Partial Differential Equations
Spring 2012
MATH 467.01 (3 credits), M_W_F, 11:00AM–11:50AM, Wickersham 218

Prerequisites: A grade of C- or better in MATH 365 (*Ordinary Differential Equations*) is the prerequisite for this course.

Instructor: Dr. Buchanan
   Office: Wickersham 217-1, Phone: 872-3659, FAX: 871-2320
   Office Hours: 10:00AM-10:50AM (M–F), or by appointment
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   Course URL: http://banach.millersville.edu/~bob/math467/

Textbook: There is no textbook for the course. Handouts of course-related materials (composed by Drs. Zhoude Shao and J. Robert Buchanan) will be given to the students throughout the semester. The following textbook, though not required for this course, provides a good source of reference and review material for this course.

Elementary Differential Equations and Boundary Value Problems, 9th edition, William E. Boyce and Richard C. DiPrima, John Wiley & Sons, Inc., New York, NY (2009) ISBN: 978-0-470-38334-6

Objectives: MATH 467 provides an introduction to partial differential equations and their applications. Upon completion of this course the student will:

- understand how partial differential equations arise in the mathematical description of heat flow and vibration,

- demonstrate the ability to solve initial boundary value problems,

- express and explain the physical interpretations of common forms of PDEs,

- understand issues related to existence and uniqueness of solutions,

- depict in series and graphical form the solutions to initial boundary value problems,

- appreciate the theory underlying the techniques of solution,

- be conversant with methods of applying partial differential equations in various applications.

Course Contents: Topics covered in this course may include the following. The material will be presented in a logical order, though not necessarily in the order shown below. Other topics will be added as time and interests allow.

- Introduction
    - **Extremely** brief review of topics from ordinary differential equations
    - Heat equation as model of heat conduction in a rod
    - Separation of variables
    - Fundamental solutions and superposition of solutions
- Fourier series

- – Orthogonality and Euler-Fourier formulas
- – Periodicity
- – The Fourier Convergence Theorem
- – Even and odd functions; sine and cosine series
- – Extensions of functions to even and odd functions
- The Heat Equation
  - – Solution of initial/boundary value problems
  - – Homogeneous Dirichlet boundary conditions
  - – Nonhomogeneous boundary conditions and steady-state solutions
  - – Other boundary conditions
  - – A Maximum Principle and uniqueness of solution for the heat equation
- The Wave Equation
  - – Solution of initial/boundary value problems
  - – Characteristic coordinates and a general solution
  - – D'Alembert's solution of the initial value problem
  - – Energy integrals and uniqueness of solution for the wave equation
- Laplace's Equation
  - – Boundary value problems in rectangular coordinates
  - – Boundary value problems in polar coordinates
    - ∗ Periodic boundary conditions
  - – Neumann problems and mixed boundary conditions
    - ∗ Lack of uniqueness of solution
    - ∗ Necessary conditions for the existence of a solution
  - – Uniqueness of solutions
    - ∗ Mean Value Property
    - ∗ Weak form of the Maximum Principle
    - ∗ Uniqueness of solutions of the Dirichlet problem
- Sturm-Liouville Theory
  - – General two-point boundary value problem
  - – Eigenvalues and eigenfunctions
  - – Lagrange's identity and consequences
  - – Normalization of eigenfunctions and general eigenfunction expansions
  - – Nonhomogeneous boundary value problems

Attendance: Students are expected to attend all class meetings per the University Approved Guidelines. If you know beforehand that you will be absent from class on the day an assignment is due, you must complete and hand in the assignment prior to the absence. If you are unexpectedly absent the day that an assignment is due you must hand in the assignment at the beginning of the class hour on the first day that you return to class. If you know you will be absent on the day of a test, you must notify me before the time the test is scheduled in order to schedule a make-up test. Students who miss a test should provide a valid excuse, otherwise you will not be allowed to make up the test. No final examination exemptions.

Homework: Students are expected to do their homework and participate in class. Homework problems will be present in the printed course materials given to the students and on separate handouts consisting only of homework exercises. Complete solutions to the homework exercises will be posted on the web at the course URL as needed.

Throughout the semester, homework problems from sources outside the course notes will be assigned for presentation in front of your peers and grading. Typically once per week 25–30 minutes of class time will be given to students presenting their exercises and solutions to the class. Volunteers will be given first choice of exercises, but all students will be expected to present the same quantity of exercises by the end of the semester. This parity condition may require calling on some students to present exercises. Exercises will be graded on a scale of 0–4.

0: student absent when called on or unable to begin exercise.

1: student able to begin exercise only (may choose to complete exercise at a future class meeting).

2: student able to partially complete exercise, though portions of the solution are missing or unjustified.

3: student able to complete exercise, though some details of the solution are missing or unjustified.

4: student able to complete exercise with all details presented and full justification.

In addition to the homework exercises there will be a course project on a topic from PDEs. The project will have a written component (a short paper) which you will hand in to me. There will also be a brief (approximately 10 minutes) public presentation of your work to other interested students during Math Awareness Week (during April 2012). You will be graded on both your written work and public presentation.

Tests: There will be two tests which are tentatively scheduled for

- Wednesday, February 22, 2012
- Wednesday, April 11, 2012

The final examination (Thursday, May 10, 2012 from 8:00AM-10:00AM) will be comprehensive.

If you feel that an error was made in the grading of a test or homework assignment, you should explain the error on a separate sheet of paper and return both it and the test to me within three class periods after the test or homework is returned to you.

Grades: Course grade will be calculated as follows.

Tests	45%
Homework	20%
Project	10%
Exam	25%

I keep a record of students' test, homework, and exam scores. Students should also keep a record of graded assignments, tests, and other materials. The course letter grades will be calculated as follows. I will not "curve" course grades.

90-92	A−	93-100	A		
80-82	B−	83-86	B	87-89	B+
70-72	C−	73-76	C	77-79	C+
60-62	D−	63-66	D	67-69	D+
		0-59	F		

Course Repeat Policy An undergraduate student may not take an undergraduate course of record more than three times. A course of record is defined as a course in which a student receives a grade of A, B, C, D, (including + and −) F, U, Z or W. The academic department offering a course may drop a student from a course if the student attempts to take a course more than three times.[1]

The last day to withdraw from a course (receiving the W grade) is April 6, 2012.

Inclement Weather Policy: If we should miss a class day due to a school delay or cancellation, any activities planned for that missed day will take place the next time the class meets. For example, if a test is scheduled for a day that class is canceled on account of snow, the test will be given the next time the class meets.

Final Word: Mathematics is not a spectator sport. What you learn from this course and your final grade depend mainly on the amount of work you put forth. Daily contact with the material through homework assignments and review of notes taken during lectures is extremely important. Organizing and conducting regular study sessions with other students in this class will help you to understand the material better.

No one can guarantee you success in this course. Your responsibilities and the instructor's expectation are outlined above. There will be no second chances, "do-overs", or extra credit assignments.

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[1]Memorandum to mathematics faculty from Dr. Charles G. Denlinger, Assistant Chair, Department of Mathematics, August 30, 2004.