ECE 695 – Spring 2017
"Numerical Simulations" – Professor Bermel
Course Policies
Section 101 (MWF 9:30-10:20 am, Room TBA)

Welcome to ECE 695, "Numerical Simulations of Electro-optic Energy Systems." In this document, we outline the course policies and procedures, particularly regarding prerequisites, communication, grading, quizzes, homework, projects, academic honesty, and resources available to you.

There are multiple sections of ECE 695 this semester, all on different topics. Grades for students in this section will be assigned by Professor Bermel, independent of any other section.

Course Prerequisites and Co-requisites:
This is an advanced graduate-level class. While Purdue has no official requirements for graduate students, undergraduates interested in this course might take this with instructor permission. Generally, undergraduates should have already taken PHYS 272 (Electric & Magnetic Interactions), CS 159 (C Programming for Engineers), MA 265 (Linear Algebra), MA 266 (Ordinary Differential Equations), and ECE 301 (Signals & Systems), or equivalents thereof, to have the best chance of succeeding in the class.

Textbook:
The primary textbook for the course is "Computational Photonics," by Salah Obayya, ISBN 978-0-470-68893-9. It is available as a hard copy through commercial booksellers, as well a soft copy through Purdue's libraries website via the following link:
http://site.ebrary.com/lib/purdue/docDetail.action?docID=10419227.
The book can also be downloaded for offline reading through Adobe Digital Editions, by following the instructions shown after clicking the 'Download' button on the link above.

The supplementary textbook is "Photonic Crystals," by John D. Joannopoulos et alia, ISBN 978-0-691-12456-8. It is available as a hard copy through commercial booksellers, as well as a soft copy through the author's website, via the following link:
http://jdj.mit.edu/book/

Another useful reference is "Numerical Recipes in C" by William H. Press et alia, ISBN 978-0-521-43108-8. It is available as a hard copy through commercial booksellers, or as a soft copy through the author's website:
http://apps.nrbook.com/c/index.html

Communication:
Most pertinent information (videos, quizzes, course handouts, homework assignments, homework solutions, and final project assignments) will be posted online through the course website:
http://web.ics.purdue.edu/~pbermel/ece695/
Grades and quizzes will be available via Purdue's Blackboard Vista system:
http://www.itap.purdue.edu/learning/tools/blackboard/.
Communication outside of class is highly encouraged.

Grading:
Each student's course grade will be based upon the total numerical score he or she earns, with the following point allocation for the quizzes, class participation, homework, and final project.

Quizzes	100 points
Class Participation	100 points
Homework	100 points
Final Project	200 points
Total	500 points

Your course letter grade will be partially determined from your performance based on the above quizzes, homework, and final project. Other factors such as class attendance and participation may be included in determining grades. The grading scheme outlined above takes into account four Course Outcomes, as defined in our ABET accreditation standards, for which each student must demonstrate a minimum level of competency. These course outcomes are outlined in the next section.

Course Outcomes:
A student who successfully fulfills the course requirements will demonstrate the following abilities:

i. Explain strengths and weaknesses of computational techniques for electronic and electromagnetic systems.
ii. Calculate computational complexity of a given algorithm.
iii. Perform conventional and Fast Fourier transforms, based on existing codes.
iv. Solve for eigenvalues and eigenvectors, for both standard and generalized eigenproblems.

You will have multiple opportunities to satisfy these ABET outcomes. The primary means will be through the regular quizzes, homework, and final projects. The professors will write questions based on these Course Outcomes. You will satisfy each Course Outcome when your score for the corresponding assignments equals or exceeds a value we specify as representing a minimal competency. If you fail to meet this level of minimal competency on a specific Course Outcome, you will have a second chance, typically on later assignments that cover overlapping materials.

Homework:
Homework assignments will be due on ten occasions, with a frequency averaging every 1.5 weeks starting Friday, January 20, as indicated on the syllabus.

