# Mth 621: Advanced Differential Equations - I

**Instructor**: Dacian N. Daescu
**Office**: Neuberger Hall 313
**E-mail**: daescu@pdx.edu
**Phone**: (503) 725-3581
**Office Hours**: 12:30 - 13:30 TR. Also by appointment.

**Class Time and Location**: TR 14:00 - 15:15 Urban Center Building 250

**Textbook:** No textbook is required. Lectures will cover topics selected from the list of references.

**References:**

*Functional Analysis, Sobolev Spaces and Partial Differential Equations*
Haim Brezis, Springer 2010.

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

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

*Elliptic Partial Differential Equations of Second Order*
D. Gilbarg and N.S. Trudinger, Springer-Verlag 1983.

*Partial Differential Equations of Mathematical Physics and Integral Equations*
Ronald B. Guenther and John W. Lee, Dover Publications Inc, 1988.

**Final Examination**: Monday, December 7, 10:15-12:05, in class

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

**Course Description:** The course will cover modern theory and applications of partial differential equations. Topics will be selected from:

- Mathematical modeling of physical systems using partial differential equations
  - Linear equations: transport equation, heat flow, advection-diffusion, wave equation
  - Nonlinear systems of conservation laws: Euler equations, Navier-Stokes equations, advection-diffusion-reaction systems.
- 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: weak derivatives; Sobolev spaces: definition and elementary properties; Sobolev embeddings, Poincaré's inequalities
  - Second-order elliptic equations: 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**: 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.*

**Special requests**: PSU values diversity and inclusion; we are committed to fostering mutual respect and full participation for all students. My goal is to create a learning environment that is equitable, useable, inclusive, and welcoming. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. The Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150, drc@pdx.edu.