EECS 801 – Numerical PDEs and Meshing Techniques
Spring 2016

Course Description
The first phase of the course will cover basic concepts in the finite difference and finite element methods; methods for parabolic, hyperbolic, and elliptic equations. The course will also cover conservation laws and multigrid methods. The second phase of the course will cover unstructured mesh generation methods (including Delaunay, advancing front, quadtree/octree, and other methods if time permits); mesh quality improvement methods; mesh morphing; adaptive mesh refinement; connect to PDEs, solvers, and applications.

Course Meetings
TR, 1-2:15pm, 2115 Learned Hall

Instructor
Dr. Suzanne M. Shontz
3016 Eaton Hall
Department of Electrical Engineering and Computer Science
Office Phone: (785) 864-8816
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Office Hours: By appointment.

Teaching Assistant
No teaching assistant.

Required Texts
Numerical Solution of Partial Differential Equations: An Introduction (Second Edition), Author: K.W. Morton and D.F. Mayers, Publisher: Cambridge Press, ISBN: 9780521607933 (to be placed on reserve in Spahr Library)

Computational Partial Differential Equations Using Matlab, Authors: Jichun Li and Yi-Tung Chen, Publisher: CRC Press, ISBN: 9781420089042

References
Geometry and Topology for Mesh Generation (Second Edition), Author: Herbert Edelsbrunner, Publisher: Cambridge Press, ISBN: 978-0521682077 (to be placed on reserve in Spahr Library)

Delaunay Mesh Generation, Authors: S.-W. Cheng, T.K. Dey, and J. Shewchuk, Publisher: CRC Press, ISBN: 9781584887300 (to be placed on reserve in Spahr Library)

Finite Element Mesh Generation, Author: S.H. Lo, Publisher: CRC Press, ISBN: 9780415690485 (to be placed on reserve in Spahr Library)

Mesh Generation: Application to Finite Elements, Authors: P.J. Frey and P.L. George, Publisher: ISTE Publishing Company, ISBN: 978-1903398005 (to be placed on reserve in Spahr Library)

Prerequisites
EECS/Math 781

Course Requirements
Lecture attendance is required, although attendance will not be recorded. The course requirements for EECS 801 include successful completion of several homework assignments and two projects.

Homework assignments will include reading research papers and other such handouts, and short exercises. During the second phase of the class, there will be two projects. The first project will involve implementing a 2D Delaunay Mesh Generator, and the second project will serve as the final project for the course. The final project will consist of three parts: (1) the project itself, (2) a project report, and (3) a project presentation. Each student will choose his/her own topic for the final project.

Programming for the assignments and projects may be done in a scientific programming language of your choice (such as C, C++, Fortran, or Matlab) *with the caveat that I must be able to read, understand, and execute your code.*

Homework will be due at the beginning of class. Due dates for each assignment will be announced in class. **There will be a late penalty of 15% per day for homework handed in late.** No homework will be accepted more than 2 days late. Projects will not be accepted later than the given deadlines.

There will be one take-home midterm exam scheduled for February 18-23. Please reserve these dates on your calendar. The midterm exam will be open book and open notes; outside references may be consulted provided they are cited appropriately. A make-up midterm exam will be given to any student who is absent from an exam for a compelling reason and gets permission from the instructor.

If you have a mandated religious observance with conflicts with the midterm examination, please contact me privately at the beginning of the semester so that a make-up examination can be scheduled at a mutually acceptable time.

The exam will cover topics drawn from the lectures and homework, and from the underlying algorithms and mathematics.

Grading
Class participation will count for 10% of the final grade. Homework assignments will count for 10% of the final grade, and the exam at the end of phase one will count for 15%. The two projects in phase two will count for 65% of the final grade, with 25% going to the first project, and 40% going to the second project.

Class Schedule
The course schedule indicates a basic plan for the course. The topics and length of time on each topic are subject to change by the instructor. Any significant changes will be announced in class.

Course Website
By the end of the week, there will be a course website available at the following URL:
http://people.eecs.ku.edu/~shontz/eecs_801_spring_2016.html .
E-mail will be used for announcements not given in class.

Academic Integrity
Students are allowed to collaborate on the homework assignments to the extent of formulating ideas with one or two others in the class. Each student is expected to write up the homework assignment by himself or herself. Students must not hand in an assignment that represents somebody else's ideas entirely. Students should do the programming by themselves--no program code should be shared.

Students are permitted to consult outside published material for the homework, although the homework will be fully based on lecture notes, the textbook, and the readings. If a student consults a source other than the lecture notes, the textbook, or the readings, he or she must cite the source--failure to cite the source will be considered cheating.

The projects will be unique for each student and thus must be the result of individual efforts. Any literature references used must be cited--failure to cite the source will be considered cheating.

If you are uncertain as to whether or not a particular behavior is considered cheating, you are highly encouraged to discuss it with the instructor before engaging in such behavior.

The penalty for cheating will range from an F for the assignment to an F for the course, depending on the severity of the offense, following a hearing with the instructor as spelled out in the university's academic integrity policy. In extreme circumstances, the instructor will in addition bring the case before the university's Academic Integrity Committee and/or the Office of Judicial Affairs.

Academic Achievement and Access
Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate the educational opportunity.

The Academic Achievement & Access Center (AAAC) coordinates accommodations and services for all KU students who are eligible. If you have a disability for which you wish to request accommodations and have not contacted the AAAC, please do so as soon as possible. Their office is located in 22 Strong Hall; their phone number is (785) 864-4064 (V/TTY). Information about their services can be found at http://www.achievement.ku.edu/ . Please contact me privately in regard to your needs in this course.

Suzanne M. Shontz, University of Kansas, shontz@ku.edu

EECS 801: Numerical PDEs and Meshing Techniques
Week-by-Week Syllabus

Week	Lecture Topics	Notes
1	**Jan. 19 and 21:** Finite Difference Method for Elliptic and Hyperbolic Equations	
2	**Jan. 26 and 28:** Finite Element Method for Elliptic and Parabolic Equations	Homework #1 out on January 26
3	**Feb. 2 and 4:** Conservation Laws/Multigrid Methods	Homework #1 due on February 4; Homework #2 out on February 4
4	**Feb. 9 and 11:** Connection of Meshes to PDEs	
5	**Feb. 16 and 18:** Connection Between Meshes and Solvers	Homework #2 due on February 16; **Take-home midterm exam handed out on February 18**
6	**Feb. 23 and 25:** Delaunay Mesh Generation Techniques/Reading assignment on Feb. 25	**Take-home midterm exam due on February 23; No class on February 25 per Dean Branicky's request**
7	**Mar. 1 and 3:** Delaunay Mesh Generation Techniques	Project #1 out on March 1
8	**Mar. 8 and 10:** Advancing Front Methods	
BREAK	**Mar. 15 and 17: Spring Break**	**No class this week**
9	**Mar. 22 and 24:** Quadtree/Octree Methods	
10	**Mar. 29 and 31:** Other Mesh Generation Methods	Project #1 due on March 31; Project #2 out on March 31
11	**Apr. 5 and 7:** Mesh Quality Improvement Methods	
12	**Apr. 12 and 14:** Mesh Quality Improvement Methods	
13	**Apr. 19 and 21:** Mesh Morphing	
14	**Apr. 26 and 28:** Adaptive Mesh Refinement	
15	**May 3 and 5:** Other Topics in Meshing	
FINAL	**May 11: Final Project Presentations**	**Final projects due/final project presentations, Wednesday, May 11 – 1:30-4:00pm**