Mth 621: Advanced Differential Equations - I

Instructor: Dacian N. Daescu
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Office Hours: 10:30 - 11:30 MW. Also by appointment.

Class Time and Location: 11:30-12:20 MWF Neuberger Hall 346

Textbook: Lectures will cover topics selected from the list of references.

References:

Partial Differential Equations: Methods and Applications. Robert McOwen, 2nd Ed., Prentice Hall 2003.

Partial Differential Equations. Lawrence C. Evans, Graduate Studies in Mathematics vol. 19, American Mathematical Society 1998.

Partial Differential Equations of Mathematical Physics and Integral Equations. Ronald B. Guenther and John W. Lee, Dover Publications, Inc., 1995.

Introduction to Partial Differential Equations with Applications. E.C. Zachmanoglou and D.W. Thoe, Dover Publications 1986.

Final Examination: Thursday, December 10, 12:30-14:20, in class

Course web site: Syllabus, homework assignments, and other information about the course will be available on the web site: http://www.mth.pdx.edu/~daescu/mth621.html
Students are responsible for checking this site on a regular basis.

Course Description: The course will cover fundamental aspects of the theory and applications of partial differential equations. Topics will include:

- Mathematical modeling of physical systems using partial differential equations:

  The transport equation, heat flow, advection-diffusion, wave equation

  Nonlinear systems of conservation laws: Euler equations, Navier-Stokes equations, advection-diffusion-reaction systems

- First order equations: the Cauchy problem, characteristics, first-order PDE systems.

- Second-order equations:

  Fourier series solutions

  Hyperbolic problems: wave equation, energy methods

  Elliptic problems: Laplace's equation, Maximum principle, Poisson's equation

  Parabolic problems: heat equation, Green's function, fundamental solution

- Modern theory and solution techniques for PDEs

Functional analysis review: L^p- spaces, Hilbert spaces, Riesz representation theorem, weak convergence, applications.

Variational methods for PDEs: Sobolev spaces: definition and elementary properties; Sobolev embeddings, Poincaré inequalities; elliptic problems: Lax-Milgram theorem, existence and regularity of weak (variational) solutions.

Additional topics may be covered to accommodate students'interests

Student Learning Objectives: To become familiar with fundamental topics in the modern theory and solution techniques for PDEs; to build the skills and understanding necessary to pursue further research in the field of PDEs.

Prerequisites: Knowledge of multivariable calculus and differential equations (Mth 427/527 and Mth 428/528).

Grading Policy: The final grade will be based on homework and a final project, as follows:

1. **Homework, 75% of the course grade**. Three sets of problems will be assigned as homework.
2. **Project, 25% of the course grade**. Each student is required to complete a project assignment divided into two parts: written report and in-class presentation.

In assigning final course grades, plus/minus grading will be used.

Main criteria for evaluating your work will be: correctness, completeness, and *clarity* of the presentation.

Working in team for your homework and project is encouraged *only if each student in the team is contributing to the problem solving.*

Disability requests: If you have a disability which may require special arrangements for seating, testing or other class requirements, please contact me after class or during my office hours.