ISC 5935 - Special Topics:
Computational Partial Differential Equations
Spring 2015

Instructor:	John Burkardt email: `jburkardt@fsu.edu` office: 445 DSL
Website:	http://www.sc.fsu.edu/∼jburkardt/classes/fem_2015/fem_2015.html
Office Hours:	MW 3:00-4:00, 445 DSL
Class:	MWF 2:00-3:00, 468 DSL
Text:	Max Gunzburger, Janet Peterson, Finite Element Methods. Anders Logg, Kent-Andre Mardal, Garth Wells, Automated Solution of Differential Equations by the Finite Element Method: The FEniCS Book, Lecture Notes in Computational Science and Engineering, Springer, 2011, ISBN13: 978-3642230981 Hans Petter Langtangen, A primer on scientific programming with Python, Springer, 2012, ISBN13: 978-3-642-30293-0.

Course Description: This course will consider:

- the kinds of partial differential equations (PDE's) that are suitable for computational treatment;
- techniques for creating a discrete model of a PDE;
- software tools available to define the geometry and approximation spaces
- direct and iterative algorithms for the linear systems of algebraic equations;
- iterative algorithms for the nonlinear systems of algebraic equations;
- explicit and implicit algorithms for systems of ordinary differential equations;
- methods of estimating error and refining the mesh
- graphics software and other tools for presenting and analyzing results.

The course will present several model partial differential equations, and show several techniques for constructing a corresponding discrete model. Techniques will be discussed for creating a computational implementation of the model, including the treatment of the problem geometry, the boundary conditions and initial conditions, and the handling of any spatially-varying coefficient functions. Depending on the original problem and its discrete model, the system of equations to be solved must be handled appropriately. The solution, returned as a set of discrete data, must then be analyzed, displayed, and possibly used as

a starting point for a second calculation with a finer grid or otherwise revised model. At every step of this process, a variety of algorithms and software are available, and the student will become familiar with how to employ them to determine a satisfactory approximate solution to a given problem.
This course will accept students with a variety of backgrounds; however, they are expected to be willing to carry out extensive study and independent investigations on their own.

Course Objectives: Students completing the course will be able to:

- describe typical instances of PDE's and their standard formulation;
- list the steps necessary to discretize and solve an elliptic PDE;
- write a program using finite differences to solve a PDE;
- use a mesh generation program to create meshes for simple domains;
- create input for a program that uses finite elements to solve a PDE;
- produce tables that analyze the convergence behavior of a solution technique as a mesh parameter is systematically reduced.

Grading: The student's grade for the course will be based upon a number of assignments and a final project report:

- Assignments 50%
- Project Report - 50%

University Attendance Policy: Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy: The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of student's academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to . . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University. (Florida State University Academic Honor Policy, found at http://academichonor.fsu.edu/policy/policy.html.)

Americans with Disabilities Act Students with disabilities needing academic accommodation should:

- register with and provide documentation to the Student Disability Resource Center; and

- bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the Student Disability Resource Center, sdrc@admin.fsu.edu, web page: http://www.disabilitycenter.fsu.edu/.

Syllabus Change Policy Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.