Homework should be emailed to pbermel@ecn.purdue.edu on the listed due dates.

Doing the homework is the only way to truly learn the subject matter. Students who do not work the homework themselves typically do not perform well in the course.

You *may* work together as you solve your homework problems, as this can be an effective means of learning the material. If you do work in a group, please **be sure that the solution you turn in is your own work**. You will receive reduced or zero credit for homework submissions that appear to be copies of each other. For written assignments, please write your solutions legibly and in an organized manner so that the grader can follow your work easily and, where possible, place your final answer in a box. For electronic assignments, please include basic documentation explaining what each block of code should achieve.

Solutions to the homework assignments are posted online shortly after they are due.

Final Projects:
The final project will be an opportunity for you to take a numerical technique discussed in class, and extend it in a novel direction. You'll have a great deal of leeway to choose a project, and are welcome to choose a research problem of interest. If you're not sure what to do, Peter Bermel can offer you several suggestions.

Everyone should work individually on their own project, as opposed to having other students write the code for them. You're welcome to ask other students for general guidance, and to ask Peter Bermel for specific feedback on your work if problems should arise.

The deliverables for your final project will consist of a working numerical code, including a list of dependent packages so a third-party could install and run it on their machine; an oral presentation with slides explaining the motivation, method, and results; and the corresponding data files.

A request to regrade the final project must be filed with Prof. Bermel ***within one week*** after the project grades have been posted. Due to Purdue policies, no such requests can be honored after the deadline.

Academic Honesty Policy:
We expect every member of the Purdue community to practice honorable and ethical behavior both inside and outside the classroom. Any actions that might unfairly improve one's score on quizzes, homework, or final project will be considered cheating, and will not be tolerated. Examples of cheating:

1. Submitting or presenting work that is not your own (particularly without citation).
2. Asking other students for quiz answers before submitting your own.
3. Altering a quiz or homework, and then requesting a regrade.

Cheating on homework or projects can result in a zero score for the assignment, or a failing grade for the course, at the discretion of Prof. Bermel. If necessary, we will also refer such a case to the Office of the Dean of Students.

Class Attendance:
Your attendance in class is extremely important. If you must miss a class, you are responsible for any material, information, handouts, announcements, etc. that you missed. Since participation is a key part of your grade, repeated absences will detract from your overall grade. Late arrivals and early departures from class can be disruptive, so please keep these to a minimum.

Students with documented disabilities:
Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. Students with disabilities must be registered with Adaptive Programs in the Office of the Dean of Students before classroom accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with Prof. Bermel as soon as possible to discuss your needs, either within the first three weeks of classes, or within one week of receiving your accommodation letter,. If you do not communicate your accommodation needs in a timely manner, testing accommodations cannot be guaranteed.

Campus Emergency:
In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. In such an event, information will be provided through email.

Schedule for ECE 695 – Spring 2017

Section 101, MWF 9:30-10:20 am, Classroom TBA.

