Midterm Study Sheet

1. Chapter 2 – Modeling concepts
    a. Modeling concepts: making the model robust, effect of scaling, degrees of freedom
        i. Financial objective functions
    b. Identify LP, QP, NLP, MILP, and MINLP problem types
    c. Explain the difference between global and local optimization techniques and when they are required (convex vs. non-convex functions)
    d. Feasible vs. Infeasible design space
    e. Interpreting graphics such as contour plots
    f. Advantages of Numerical derivatives vs. Exact derivatives
    g. Demonstrate the use of Parameters, Variables, Inequality Constraints, and Equality Constraints to solve engineering design problems
    h. Programming logical conditions (IF, MAX, MIN, ABS, Piece-wise Linear, etc.)
2. Chapter 3 – Unconstrained Optimization
    a. Gradient, Hessian, positive or negative definiteness, indefinite
    b. Vectors that point uphill, downhill
    c. Representations of quadratic functions: scalar form, vector form, Taylor series
    d. Properties of quadratic functions
    e. Necessary and sufficient conditions
    f. Line search with quadratic fit
    g. Steepest descent (Understand Convergence theorem)
    h. Newton's method (Be able to derive)
    i. Quasi-Newton method: Rank 2 BFGS update
    j. Conjugate gradient method
3. Chapter 4
    a. Determine the number of potential feasible designs from a problem statement
    b. Demonstrate the following techniques for discrete optimization
        i. Exhaustive Search
        ii. Branch and Bound
        iii. Simulated Annealing
        iv. Genetic Algorithms
    c. Solve problems with binary, integer, or discrete variables
    d. Solve problems non-convex problems with multiple local minima

Exam will consist of 2 parts:

Part I: (50 minutes max, in class) Closed book and notes except for one half of an 8.5 X 11 sheet of paper (one side).
Part II: (take home) Open book and notes. MATLAB or Python will be required.