UMICH

Math 454
Boundary Value Problems for Partial Differential Equations

Fall 2012

Instructor

Instructor:	Lydia Bieri
Office:	East Hall 5862
E-mail:	lbieri@umich.edu
Office hours:	Tuesdays 2:00 pm. - 3:30 pm.
	Wednesdays 8:00 am. - 9:30 am.

Lectures

Class hours section 002:	Tue/Thu:	10:00 am. - 11:30 am.
Class hours section 003:	Tue/Thu:	11:30 am. - 1:00 pm.
Class location section 002:	DENN 430	
Class location section 003:	DENN 330	

Course Content

Use of Fourier series and other orthogonal expansions in the solution of initial-value and boundary-value problems for second-order linear partial differential equations. Emphasis is on concepts and calculation.

Classical representation and convergence theorems for Fourier series; method of separation of variables for the solution of the one-dimensional heat and wave equation; the heat and wave equations in higher dimensions; eigenfunction expansions; spherical and cylindrical Bessel functions; Legendre polynomials; methods for evaluating asymptotic integrals (Laplace's method, steepest descent); Laplace's equation and harmonic functions, including the maximum principle. As time permits, additional topics will be selected from: Fourier and Laplace transforms; applications to linear input-output systems, analysis of data smoothing and filtering, signal processing, time-series analysis, and spectral analysis; dispersive wave equations; the method of stationary phase; the method of characteristics.

Exams, Reading and Homework

Frequently, sections from the text will be assigned for reading, for the following week. Please read the book before coming to class. Students are responsible for all topics covered in the readings and lectures. Lectures may go beyond the reading, and not every topic in the reading will be covered in class.

Homework and reading will be posted on the course website (CTools) every week. Assignments can be turned in at the due date during lecture. Late homework will be accepted only under exceptional circumstances and only with prior approval.

Homework:	Homework, roughly once a week
Midterm:	There will be one midterm. It will take place in class.
	The date of the midterm is October 18th, 2012.
Final Exam:	Date, time and location to be announced.
Grading:	Homework (0.3), Midterm (0.3), Final Exam (0.4)

Textbooks

Required text:
Partial Differential Equations for Scientists and Engineers, by Stanley J. Farlow, published by Dover in 1993, ISBN 9780486676203.

Program

1. Types of partial differential equations (pde); heat equation; introduction to separation of variables. (2 weeks)
2. Method of separation of variables; classical representation and convergence theorems for Fourier series; introduction to wave equations. (2 weeks)
3. Heat and wave equations in one and higher dimensions. (2 weeks)
4. Midterm (October 18, 2012)
5. Eigenfunction expansions; spherical and cylindrical Bessel functions; Legendre polynomials, Green's function. (2 weeks)
6. Laplace's equation and harmonic functions, including the maximum principle.
(1-2 weeks)
7. Fourier and Laplace transforms. (2 weeks)
8. Methods for evaluating asymptotic integrals (Laplace's method, steepest descent).
(1 week)
9. Dispersive wave equations. (rest of the semester)