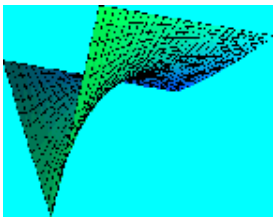

Math 300 Fall 2007
Advanced Boundary Value Problems I
Course Information

Department of Mathematical and Statistical Sciences
University of Alberta

Lecture A1: M W F 1:00 - 1:50 CME 345

Instructor: Thomas Hillen, 575 CAB

telephone: 492-3395

e-mail: thillen@ualberta.ca

web: http://www.math.ualberta.ca/~thillen/fall07/math300.html

(class notes, handouts, solutions, etc. will be available here)

office hours: T R 4:00 - 5:00, or by appointment

Lecture A2: M W F 1:00 - 1:50 MEC 4 - 3

Instructor: Ed Leonard, 679 CAB

telephone: 492-2388

e-mail: isaac@math.ualberta.ca

web: http://www.math.ualberta.ca/~isaac/

(class notes, handouts, solutions, etc. will be available here)

office hours: M W F 3:00 - 4:00 in CAB 679, or by appointment

Course Objectives:

Learn about the three most important classes of partial differential equations of applied mathematics, that is, the heat equation, the wave equation, and Laplace's equation. Apply elementary solution techniques and be able to interpret the results.

Course Description:

Derivation of the classical partial differential equations of applied mathematics, solutions using separation of variables. Fourier expansions and their application to boundary value problems. Introduction to the Fourier transform. Emphasis on building an appropriate mathematical model from a physical problem, solving the mathematical problem, and carefully interpreting the mathematical results in the context of the original physical problem.

Course Prerequisites:

Math 201 and 209 or equivalents. Notes: (1) Open only to students in Engineering, Specialization Computing Science, Specialization Physics, and Specialization Geophysics. (2) This course may not be taken for credit if credit has already been obtained in MATH 337.

Required Textbook:

Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, 4th Edition

by Richard Haberman

Assignments:

There will be between 7 and 8 problem sets given during the term. Each problem set will consist of 10 problems taken from the text. Sections A1 and A2 have the same problem sets.

Problem sets will not be collected for marking. Solutions to the problem sets will be posted on the course webpages.

The quiz problems and examination problems will be similar to problems from these problem sets.

Grading Scheme:

Quiz ..... (in class, Wednesday October 3, 2007) .. 20%
Midterm Exam ... (in class, Wednesday November 7, 2007) .. 30%
Final Exam ..... (2:00 - 4:00 Monday December 17, 2007) .. 50%

Grade Evaluation:

Grading is done according to the University of Alberta Marking and Grading Guidelines:

http://www.registrar.ualberta.ca/calendar/Regulations-and-Information/Academic-Regulation/23.4.html#23.4

Recommended distributions as percentages of students in class				
Grade	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**
A^+	4%	5%	6%	8%
A	7%	7%	9%	12%
A^-	10%	12%	14%	17%
B^+	11%	15%	16%	16%
B	15%	16%	18%	16%
B^-	14%	14%	14%	12%
C^+	11%	11%	9%	7%
C	9%	8%	6%	5%
C^-	6%	5%	4%	3%
D^+	4%	3%	2%	2%
D	3%	2%	1%	1%
F	6%	2%	1%	1%
Mean	**2.62**	**2.83**	**3.00**	**3.11**
Median	**B^-**	**B**	**B**	**B^+**

The instructor reserves the right to make minor adjustments to the above distribution in order to obtain an overall fair grading scheme.

Withdrawal Date:

The last day for withdrawal from Fall Term courses course is November 9, 2007. If you are unsure of your performance in this course, please go and talk to your instructor.

Format of Examinations:

Quiz: 20 minute written quiz. No calculators or course materials are allowed.

Midterm Exam: 50 minute written examination. No calculators or course materials are allowed.

Final Exam: 2 hour written examination. No calculators or course materials are allowed.

Missed Term Examinations:

A student who cannot write the quiz or the midterm examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for deferral of the weight of the missed quiz or examination to the final examination.

Applications for deferral of term work worth less than or equal to 20% of the final grade must be made in writing to the *instructor*, with supporting documentation, within 48 hours of the missed quiz or examination date.

Applications for a deferral of term work greater than 20% of the final grade must be made to the *instructor* within 48 hours of the missed quiz or examination and must be supported by a completed University of Alberta Medical Statement Form or other appropriate documentation (Calendar section 23.5.6).

Deferral of term work is a privilege and not a right; there is no guarantee that a deferral will be granted. Misrepresentation of facts to gain a deferral is a serious breach of the *Code of Student Behaviour*.

Deferred Final Examination:

A student who cannot write the final examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination.

Such an application must be made to the student's Faculty Office within 48 hours of the missed examination and must be supported by a completed University of Alberta Medical Statement or other appropriate documentation (Calendar section 23.5.6).

Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of facts to gain a deferral is a serious breach of the *Code of Student Behaviour*.

