended to teach students how to use optimization algorithms to improve the design and operation of chemical processes. The first part of the course emphasizes problem formulation; i.e., how one develops a mathematical statement for the objective function (usually an economic model) to be minimized or maximized and the equality and inequality constraints (the process model). Hence, some discussion of fitting models to data and profitability measures is required. Once the problem is formulated, the student should be able to select the optimization technique which is best suited to the problem characteristics.

Knowledge, Abilities and Skills Students Should Gain in this Course:
1. Be able to use economics to derive an objective function
2. Be able to use principles of engineering to develop equality and inequality constraints
3. Be familiar with the preferred software packages and optimization techniques to solve linear programming and nonlinear programming problems.
4. Learn about applications of optimization for optimizing important industrial processes.

Topics covered:
1. Formulation of optimization problems
2. Solving optimization problems using computer programs
3. Time value of money
4. Stationary points, convexity, concavity, unimodal functions
5. One dimensional search
6. Unconstrained multidimensional optimization
7. Polymer properties

Class/laboratory schedule, i.e., number of sessions each week and duration of each session:
3 hours of lecture per week for one semester.
Contribution of course to meeting the professional component:
Students are introduced to techniques used to optimize process design and operations.

Relationship of course to program outcomes:
1. An ability to apply knowledge of mathematics, chemistry, physics, computing, safety, and engineering. (a)
2. An ability to design, conduct, analyze, interpret, and report on experiments relevant to chemical engineering practice. (b, g)
3. An ability to use the techniques, skills, and modern engineering tools necessary for the practice of chemical engineering. (k)
4. An ability to apply and integrate the major elements of chemical engineering to solve problems of analysis, design, optimization, and control of components, systems, and processes important in chemical engineering practice. (c, e)

Person(s) who prepared this description and date of preparation:
T.F. Edgar January 30, 2004