**Description**: The course will cover fundamental concepts of optimization and numerical methods for solving optimization problems. It will present applications of optimization in mechanical and industrial engineering.

**Learning Outcomes**: At the end of the course, students will understand the fundamental concepts of optimization including the general formulation of an optimization problem, the necessary and sufficient conditions for existence and uniqueness of an optimum solution to both unconstrained and constrained optimization problems. They will be able to explain the advantages and disadvantages of numerical optimization and the basic terminology. They should understand popular numerical techniques for solving constrained and unconstrained optimization problems and be able to implement some of these techniques on a computer program.

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**Textbook**: Vanderplaats, G. N. *Multidiscipline Design Optimization*, Vanderplaats Research and Development, Inc. Click this link to order: [https://www.vrand.com/cgi-bin/vrand_shop.pl](https://www.vrand.com/cgi-bin/vrand_shop.pl)

**References**:  

**Material**:

1. Basic concepts of optimization  
   - Introduction  
   - General optimization problem statement  
   - Examples of optimization problems in various engineering fields  
   - Taxonomy of optimization problems  
   - Iterative procedures for solving optimization problems  
   - Existence and uniqueness of the solution  
   - Sensitivity analysis

2. Functions of one variable

3. Unconstrained optimization

4. Constrained optimization  
   - Linear programming  
   - Sequential unconstrained minimization
Direct methods

**Exams, homework and grading:** There will be 7-8 assignments and a final project. These will be posted on Blackboard. You are encouraged to collaborate in the homework but copying another student’s homework is unacceptable. Your grade will be based on the following:

Homework (70%)
Final (30%)

**Lectures:** Lectures will be recorded and posted on YouTube approximately once a week. Links will be emailed to students and posted on Blackboard.

**Computer usage:** Some homework problems can be solved efficiently on a computer. You can use any software program you like including Excel, MathCad, MATLAB, FORTRAN, C, C++.

**Communication:** Homework assignments, design problems, solutions, review sessions, and assignments will be posted on Blackboard.