

Course Syllabus – Biophysics 03240A Fourier Transforms

Date: Fall Semester, 2011

Time: Mondays and Wednesdays; 9:00-10:30 a.m.

Place: Biophysics Conference Room (MACC Fund Research Center; Room 2063)

Course Director and Contact Information:

Shi-Jiang Li, PhD: Biophysics; sjli@mcw.edu; 456-4029

Instructors:

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Credit: 3 credits

Course Description:

This course provides basic knowledge for students who will continue to study EPR or MRI. Material will cover the theory of Fourier transforms, digital transforms, MRI image generation, Fourier image reconstruction, and digital signal processing. An understanding of calculus and matrix algebra is recommended.

Student Learning Objectives/Outcomes: Students are expected to become familiar with both the theory and practice of the Fourier transform, particularly as it applies to MRI image processing.

The course emphasizes the following core competencies: Knowledge within program area (MRI signal generation and Fourier image reconstruction); Research skills (experimental design); Critical and creative thinking (recognize image artifacts and know how to apply ameliorative image processing techniques); Communication skills (presentation skills).

Course Structure and Expectations: The course meets twice/week for 1.5 hrs each session. Most sessions are comprised of a 60 min lecture, preceded by a 30 min period for student presentation of answers to the previously assigned homework problems. Written answers to the problem sets are due immediately before the answers are discussed. Students should bring a second copy of their answers for discussion purposes.

Students are expected to attend all sessions unless specifically excused by the Course Director.

Course Schedule:

Week 1	Fourier Series Representation of Signals
Week 2	Representation of Systems: Impulse Response and Convolution Integral
Week 3	Continuous Fourier Transform
Week 4	Continuous Fourier Transform Properties
Week 5	2D & 3D Fourier Transform
Week 6	1st Midterm Exam
Week 7	Discrete Sampling
Week 8	Discrete Fourier Transform and Fast Fourier Transform
Week 9	Discrete Fourier Transform Properties
Week 10	2D & 3D Discrete Fourier Transform
Week 11	Temporal and Spatial Filtering
Week 12	Frequency Filtering
Week 13	2nd Midterm Exam
Week 14	The MRI Signal Equation and k-Space
Week 15	A MRI Signal Simulator and Ideal Fourier Reconstruction
Week 16	EPI Reconstruction and Observation Gridding
Week 17	Image Artifacts from Broken Assumptions and Image Processing
Week 18	Final Exam

Grading Policy: The course grade is determined by answers to the homework problem sets (25 %), the two mid-term exams (25 % each), and a final examination (25 %).

Resources: The assigned textbook is “The Fourier Transform: A Technical Understanding with Applications to MRI” by Daniel B. Rowe.

Technical Requirements: All students will need access to the MATLAB© computer program that allows them to carry out the numerical processing required for the course.

Course Evaluations: All students completing the course for credit are required to complete an on-line Course Evaluation on ANGEL at the end of the course. Participation by all students is important for the Graduate School's course evaluation process and for our continued accreditation. The Graduate School will provide instructions on how to complete the evaluation about 2 weeks before the course ends, and you will have until 2 weeks after the end of the course to complete the evaluation. Students who fail to complete the evaluation are no longer in good standing. The Graduate School will not provide transcripts, confirm enrollment, allow enrollment in additional courses, allow graduation, or support payment of stipends to students who are not in good standing. The Graduate School may impose a \$100 fine for each course evaluation not completed on time.

Missed Assignments or Examinations: Students are referred to the online Graduate School Handbook for the policy on missed assignments or examinations. In brief, vacations and personal travel are not acceptable excuses for missed assignments or examinations. If students will be away to attend a scientific meeting, the proposed absence must be discussed with the Course Director in advance of the absence. Absences due to illness should be discussed with the Course Director as soon as possible after recovery. If the final examination is missed due to illness, a note from a licensed health care provider supporting the absence will be required.