

# IT Curriculum Committee

Agenda Summary

Feb. 2, 2010

Full agenda is on the web site: <http://www.aem.umn.edu/~shield/itcc/>

1. Approval of Dec. 8 2009 meeting Minutes – see web site.
2. Reminder: Meeting Schedule for Spring 2010
  - 2:30 on Tuesday 2010-4-20 in 4-192/4-178 EE/Csci
3. Items for Information only (already approved in ECAS):
  - a. See web site.
4. Items for Approval without Objection (already approved in ECAS):
  - a. GEO 2303W renumbered to 3303W as its for juniors (new course from last time).
  - b. SENG 5708: title change: Advanced Database Management -> Data Analytics
  - c. SENG 5131: title change: Network Programming: Distributed Objects -> Distributed Application Design and Development
5. Action Items (new course syllabi are below or separate handouts):
  - a. New Course: BBE 3002: Intro to Engineering Design (separate handout)
  - b. BBE 4013: Change 4 to 3 credits
  - c. New Courses: BBE 4535/5535: Assessment and Diagnosis of Impaired Waters (separate handout) (5535 is a renumbered 5533)
  - d. New Course: BMEN 5111: Biomedical Ultrasound (see below)
  - e. New Course: CHEM 4601: Green Chemistry (handout)
  - f. New Course: CSCI 2033: Elementary Computational Linear Algebra (see below)
  - g. New Course: CSCI 4994H: Honors Thesis (see below)
  - h. New Course: CSCI 5129: e-Public Health:Online Intervention Design (handout)
  - i. IE 5441: Course Title Long: New: Financial Decision Making Old: Engineering Cost Accounting and Cost Control and description update (tabled past 3 meetings)
6. New Business
7. Adjourn

## New Courses Syllabi

### **BMEEn 5111: Biomedical Ultrasound**

3.0 credits

Prof. Shai Ashkenazi (ashke003@umn.edu )

This course is aimed to provide a gateway into the rich and versatile field of biomedical ultrasound. We will start from the basic physics of ultrasonic waves and their interaction with biological tissues, and then move to describe ultrasonic devices, imaging technology, and their applications in medicine and biology. New and emerging techniques in biomedical ultrasound will be introduced in the last part of the course.

The major sections of the course include

- Physics of ultrasound - Propagation in fluids and solids, reflection, scattering, absorption, ultrasonic properties of tissues.
- Transducer technology - Piezoelectric transducers, CMUTs
- Medical ultrasound imaging - Pulse echo, flow estimation and Doppler imaging, design of imaging transducer arrays, contrast agents.
- Photoacoustic imaging & Laser generated ultrasound, Acoustic field of volume sources, photoacoustic image reconstruction, tissue optical properties, diffusion model for tissue optics, photoacoustic contrast agents.
- Applications of non-linear acoustic: Basic concepts of non-linear waves, harmonic imaging, and radiation force imaging.

Prerequisites: IT upper division undergraduate or graduate student, or consent of instructor  
Physics II (PHYS 1112 or equivalent), Calculus II (Math 1272 or equivalent).

Course Format: Lectures

Course Requirements: Homework sets, midterm exam and a final project

Grading: Midterm 30%, Homework 30%, Final Project 40%

Office hours: Monday 2-4pm., Shepherd Lab 391 (or by appointment)

Text Book: Foundations of Biomedical Ultrasound / R.S.C. Cobbold

BMEEn 5111 -- Course general plan

- Physics of ultrasound
  - Wave motion derived from basic principles (hydrodynamics, thermodynamics)
  - Wave propagation
  - Mechanical waves: energy, momentum
  - Waves in solids

- Attenuation, scattering, and dispersion
- Solving the wave equation
  - General solutions
  - Problems of simple geometry
  - Approximation methods
  - Numerical methods
- Transducer technology
  - Methods for ultrasound generation and detection
  - Materials, fabrication, and other practical considerations
  - Focusing and array transducers
- Ultrasound imaging
  - Basic pulse-echo imaging
  - Flow imaging (Doppler)
- Non-linear acoustics
- Photoacoustic imaging
- Projects presentation

### Final Projects

Final projects will be assigned to individual students or groups of two students. The project goal is to explore in more depth a specific application of ultrasound to medical diagnosis, therapy, clinical intervention or basic research. During the last week of the semester each group (or student) will present a brief summary (20 minutes) of their project and submit a written report.

