# MTH418/MTH518 - Survey of Partial Differential Equations (Spring 2013)

**Lecture:** Tuesday and Thursday 2:00PM-3:20PM in Math 150
**Recitation:** Wednesday 4:00PM-4:50PM in Math 150

**Instructor:** Avner Peleg
Office: Math Building, room 325
Phone: 645-8811
E-mail: apeleg@buffalo.edu
Office hours (tentative): Tuesday 11:00AM-12:00noon, Friday 3:00PM-4:00PM.

**Textbook:** Applied partial differential equations: with Fourier series and boundary value problems, by Richard Haberman, Pearson Prentice Hall, Fourth Edition **or** Fifth Edition.

**Prerequisites:** MTH241, MTH306 and MTH309, all with grade of C or higher.

**Tentative syllabus:** Chapters 1-5, 7-8, and 10 of the textbook.

**Course description:**
(1) The heat equation: derivation of the heat equation in one dimension, boundary conditions, equilibrium temperature distribution, derivation of the heat equation in two and three dimensions.
(2) The method of separation of variables: introduction, time-dependence and space-dependence, eigenvalues and eigenfunctions, product solutions and the principle of superposition, orthogonal sets of functions, examples.
(3) Laplace's equation: solution on a rectangle and on a circular disk, qualitative properties of Laplace's equation.
(4) Fourier series: definition, conditions for convergence, sketching Fourier series, Fourier sine and cosine series, term-by-term differentiation and integration.
(5) The wave equation: derivation of the wave equation in one dimension (vibrating string), boundary conditions, vibrating string with fixed ends, normal modes, the wave equation in two and three dimensions.
(6) Sturm-Liouville eigenvalue problems: examples, definition and classification, theorems on properties of regular Sturm-Liouville eigenvalue problems, the Rayleigh quotient, vibrations of a nonuniform string, boundary conditions of the third kind.
(7) Higher dimensional partial differential equations: the two-dimensional wave equation (vibrating membrane), the two-dimensional heat equation, vibrating rectangular membrane, eigenvalue problem for the Helmholtz equation, the Rayleigh quotient, vibrating circular membrane, Bessel's differential equation and Bessel functions, spherical problems and Legendre polynomials.
(8) Nonhomogeneous problems: heat flow with sources and nonhomogeneous boundary conditions, the

method of eigenfunction expansion, the method of eigenfunction expansion using Green's formula, Poisson's equation.
(9) Infinite domain problems and the Fourier transform: the heat equation on an infinite domain, the Fourier transform pair, solution of the heat equation by Fourier transform, the heat equation on a semi-infinite domain, Fourier sine and cosine transforms, examples.

**Homework:** Homework will be assigned each week. Selected homework problems on each assignment will be graded. Homework is an important component of the course and is worth 30% of the final grade. Notice that: (1) Late homework will not be accepted. (2) It is your responsibility to show your work and to present it in readable form. Unreadable answers or answers without justification will not receive credit.

**Exams:** There will be one midterm exam and a final exam. The midterm exam is scheduled for Tuesday, March 19 between 2:00PM-3:20PM in Math 150. The final exam is scheduled for Friday, May 3 between 3:30PM-6:30PM in Math 150. The weight of the midterm exam is 30%, and the weight of the final exam is 45%.

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|---|---|---|
| **Grade:** | Homework | 30% |
| | Midterm | 30% |
| | Final | 45% |

The final number grade will be translated to a letter grade, and the translation will not be worse than:

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|---|---|
| 85-105 | A |
| 70-84 | B |
| 60-69 | C |
| 50-59 | D |
| 0-49 | F |

The boundaries for plus/minus grades (A-, B+, B-, etc.) will be determined only after the final exam.

**MTH518 students:** in accordance with the graduate school policy, MTH518 students will have additional coursework, consisting of additional homework and/or exam problems.

**Course web site:** http://www.math.buffalo.edu/~apeleg/mth418.html
This web site will be updated with announcements, homework assignments and other useful resources. It is recommended that you visit the web site on a regular basis.

**Attendance:** Students are expected to attend every scheduled class. All students attending the class must be registered for the class.

**Make-up exams: there will be no make-up exams (for the midterm).** If due to severe circumstances beyond your control (car accident, illness, etc.), you will not be able to take the midterm exam, please call me immediately (before the exam) and let me know your situation. If you have a good reason and can present convincing documentation as to why you are not able to take the midterm exam, your final grade will be calculated without taking into account the exam.

**Academic integrity**: Students are expected to behave in accordance with the university policy on academic integrity. The guiding principle of academic integrity is that a student's submitted work must be the student's own. Cheating and plagiarism will result in formal charges.

**Incomplete:** A grade of incomplete (I) will be assigned only under extraordinary circumstances, which are beyond the student's control (like a non-elective surgery during the last week of class).

**Students with disabilities:** If you have a diagnosed disability (physical, learning or psychological), which will make it difficult for you to carry out the coursework as outlined, or requires accommodations such as recruiting note takers, readers, or extended time on exams and/or assignments, please advise me during the first two weeks of the course, so that we may review possible arrangements.

**Studying strategy:** Below are some tips on how to do well in the course.
(1) Review background material at the beginning of the semester.
(2) Study regularly throughout the semester.
(3) Read each topic in the book before class.
(4) Review the theory afterwards using your notes and the book.
(5) Do the homework regularly.
(6) Seek help from me or from the TA when you don't understand something.

**Some important dates:**
Sat Jan 19: Last day to drop the course (no record will appear on your transcript if you drop the course).
Tue Jan 22: (a) Last day to add the course. (b) Last day to file “Petition to make up an Incomplete” with the Math Department.
Mon Mar 11 through Sun Mar 17: No class (Spring Recess).
Fri Mar 29: Last day to resign from the course (an “R” will appear on your transcript).
Thu Apr 25: Last MTH418/MTH518 class.
Mon Apr 29: Semester ends.