MATH 666: FINITE ELEMENT METHODS (FALL 2018)
TTH 08:00AM – 09:15AM, 0150 CARVER HALL
http://www.public.iastate.edu/~rossmani/math666/

INSTRUCTOR

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Office Hours: Tues. & Thurs. 1:00pm – 2:00pm

PREREQUISITES

- Math 561 (Numerical Analysis I) or equivalent
- Basic computer programming skills (any language is fine)

TEXTBOOK

C. Johnson, *Numerical Solutions of Partial Differential Equations by the Finite Element Method*, Dover, 2009.

COMPUTER LANGUAGE

MATLAB (MATrix LABoratory)

- This software is available in computer labs around campus.
- Student version can be obtained for free from the ISU IT Services.

COURSE TOPICS

1. **Topic 1:** FEMs for boundary value problems (basic method, weak formulations, minimization problem formulation, *a priori* and *a posteri* error analysis, extension to higher-order)
2. **Topic 2:** Abstract formulation of FEM (Hilbert spaces, Riesz representation theorem, coercivity, Lax-Milgram theorem, conforming FEMs)
3. **Topic 3:** Unstructured meshes (what are they, how does one describe them, how does one generate them)
4. **Topic 4:** FEMs for 2D Poisson equation (basic method, error estimation, implementation details)
5. **Topic 5:** FEMs for parabolic PDEs (i.e., heat equation)
6. **Topic 6:** Nonconforming FEMs and mixed FEMs
7. **Topic 7:** FEMs for hyperbolic PDEs (discontinuous Galerkin methods)

LEARNING OUTCOMES

- Learn how to use the finite element method to solve elliptic, parabolic, and hyperbolic partial differential equations
- Learn how to do *a priori* and *a posteriori* error analysis for the conforming finite element methods
- Learn about the abstract mathematical formulation of the finite element method
- Learn how to implement the finite element method, including aspects of mesh generation, mass and stiffness matrix construction, and linear algebra solutions
- Learn about other types of finite element constructions including non-conforming and mixed finite element methods

GRADING

50% – ∼4 Homework assignments (mix of theory and implementation)
50% – Final project (paper + presentation)

FINAL PROJECT

Each student will pick either a journal article or chapter out of a book. Some original work must be done (implementation of a method, detailed writeup of important theorem, …). At the end of the semester, each student will write a short paper on their work and give a short presentation to the whole class.

ATTENDANCE

I do not take attendance, but it is very likely if you skip classes that you will not do well in the course. If you decide to skip class for no good reason, then you are deciding that you are okay with missing what I teach that day. In this case, do not come to my office hours expecting me to teach you the things you missed.

DISABILITY ACCOMMODATIONS

If you have a disability and require accommodations, please contact the instructor early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Disability Resources (DR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-6624.

Class Days

WEEK	TUESDAY	THURSDAY
1	Aug. 21	Aug. 23
2	Aug. 28	Aug. 30
3	Sept. 4	Sept. 6
4	Sept. 11	Sept. 13
5	Sept. 18	Sept. 20
6	Sept. 25	Sept. 27
7	Oct. 2	Oct. 4
8	Oct. 9	Oct. 11
9	Oct. 16	Oct. 18
10	Oct. 23	Oct. 25
11	Oct. 30	Nov. 1
12	Nov. 6	Nov. 8
13	Nov. 13	Nov. 15
14	**Nov. 20** **Thanksgiving**	**Nov. 22** **Thanksgiving**
15	Nov. 27	Nov. 29
16	Dec. 4	Dec. 6

FINAL EXAM: Monday Dec. 11th (7:30am–9:30am) (Will be used for completing student presentations)