Math. 412, Sec. 200/501 (Stacked Honors) Fall, 2015

Partial Differential Equations

Course description and learning objectives: In addition to some basic facts about partial differential equations, the course concentrates on solution techniques for linear differential equations and the properties of the solutions thus obtained. In particular, the student will acquire skill with the tools employed in solution by separation of variables, such as Fourier series and transforms, Bessel and other special functions, Green functions, and the principles of superposition. The emphasis is on the explicit construction of solutions as employed in applications of mathematics. (The word "theory" in the catalog title is a historical anachronism.) Neverthless, math majors are very welcome.

Prerequisite: M. 308 or equivalent (differential equations). (M. 311 or other linear algebra will help, but is not required.)

Classes: MWF 12:40–1:30(p.m.), BLOC 161

Web page: `http://calclab.math.tamu.edu/~fulling/m412/f15`

Instructor: S. A. Fulling
620H Blocker Bldg.
`fulling@math.tamu.edu`
`http://www.math.tamu.edu/~fulling/`

If I am not in my office, you can leave a note in my mailbox (in Blocker 226) or in the wall pouch beside my office door.

Tentative office hours: M 3:00–3:50, T 3:00-3:50, W 1:50–2:40 (also R 3:00-3:50 if we have a test on Friday). Permanent hours (probably the same as these) will be announced later.

Required textbooks:

1. R. Haberman, *Elementary Applied Partial Differential Equations with Fourier Series and Boundary Value Problems*, 5th edition, Prentice–Hall, 2013. (The 4th edition should be OK. We'll try to catch any changes in the assigned homework problems.)
2. S. A. Fulling, Math 412 lecture notes,
`http://calclab.math.tamu.edu/~fulling/m412/312.pdf`

Supplementary textbooks (not required):

There are many other textbooks on Fourier methods and PDEs. Here are two with a strong problem-solving orientation (i.e., many worked examples):

3. C. Constanda, *Solution Techniques for Elementary Partial Differential Equations*, Chapman & Hall/CRC, 2002 (used in Math. 401).
4. M. R. Spiegel (Schaum's Outline Series), *Fourier Analysis*.

And at the theoretical end, the most readable proofs of the theorems are in:

5. G. P. Tolstov, *Fourier Series*, Dover.

Grading system:

Hour tests:	$100 \times 3 = 300$
Final exam:	200
Homework and class participation:	200
Total	700

The "curve" will be at least as generous as the "standard" scale [i.e., 90% (= 630 pts) will guarantee an **A**, etc.].

Dates of hour tests: Friday, Sept. 25; Friday, Oct. 23; Friday, Nov. 20.
Final exam: Monday, Dec. 14, 10:30(a.m.)–12:30.
Please bring your own paper for tests.

Homework will usually be collected on Wednesdays. Assignments will be on the Web page.

Class participation: We will sometimes discuss homework problems and other examples at the blackboard (or projector) in class. Sometimes I'll assign problems for you to work on in class in groups. At other times volunteers and random draftees will simply be called on. (You may also be called to the board to help me introduce a new concept or technique "Socratically". In such cases a good participation score is attained merely by being alert and cooperative.) Attendance records may influence class participation scores slightly.

Special provisions for stacked honors class

Tests

Some test questions will come in two versions, one for honors students and one for other students. In addition to your required question, you may attempt the other question for extra credit. The maximum extra credit is half the nominal point value of the question. An honors student's score on the optional problem will be divided by 2. A regular student's score on the optional problem will just be capped at half.

Example: Suppose a 30-point problem comes in two versions.

	honors question		regular question	
	raw score	score	raw score	score
honors student	28	28	30	15
regular student 1	2	2	28	28
regular student 2	20	15	28	28

Enrichment material

A major goal of an honors class is to provide occasionally some advanced and interesting material that won't be on tests. This will happen approximately one day every two or three weeks. I will be receptive to requests from "regular" students for occasional out-of-class help sessions to compensate for the lost class time, or from honors students for occasional out-of-class meetings for additional advanced discussion.

