MATH 5563, Finite element methods, Spring 2016

TR 2:00–3:15 pm, MATH 509

Instructor Yanqiu Wang

- Office: MATH 441 (405-744-5698)
- Office hours: TR 3:30-4:30 pm or by appointment
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Course Description Theory and practice of finite element methods, including elliptic boundary value problems, weak formulations, the Ritz-Galerkin method, conforming and non-conforming finite elements, error estimates, and numerical experiments.

Prerequisites Math 4023; 4263; and 4513 or CS 4513 or equivalent. 4143 or 5043 preferred. Students should be familiar with at least one of the following computer programming languages: Matlab, C/C++, Fortran, Python.

Course Contents

1. Introduction to the finite element methods using an example of one-dimensional elliptic boundary value problem. Weak(variational) formulation, natural and essential boundary conditions, Ritz-Galerkin method, 1-d finite element space.
2. General finite element theory. Well-posedness of the discrete system, 2-d and 3-d finite element spaces, non-conforming finite elements, error estimates.
3. Data structure of finite element codes.
4. Finite element methods for time-dependent problems, if time allows.

Textbook *The mathematical theory of finite element methods* (3rd edition) by Susanne C. Brenner and L. Ridgway Scott.
OSU students have online access to the entire book through the library link.

Additional readings

1. C. Johnson, Numerical solution of partial differential equations by the finite element method, Cambridge University Press, 1987;
2. G. Strang and G.J. Fix, An Analysis of the Finite Element Method, Wellesley-Cambridge Press, 1988;
3. P.G. Ciarlet, The Finite Element Method for Elliptic Problems, North-Holland, Amsterdam, 1979 (also in Classics in Applied Mathematics, Vol 40, SIAM, Philadelphia, 2002);
4. A. Ern and J.-L. Guermond, Theory and Practice of Finite Elements, Springer, 2004. (This is a more theoretical book but very well-written)

Grading Policy Your final grade will be based on 5 homework assignments, 20 points each; 1 midterm exam worthing 100 points; and 1 final exam worthing 150 points. The total is 350 points. It is guaranteed that $A \geq 90\%$, $B \geq 80\%$, $C \geq 70\%$, and $D \geq 60\%$. **You sacrifice 5 points per day for each late homework assignments.** Early submissions are always welcome. Make-up for exams will only be allowed for authorized absence under the University Regulations, and you need to contact me by the end of the next working day of the missed exam.