Principles and Techniques of Applied Mathematics

MATH 373-01, MWF 1:00 - 1:50, Swords 359, Spring 2005

Dr. Gareth Roberts

Contacting me: Office: SWORDS 326, e-mail: `groberts@radius.holycross.edu` (Please use this email, it is **NOT** my groupwise account!) phone: x2350

Office hours: Mon., Wed. and Fri. 9:00 - 10:00, Tues. 9:00 - 11:00 or by appointment.

Required Text: *Partial Differential Equations: An Introduction*, Walter A. Strauss

Course Prerequisites: MATH 304 (Ordinary Differential Equations)

Web page: `http://mathcs.holycross.edu/~groberts/Courses/MA373/homepage.html`
Homework assignments, exam materials, schedule changes, useful links and other important information will be posted at this site. Please bookmark it!

Syllabus: This is an applied mathematics course focusing on partial differential equations (PDE's), that is, equations relating the partial derivatives of unknown functions to themselves. Any physical process which involves both a spatial variable and a time variable can often be represented using a PDE.

One famous example is the one-dimensional wave equation $u_{tt} = c^2 u_{xx}$ where $u(x,t)$ is the displacement from the equilibrium position at the position x and time t. This equation describes the vibration of a plucked guitar string, the sound waves in a pipe, vibrations of an elastic bar and the long water waves in a straight canal. As with ordinary differential equations, the goal is to find the unknown function $u(x,t)$ which satisfies the given PDE as well as some prescribed initial conditions and/or boundary conditions.

Many of the equations we will study arise from physical processes such as heat flow, diffusion or vibrations. In addition to developing the mathematical techniques for solving these equations (the method of characteristics, the coordinate method, separation of variables, Fourier series), we will also be concerned with the physics behind the derivation and solution of these equations. As with your previous course on ODE's, geometric and qualitative ideas will also play an important role (equilibria, existence and uniqueness, stability, the principle of causality, the maximum principle.)

We will cover material from Chapters 1 through 6 of the text. Time permitting, we will consider boundary value problems in higher dimensions (Chapter 10). A rough outline of the semester is as follows:

- Classical PDE's (first-order, flows, vibrations and diffusions) 6 classes
- Solving the Wave Equation and the Diffusion Equation 6 classes
- Exam 1 – February 24, 6:30 - 8:00 pm
- Reflections and Sources (diffusion on the half-line, with source) 3 classes
- Boundary Value Problems (separation of variables, boundary conditions) 4 classes
- Fourier Series (coefficients, orthogonality, convergence, Gibbs phenomenon) 10 classes
- Exam 2 – April 14, 6:30 - 8:00 pm

- Harmonic Functions (Laplace equation, Poisson's formula) 6 classes
- Boundary Value Problems in the Plane and Space (vibrating drum) 3 classes
- Final Exam

Homework: There will be homework assigned roughly every 9 - 10 days (approximately 7 - 8 assignments for the semester). Assignments will be posted on the course web page. There will be a list of problems for you to hand in, a nonempty subset of which will be graded. Although there are no formal computer projects for this course, certain homework problems will involve the use of MAPLE (for example, plotting more and more terms of a Fourier series to see convergence). The goal is to use the computer as a visual and computational aid to further your understanding of the underlying mathematical process.

While you are allowed and encouraged to work on homework problems with your classmates, the solutions you turn in to be graded should be your own. Take care to write up solutions **in your own words**. Plagiarism will not be tolerated and will be treated as a violation of both the departmental policy on academic integrity and the college's policy on academic honesty.

NOTE: LATE homework will NOT be accepted. The only excused homework which is late will be accompanied by a letter from your Class Dean. However, you will be allowed ONE "mulligan" over the course of the semester where you can turn in the assignment up to one week after the original due date.

Exams: There will be two evening midterm exams and a comprehensive final at the end of the semester. Please make a note of these dates and plan accordingly. Any conflicts must be legitimate and brought to my attention well before the scheduled exam date. If you have any specific learning disabilities or special needs and require accommodations, please let me know early in the semester so that your learning needs may be appropriately met. You will need to contact Dr. Matthew Toth of Disability Services in Hogan 207 (x 3693) to obtain documentation of your disability.

	Exam 1	**Thurs., Feb. 24**	**6:30 - 8:00 pm**
Exam Schedule:	**Exam 2**	**Thurs., April 14**	**6:30 - 8:00 pm**
	Final	**Sat., May 14**	**2:30 - 5:30 pm**

Academic Integrity: The Department of Mathematics and Computer Science has drafted a policy on academic integrity to precisely state our expectations of both students and faculty with regards to cheating, plagiarism, academic honesty, etc. You are required to read this policy and sign a pledge agreeing to uphold it. Anyone who violates the Departmental Policy on Academic Integrity will receive a 0 for that assignment as well as possible further disciplinary action involving your Class Dean.

Grade: Your course grade will be determined as follows: homework 30%, classroom participation/interest 5%, midterm exams 35% (best exam 20%, second best 15%) and final exam 30%.

How to do well in this course: Attend class, participate and ask questions. Be an active learner. Do your homework regularly and learn to **read the text.**

WORK WITH YOUR CLASSMATES. Some of the best assets available to you are the knowledge and abilities of your peers. Mathematics can be fun and rewarding when there are people around you who enjoy figuring out problems as much as you do. Take advantage of this opportunity and organize study groups.