Math 3150-001: Partial Differential Equations for Engineers
Summer 2014

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Lectures: M,W,F 12:30-2:00PM AEB 310
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*****Announcements, assignments, files, and grades will be updated on Canvas (access through CIS)*****

Textbook: *Linear Algebra and Differential Equations (Custom Edition for the University of Utah)*
(ISBN-10: 1-269-42557-0)
(ISBN-13: 978-1-269-42557-5)

Important Dates:	Midterm Exam:	May 30, 2014
	Final Exam:	June 18, 2014

Course Learning Objectives: Students will become knowledgable about partial differential equations (PDEs) and how they can serve as models for physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer, and advection, and electrostatics. Students will be able to derive heat and wave equations in 2D and 3D using The Divergence Theorem. More broadly, students will master the use of flux laws in combination with the conservation principle, expressed as the continuity equation, to derive PDEs associated with transport phenomena.

Students will master how solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero. Students will also master the technique of separation of variables to solve PDEs and analyze the behavior of solutions in terms of eigenfunction expansions.

Students will be versed in the use of Fourier series for representation of functions, and the conditions for series convergence. Students will understand and use inner products and the properties of orthogonality of functions to determine Fourier coefficients for general basis function sets in order to approximate functions.

Students will be able to solve for the electric potential in an area or volume region by specifying the charge distribution on the boundary of the region (i.e. boundary conditions) and use separation of variables to obtain the solution. Students will be able to derive basic properties of these electric potentials, including points of minimum/maximum potential, and use Stokes' Theorem to determine work done moving charges in a closed path through the potential field.

Students will also master the use of the Fourier transform to analyze and solve the wave equation using d'Alembert's formula. Students will also use Fourier transforms and the convolution theorem to analyze and solve the heat equation on the real line using the heat kernel.

In addition to topical content, students will also gain experience and further mastery of complete problem solving fluency. Students will be able to read and interpret problem objectives, be able to select and execute appropriate methods to achieve objectives, and finally, be able to interpret and communicate results.

Course Work: The work you will complete in Math 3150 is comprised of the following: homework which will be turned in daily, spot-check quizzes given at the beginning of class on most days, one midterm exam, one final exam. The four lowest homework scores will be dropped and the three lowest quiz scores will be dropped.

Grading Policies: Grades are computed as a weighted average comprising 25% homework scores, 10% quiz scores, 30% for the midterm exam score, and 35% for the final exam score. All students are required to take the final exam. The grading scale will be as follows:

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

Additional Tutoring: The Benny T. Rushing Math Center (located in the basement of LCB) offers free drop-in tutoring for students at the U. This is another great resource! The hours of operation are Monday-Thursday 8-8 and Friday 8-6. They can also give you information about private tutors.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with dis- abilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

Honor Code You are expected to abide by the University of Utah Honor Code and to avoid any instances of academic misconduct, including but not limited to: (1) possessing, using, or exchanging improperly acquired written or oral information during an exam, (2) substitution of material that is wholly or substantially identical to that created or published by another individual(s), and (3) false claims of performance or work.

Week-by-week guide

- Week 1: Conservation and heat transfer
  - Monday: Vector calculus review, flux integrals in rectangular, polar, and spherical coordinates, the conservation principle, the continuity equation
    Assignment: Worksheet
  - Wednesday: 12.1-3, derivation of the heat/diffusion equation and boundary conditions
    Assignment: 12.2: 3, 8, 9
    12.3: 2
  - Friday: 12.3-5, boundary conditions, derivation of heat equation in 2-3D, polar coordinates
    Assignment: 12.4: 1 a-h
    12.5: 1, 5, 8, 12
- Week 2: Seperation of variables
  - Monday: 13.1-3, linearity, homogeneity and non-homogeneity, separation of variables, heat equation with zero-end-temperature.
    Assignment: 13.2: 2
    13.3: 2, 3, 5, 6, 7
  - Wednesday: Separation of variables continued, insulated boundaries, heat transfer on a ring, superposition with equilibrium solution
    Assignment: 13.4: 1b, 2, 6
  - Friday: Laplaces equation on rectangles and disks
    Assignment: 13.5: 1b (with $g(y) = \sin(\pi/Hy)$), 2, 3, 6, 10 (start with the supposition that there is distinct u, w both solving $\Delta u = g$, set up an appropriate linear combination of u and w and use linearity of the Laplacian operator to obtain a contradiction)

- Week 3: Exam week
  - Monday: Memorial Day - no class
  - Wednesday: Review for midterm
  - Friday: Midterm exam
- Week 4: Fourier series and inner product spaces, Fourier transforms
  - Monday: Inner product spaces
    Assignment: 4.10: 21 (only check for orthogonality), 22, 26, 28, 29
  - Wednesday: Fourier series, sine and cosine series
    Assignment: 14.2: 1e, 2b
    14.3: 2c, 5c
  - Friday: The wave equation
    Assignment: 15.2: 1, 2
    15.3: 1
    15.4: 1, 9, 10, 13
- Week 5: Fourier transforms, continuous spectra, d'Alembert's formula
  - Monday: Fourier transforms for solving PDEs
    Assignment: 16.3: 5, 3, 11, 14
    16.4: 3, 5, 8
  - Wednesday: The wave equation solution on the real line
    Assignment: Worksheet on d'Alembert's formula
  - Friday: Review for Final
- Week 6: Final exam week
  - Monday: Review for final
  - Wednesday: Final exam