MAE 502 Partial Differential Equations in Engineering

Spring 2009 Mon/Wed 5:30-6:45 PM SCOB 201

- Instructor: Huei-Ping Huang (hp.huang@asu.edu), ISTB2 Room 219A
- Office hours: Tuesday 3:00-4:30 PM, Wednesday after class (nominally 6:45-8:00 PM), or by appointment
- Course website http://www.public.asu.edu/~hhuang38/MAE502.html

Course Outline

I. Analytic treatment for linear PDE

1. Overview of PDE
   - Commonly encountered PDEs in engineering and science
   - Types of PDEs, the physical phenomena they represent, and relevant boundary conditions
2. Some analytical solutions of PDEs; Separation of variables, Method of characteristics, etc.
3. Review of boundary value problems with ODE;
   - Sturm-Liouville Problem and orthogonal functions; Representation using orthogonal basis
4. Fourier Series
   - Solution of ODE and PDE by Fourier Series expansion
5. Fourier transform and Laplace transform
   - Solution of PDE by Fourier/Laplace transform
6. Series expansion and integral transform methods for PDEs with non-Cartesian geometry

II. Numerical methods for PDE

7. Numerical solution of PDE
   - Overview; Numerical error and stability condition
   - Evolution equations (Heat equation, advection equation, etc.)
   - Elliptic equations with closed boundary (Laplace equation, etc.)
   - Spectral method

III. Additional topics (while time allows)

8. Brief introduction to nonlinear PDE
   - Examples of nonlinear PDEs for real world phenomena; Behavior of their solutions
   - Conservation laws; Strategies for numerical solutions
9. Miscellanies
   - Green's function and applications to solutions of ODE and PDE
   - Asymptotic solutions

- Primary textbook: "*Applied Partial Differential Equations*", 4th Edition, by R. Haberman. Prentice Hall. **Required**
- Additional material for numerical methods will be drawn from "*Applied Partial Differential Equations*", by P. DuChateau and D. Zachmann. Dover Publications. **Recommended**
- Lecture notes by instructor

Grade: **50% Homework/projects 20% Midterm (1 exam) 30% Final**