Math. 412 Schedule

(Except for test days, this is only approximate.)

Block 1:

Topic	*Days*	*Haberman sections*	*Fulling notes pages*
Introductory examples*	4	1.1–1.4, 2.1–2.4	1–15
Fourier series	4	3.1–3.3, 3.6	16–29
Linearity and homogeneity	1	2.2	30–37
Rectangle problems	1		
Catchup or review	1		
Test A	**Friday, Sept. 25**		

* wave equation in lecture, heat equation in textbook

Block 2:

Topic	*Days*	*Haberman sections*	*Fulling notes pages*
Rectangle problems	1	2.5.1, 7.1–7.4	38–48
Fourier transforms	4	10.1–10.6	49–60
Green functions	5	9.1–9.3, (11.3)*	61–79
Catchup or review	1		
Test B	**Friday, Oct. 23**		

* Parts of Sec. 11.3 assume that you've studied all of Chapters 8 and 9.

Block 3:

Topic	*Days*	*Haberman sections*	*Fulling notes pages*
Green fns. for nonhom. problems	2	Ch. 8, 9.5	80–88
Sturm–Liouville problems	3	5.1–5.5, 5.8–5.10, 7.5	89–99
Polar coords., Bessel fns.	5	1.5, 2.5.2, 7.7–7.9	100–119
Catchup or review	1		
Test C	**Friday, Nov. 20**		

Block 4:

Topic	*Days*	*Haberman sections*	*Fulling notes pages*
Spherical harmonics	3	7.10	120–127
Classification	1	2.5.4, 6.1	128–134
Catchup or review for final	2		
Final Exam	**Monday, Dec. 14, 10:30–12:30**		

Advanced reading:

Topic	*Haberman sections*	*Fulling notes pages*
More on the wave equation	Ch. 4, 11.2, Ch. 12	
Convergence thms. for Fourier series	3.4–3.5	App. B
History		App. C

Make-up tests: Make-up tests are very hard to grade fairly, and they absorb a large amount of my time which would be better spent for the benefit of the whole class. Please cooperate in making these incidents as rare as possible. If you miss (or foresee that you will miss) a test, it is *your* responsibility to contact me as soon as possible to request, justify, and schedule a make-up test. (If you can't reach me directly, you can leave a message at the Math Department office, (979) 845-3261.) If the absence is not clearly excused under the Attendance section of *Student Rules*, the request may be denied.

An Aggie does not lie, cheat, or steal or tolerate those who do. See Honor Council Rules and Procedures, `http://www.tamu.edu/aggiehonor` .

Plagiarism: Finding information in books or on the Internet is praiseworthy; *lying* (even by silence) about where it came from is academic dishonesty. Whenever you copy from, or "find the answer" in, some other source, *give a footnote or reference*. Otherwise, you are certifying that it is your own work.

Joint work: On a homework assignment (*not* a take-home test!) discussion with other students is permitted, even encouraged. However, the grader will not give homework credit for "work" that is parasitical (and your test scores will suffer, too!). To forestall problems, please follow these policies: (1) When two or more students work together on an assignment, they should all indicate so on their papers. (2) If the cooperation is of the divide-and-conquer variety, you are certifying that you *have studied and understand* every problem solution on your paper. Mindless copying is dishonest and academically worthless.

Calculators in exams: Calculators are to be used only to perform *elementary operations* such as addition, multiplication, and evaluation of simple functions such as square roots. Advanced facilities are prohibited, especially *storing formulas in memory* or executing programs to carry out algorithms that are part of the subject matter of the course. (Again, when in doubt, give a "footnote" describing what you did.) Violations of this rule may lead to total prohibition of calculators in exams (probably at the insistence of other students).

Copyright: Course materials (on paper or the Web) should be assumed to be copyrighted by the instructor who wrote them or by the University.

Disabilities: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Disability Services Office in Cain Hall, Room B118, or call 845-1637. See also `http://disability.tamu.edu` .