Physics 450  Mechanical Engineering 502
Computational Physics  Interdisciplinary Simulation and Modeling

Fall 2005

Instructors:  James A. McNeil  
Meyer 325  
jamcneil@mines.edu  

Mark T. Lusk  
Brown 326  
mlusk@mines.edu

Office Hours:  MW 1:30-3, F 10-12  
MWF 2-3


Additional references:

Course Objectives:
The purpose of this course is to empower the student with practical skills in attacking complex physics and engineering problems, beginning with an analysis of the relevant principles at play, the dimensions and scale of the problem, and concluding with the design and implementation of the numerical, graphical, and/or analytic/symbolic analysis that leads to an understanding of the system. At the conclusion of this course, when confronted with a complex system, a student should be able to:

1. recognize and mathematically articulate the fundamental physics and engineering concepts;
2. organize the problem in appropriate form by treating the relevant scale, scope, and dimensions;
3. identify appropriate numerical (or other) strategies;
4. implement the strategies in a well-designed algorithm;
5. evaluate the solutions relative to special analytic or limiting cases and analyze the algorithm in terms of stability and accuracy; and
6. effectively communicate the results.
General:
The learning objectives for these courses are essentially the same which enables an experiment in team teaching. The learning objectives center around skills and therefore the deliverables will be projects. The course will be organized around a set of physics and engineering problems the analytic and numerical analysis of which will require a specific set of numerical techniques. There will naturally be some (re-)learning of some of the major principles of physics as well as the ways complex physics and engineering problems are analyzed and reduced. Numerical methods are introduced in some (hopefully interesting) physical contexts. Where appropriate, the background physics/engineering will be presented in a (nearly) self-contained form.

A secondary learning objective for mechanical engineering students is an introduction to the principles and methods of quantum mechanics. This is deemed to be an important element of graduate level engineering education in light of the continued trend towards engineering at length scales where quantum effects play a significant role. This course requires little new mathematics beyond differential equations. The format for the course will be lecture/workshops and a laboratory each Friday (required for EGGN502, optional for PHGN450).

Grading:
The grading will be based upon the projects assigned at intervals throughout the course.