The deferred final examination for this course will be held on Saturday, January 12 2008, from 9:00 until 12:00, in CAB 243.

Reexamination:

A student who writes the final examination and fails the course may apply for a reexamination. It should be noted that reexaminations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar section 23.5.5) and Faculty of Science Regulations (Calendar Section 182.5.9). Misrepresentation of facts to gain a reexamination is a serious breach of the *Code of Student Behaviour*.

Student Responsibilities:

Academic Integrity:

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the *Code of Student Behavior* (online at http://www.ualberta.ca/secretariat/appeals.htm) and avoid any behavior which could potentially result in suspicion of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All forms of dishonesty are unacceptable at the University. Cheating, plagiarism, and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive at minimum a grade of zero for the examination or paper in question and no opportunity will be given to replace the grade or redistribute the weights. Any offense will be reported to the Senior Associate Dean of Science, who will determine the disciplinary action to be taken.

Examinations:

You student photo I.D. is required at examinations to verify your identity. Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the examination room for at least 30 minutes from the time the examination commenced. Electronic equipment is not to be brought to the examination.

Cell Phones: Cell phones are to be turned off during lectures, labs, and seminars. Cell phones are not to be brought to examinations.

Students with Disabilities:

Students who require accomodation in this course due to a disability are advised to discuss their needs with Specialized Support and Disability Services (2-800 Student Union Building).

Academic Support Centre:

Students who require additional help in developing strategies for better time management, study skills, or examination skills, should contact the Academic Support Centre (2-703 Student Union Building).

Additional tutorial services are available through the Mathematics and Applied Sciences Centre

http://www.uofaweb.ualberta.ca/MASC/

Lecture Topics:

1. Heat Equation
   - 1.1 Introduction
   - 1.2 Derivation of the Conduction of Heat in a One-Dimensional Rod
   - 1.3 Boundary Conditions
   - 1.4 Equilibrium Temperature Distribution
   - 1.5 Derivation of the Heat Equation in Two or Three Dimensions
2. Method of Separation of Variables
   - 2.1 Introduction
   - 2.2 Linearity
   - 2.3 Heat Equation with Zero Temperatures at Finite Ends
   - 2.4 Worked Examples with the Heat Equation: Other Boundary Value Problems
   - 2.5 Laplace's Equation: Solutions and Qualitative Properties
3. Fourier Series
   - 3.1 Introduction
   - 3.2 Statement of Convergence Theorem
   - 3.3 Fourier Cosine and Sine Series
   - 3.4 Term-by-Term Differentiation of Fourier Series
   - 3.5 Term-by-Term Integration of Fourier Series
   - 3.6 Complex Form of Fourier Series
4. Wave Equation: Vibrating Strings and Membranes
   - 4.1 Introduction
   - 4.2 Derivation of a Vertically Vibrating String
   - 4.3 Boundary Conditions
   - 4.4 Vibrating String with Fixed Ends
   - 4.5 Vibrating Membrane
5. Sturm-Liouville Eigenvalue Problems
   - 5.1 Introduction
   - 5.2 Examples
   - 5.3 Sturm-Liouville Eigenvalue Problems
   - 5.4 Worked Example: Heat Flow in a Nonuniform Rod without Sources
   - 5.5 Self-Adjoint Operators and Sturm-Liouville Eigenvalue Problems
   - 5.6 Rayleigh Quotient
   - 5.7 Worked Example: Vibrations of a Nonuniform String
   - 5.8 Boundary Conditions of the Third Kind

7. Higher Dimensional Partial Differential Equations

    7.1 Introduction
    7.2 Separation of the Time Variable
    7.3 Vibrating Rectangular Membrane
    7.7 Vibrating Circular Membrane and Bessel Functions
    7.8 More on Bessel Functions
    7.9 Laplace's Equation in a Circular Cylinder

8. Nonhomogeneous Problems

    8.1 Introduction
    8.2 Heat Flow with Sources
        and Nonhomogeneous Boundary Conditions
    8.3 Method of Eigenfunction Expansion with Homogeneous Boundary
        Conditions (Differentiating Series of Eigenfunctions)

10. Infinite Domain Problems:

    Fourier Transform Solutions of Partial Differential Equations

    10.1 Introduction
    10.2 Heat Equation on an Infinite Domain
    10.3 Fourier Transform Pair
    10.4 Fourier Transform and the Heat Equation
    10.5 Fourier Sine and Cosine Transforms
    10.6 Worked Examples Using Transforms

12. The Method of Characteristics for Linear and Quasilinear Wave

    Equations

    12.1 Introduction
    12.2 Characteristics for First-Order Wave Equations
    12.3 Method of Characteristics for the One-Dimensional Wave Equation
    12.4 Semi-Infinite Strings and Reflections
    12.5 Method of Characteristics
        for a Vibrating String of Fixed Length
    12.6 The Method of Characteristics
        for Quasilinear Partial Differential Equations