DATE	LECTURE NO.	TOPICS	Reading Assign. SECTIONS	HOMEWORK SET DUE
1/9-M	1	Introduction and Overview of Our Class	--	--
1/11-W	2	Goals of Numerical Computing	SO 1.1*	--
1/13-F	3	Computability Theory and Computational Complexity	SO 1.2	--
1/16-M	--	**NO CLASS – MARTIN LUTHER KING DAY**	--	
1/18-W	4	Practical Assessment of Code Performance	--	--
1/20-F	5	Formulating Eigenproblems in Electro-Optic Systems	JJ 2§; JJ App. D	1
1/23-M	6	Eigenproblem Techniques: Power, Rayleigh-Ritz, Householder, QR, LU	NR 11†	--
1/25-W	7	Generalized Eigenproblems	NR 11	--
1/27-R	8	Formulating Electro-Optic Problems in the Fourier domain	NR 11	2
1/30-M	9	Discrete Fourier Transform (DFT) Algorithms	JJ App. D	--
2/1-W	10	Fast Fourier Transforms (FFT): Algorithms and Computational Complexity	JJ App. D	
2/3-R	11	FFTW Design and Usage	fftw.org	3
2/6-M	12	Beam Propagation Method (BPM) Analysis	SO 2	--
2/8-W	13	Finite-Element BPM Analysis and Mode Solving	SO 2.2-2.9	
2/10-F	14	Application of BPM: Waveguiding	SO 3.1-3.5	4
2/13-M	15	Finite-Element Full-Wave Modeling	--	--
2/15-W	16	Finite-Element Heat Transfer	--	--
2/17-F	17	Finite-Element Electronic Transport	--	5
2/20-M	18	Finite-Element Multiphysics Modeling	--	--
2/22-W	--	**NO CLASS**	--	--
2/26-F	--	**NO CLASS**	--	--
2/27-M	19	Bandstructure Problems and Solution Methods	JJ 3	--
3/1-M	20	Bandstructure Solution Methods	JJ App. D	--
3/3-F	21	Photonic Bandstructures: Master Equation, Conjugate Gradient Methods	JJ 3	6
3/6-M	22	Photonic Bandstructures: MIT Photonic Bands (MPB)	JJ 3	--
3/8-W	23	Electronic Bandstructures: Master Equation, Density Functional Theory	JJ App. A	--
3/10-F	24	Electronic & Photonic Bandstructures for Photovoltaics & Thermophotovoltaics	JJ 6	7
3/13-M		**NO CLASS – SPRING VACATION**	--	--
3/15-W		**NO CLASS – SPRING VACATION**	--	--
3/17-F		**NO CLASS – SPRING VACATION**	--	--
3/20-M	25	Transfer Matrix Methods (TMM): T-, R-, S-, and H-matrices	JJ App. D	--
3/22-W	26	Solving Optical Problems Using S-Matrices	JJ 9	--
3/24-F	27	Solving Quantum Electronics Using Transfer Matrices	--	8
3/27-M	28	Rigorous-Coupled Wave Analysis (RCWA)	JJ 10	--
3/29-W	29	Coupled Mode Theory (CMT)	JJ 10	--
3/31-F	30	CMT and RCWA for Optics Problems (using CAMFR and S4)	JJ 10	9
4/3-M	31	Finite-difference time domain (FDTD)	SO 5.1—5.2	--
4/5-W	32	FDTD: Yee Lattice	SO 5.3	--
4/7-F	33	FDTD: Evaluation Method	SO 5.4	10
4/10-M	34	FDTD: Numerical Stability	SO 5.5—5.6	--
4/12-W	35	FDTD: Uniaxial PML	SO 5.7—5.10	--
4/14-F	36	FDTD Simulations Using MEEP	SO 5.11—5.14	--
4/17-M		**FINAL PROJECT PRESENTATIONS**	--	--
4/19-W		**FINAL PROJECT PRESENTATIONS**	--	--
4/21-F		**FINAL PROJECT PRESENTATIONS**	--	--
4/24-M		**FINAL PROJECT PRESENTATIONS**	--	--
4/26-W		**FINAL PROJECT PRESENTATIONS**	--	--
4/28-F		**FINAL PROJECT PRESENTATIONS**	--	--

*SO=S. Obayya; †NR=Num. Recipes; §JJ=J. Joannopoulos

ECE 695 – Spring 2017

Instructors and Staff

Class	Professor	Secretary
Section 101		
MWF 9:30-10:20 am	Peter Bermel, EE 332, BRK2270	Mary Ann Satterfield, EE 326B
Classroom TBA	Tel: 49-67879	Tel: 49-46389
	Email: pbermel@ecn.purdue.edu	Email: msaterfi@purdue.edu
	Office hours: MWF 10:20-11:20 am or by appointment	Office hours: M-F 8 am – noon & 1 pm – 5 pm