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Prerequisites: MTH 141, MTH 142, MTH 241, MTH 306 with grade of “C” or above, or equivalent background in calculus and differential equations.

Lectures: Tue/Thu 11:00-12:20 in Math 250

Recitations: Tue 8:00-8:50 in Fronczak 454 (MTH 418 students only)

Scope of course: The course presents a survey of the basic types of partial differential equations which appear frequently in scientific applications (diffusion equation, wave equation, Laplace’s equation). We will study the different methods available for the solution of these equations in different fundamental geometries (one-dimensional bar, rectangle, cylinder, infinite domain, etc) and develop an understanding of the qualitative properties of the solutions. In addition to Fourier series and Fourier transform methods, a brief introduction to finite difference methods and numerical solutions will be given. The software Maple will be used to augment pen-and-paper analysis. A rough outline of the topics is:

- review of differential equations and survey of elementary differential equations (1 lecture)
- heat diffusion equation and boundary conditions (1 week)
- method of separation of variables (1 week)
- Laplace’s equation and solutions (1 week)
- Fourier series (1 week)
- wave equation and solutions (1 week)
- Sturm-Liouville theory and applications (1 week)
- finite difference methods (1/2 week)
- methods for inhomogeneous problems (1 week)
- separation of variables in 2 and 3 space dimensions (2 weeks)
- Fourier transform methods (2 weeks)

Course Materials

Book: R. Haberman, Applied Partial Differential Equations (4th edition – black cover)

UBLearns: contains posting of material for viewing/download such as exam solutions, Maple programs.

Maple: Software for mathematics applications that we will use occasionally to solve equations and graph solutions. Maple 13 is on all CIT public computers on campus. A version of Maple 13 for your own computer is available by download at <http://ubit.buffalo.edu/software/win/index.php>.

Coursework

Homework: In each lecture, homework problems will be assigned to reinforce the topics covered in class. About once a week the homework problems are collected. A small number of the assigned problems will be graded. Each graded assignment is worth 10 points unless specified otherwise. Homework is due at the beginning of class on the date specified; late homework is accepted with the following penalties (rounded to nearest integer point):

- turned in at end of class = -5%
- turned in on due date by 5pm = -10%
- turned in next day by 5pm = -20%
- after 5pm next day = not accepted

Projects: There will be 3-4 longer “projects” which involve some analysis, computation, critical thinking and writing. These are typically worth 20-50 points, depending on difficulty. Late projects are accepted with the following penalties.

- turned in at end of class = -5%
- turned in on due date by 5pm = -10%
- turned in next day by 5pm = -20%
- turned in second day by 5pm = -30%
- after 5pm of second day late = not accepted

Exams: Material covered on the exam is anything in the book or presented in lecture unless stated otherwise. The exam will consist of a mix of questions: some easy, some hard, and may also contain essay-answer questions. The exams are:

- Exam #1 –Thu Feb 16 (Chapters 1-3)
- Exam #2 –Thu Mar 25 (Chapters 4-6, 8)
- Exam #3 – during finals week (Chapters 7, 10)

Course grades

Exams will be graded on the basis of points (typically 5-10 problems at 5-20 points per problem) and assigned a letter grade based on a curve. The class average usually falls in the B-/B/B+ range.

Homework and projects are graded on points (roughly 250 points total) and assigned a letter grade based on a curve. The class average usually falls in the B-/B/B+ range.

Your **final grade** is determined by averaging your grades for exams and homework/projects with the following weightings (+/- grades will be used)

Exam #1	20%
Exam #2	20%
Exam #3	20%
Homework/Projects	40%

For averaging grades, a **5-point grading scale** is used in the course:

A+	= 4.67-5.00
A	= 4.33-4.67
A-	= 4.00-4.33
B+	= 3.67-4.00
B	= 3.33-3.67
B-	= 3.00-3.33
C+	= 2.67-3.00
C	= 2.33-2.67
C-	= 2.00-2.33
D+	= 1.67-2.00
D	= 1.33-1.67
D-	= 1.00-1.33

Other info

Academic Honesty: Students are expected to follow the university policy on academic honesty. Cheating on exams or copying of assignments is explicitly forbidden. You must have your student ID for exams.

Make-up Exams: If, due to severe circumstances beyond your control (car accident, illness, death in the family, etc), you will not be able to take an exam, please call me immediately (before the exam) and let me know your situation. If you have a really good reason and can present adequate documentation we can make arrangements for a make-up exam to be taken at the end of the semester.

Incompletes: Incompletes will be given only under extraordinary circumstances (like surgery during the last week of class).

Important Dates:

Fri Jan 22 - Last day to drop the course - no record appears on transcript

Fri Jan 22 - Last day to file 'Petition to make up an incomplete' with the Department

Fri Mar 26- Last day to resign from the course - an 'R' appears on transcript (first semester undergraduates have an extended deadline through their academic advisor).

Students with disabilities:

If you have a diagnosed disability (physical, learning, or psychological) which will make it difficult for you to carry out the course work 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 for reasonable accommodations.

Lecture Schedule

Tue Jan 12	syllabus, review of differential equations, 1.1 intro to partial differential equations
Thu Jan 14	1.2 derivation of heat equation
Tue Jan 19	1.3 boundary conditions, 1.4 equilibrium temperature distribution, 2.2 linearity
Thu Jan 21	2.3 separation of variables
Tue Jan 26	2.4 examples of separation of variables
Thu Jan 28	2.5.1 Laplace's equation
Tue Feb 2	2.5.2 Laplace's equation in a disk, 2.5.4 qualitative properties of Laplace's equation
Thu Feb 4	3.1, 3.2, 3.3 Fourier series
Tue Feb 9	3.3, 3.4, 3.5 Fourier series: continuity, differentiation, integration
Thu Feb 11	Review for Exam #1
Tue Feb 16	Exam #1
Thu Feb 18	4.2 derivation of wave equation, 4.3 boundary conditions for wave equation
Tue Feb 23	4.4 solution to wave equation
Thu Feb 25	5.3 Sturm-Liouville eigenvalue problem, 5.4 Sturm-Liouville example
Tue Mar 2	5.8 third kind boundary condition (physical only)
Thu Mar 4	6.2 finite difference method, 6.3.2, 6.3.3 finite difference method for heat equation
Tue Mar 9	Spring Break
Thu Mar 11	Spring Break
Tue Mar 16	8.2 non-homogeneous problems
Thu Mar 18	8.3 eigenfunction expansion for non-homogeneous problems
Tue Mar 23	Review for Exam #2
Thu Mar 25	Exam #2
Tue Mar 30	7.1, 7.2, 1.5 pde in higher dimensions, derivation of heat equation in 3D
Thu Apr 1	7.3 vibrating rectangular membrane
Tue Apr 6	7.7 vibrating circular membrane
Thu Apr 8	7.7 vibrating circular membrane
Tue Apr 13	10.3 Fourier transform pair
Thu Apr 15	10.4 Fourier transform solutions
Tue Apr 20	10.5 Fourier sine and cosine transforms, examples
Thu Apr 22	Review for Exam #3