Projects activity may include:

1. Read and review an article or several articles discussing a specific topic.
2. Design a special purpose ultrasound transducer using Field II software.
3. Apply theoretical modeling to estimate feasibility of ultrasound application.
4. Your suggestion (with my approval)

### Topics list (partial list)

1. Triple beam 3-d flow estimation
2. Quantitative bone ultrasound
3. 2D arrays for real-time 3D imaging
4. Coded excitation (golay)
5. Ultrasound driven drug delivery
6. Targeted microbubbles contrast agent for inflammation diagnosis
7. Time reversal ultrasound
8. Shear wave excitation using phased array
9. Capacitive micromachined ultrasound transducers (CMUT)
10. Photoacoustic ultrasound transducers
11. Vibroacoustography ; Low frequency vibrations by non-linear ultrasound interaction
12. Harmonic imaging ; Contrast enhancement using second harmonic generation

13. Static pressure assessment by sub-harmonic generation in microbubbles
14. Volume flow measurement techniques
15. Ultrasound modulated optical imaging
16. Histotripsy & Tissue ablation by high intensity focused ultrasound (HIFU)
17. X-beams & Limited diffraction ultrasonic beams.
18. Ultrasound Biomicroscopy (UBM)

References and more information on the topics on the list will be provided later. Project's choice and definition of its contents should be made before spring break. Please set up a meeting with me (or come over during office hours) to arrange that. Topics list is a suggestion. You are welcome to suggest topics that are not on the list.

### **CSCI 2033**

Elementary Computational Linear Algebra, 4 credits

Prerequisites: Math 1271 or Math 1371 or #

Goal: While this class covers the fundamentals of linear algebra, it also teaches how the theory and methods answer many fundamental questions in Computer Science and Computer Engineering. The basic algorithms will also be used to introduce the core concepts of operation counting and computational complexity.

Course Description: Matrices and linear transformations, basic theory. Linear vector spaces. Inner product spaces. Systems of linear equations Eigenvalues and singular values. Algorithms and computational matrix methods using MATLAB or similar. Applications with emphasis on the use of matrix methods to solve a variety of computer science problems.

Contact Hours: 3 contact hours of lecture plus a contact hour of recitation

Workload: 2 or 3 midterms. Hands-on recitations with Matlab exercises. Weekly or bi-weekly homeworks.

Students will be expected to read approximately 1 chapter per week, or over two weeks for particularly difficult conceptual material.

Text: *Elementary Linear Algebra with Applications* by B Kolman & D R Hill, 9th edition - Prentice Hall 2008.

or: *Introduction to Linear Algebra* by Gilbert Strang, Cambridge Press 2009

The order of the topics listed below may be changed to match the textbook that is chosen for this class.

Schedule:

Week	Topic
1	Elementary Linear Mappings. Applications in Graphics and Statistics + Graphs and Matrices: Paths and Adjacency Matrix. Pagerank. + Correlations. = Elementary Matlab Programming
2-3	Systems of Linear Equations: Examples. Elementary Solution Methods. + Global Positioning System
4	Theory of Linear Equations: Complexity. Counting.
5-6	Determinants -- Theory. Proofs. + geometry: Volumes. = Matlab: functions, graphical outputs.
7-8	Vector Spaces. Abstract Linear Spaces. Subspaces. Dimensionality
9	Theory of Linear Equations: Existence, Uniqueness.
10-11	Inner Products. Orthogonality. Least Squares. Norms, Condition Numbers, and Numerical Stability. + Data Fitting. = Matlab: advanced data structures.
12	Abstract linear transformations. + Robotics + graphics: Coordinate Transformations
13	Eigenvalues. diagonalization of symmetric matrices.
14-15	+ Singular Value Decomposition. Data Mining. + Principal Component Analysis Image compression. + Non-symmetric Eigenproblems: Markov chains, Pagerank, Recurrences.

notes: + Denotes worked example: a use of matrix method in Computer Sci/Eng.  
= Denotes programming topics presented as part of basic material.

**CSCI 4994H: Honors Thesis**

3.0 to 1.0 credit(s), up to 6 credits with 2 repetitions.

This course is to allow a student to receive credit and an University Honors Program honors experience for writing their senior honors thesis. Students, under the direction of an adviser, will conduct research and be taught how to write a research paper in a format and style appropriate for submission to a research conference or journal. Grade will be assigned on an A-F scale based on the written honors thesis.