PHY 341
Mathematical Physics
Dillard University – Spring 2005

Meeting Times:
T R (2:30 PM- 3:45 PM) Main Campus / Stern Hall / 115 ******MAY BE ALTERED DUE TO SCHEDULING CONFLICTS******

Instructor: **Rob Salgado** Office: **Stern 307A** Voice: **(504)-816-4510**	E-mail: **rsalgado@dillard.edu** Instant-Messengers: AOL, MSN, Yahoo: **dillardphysics** (do *not* email here)	Office hours: **-to be announced**

Catalog Description:

PHY 341 Mathematical Physics (3 credits)
Theoretical and mathematical methods used in classical and quantum physics including: applications of transformation, special functions, Green's functions, perturbation theory, tensor and group theory, and Lie algebra. Class meets three hours per week for lecture. *[Prerequisite: MAT 203 (Analytic Geometry and Calculus III).]*

My Description:

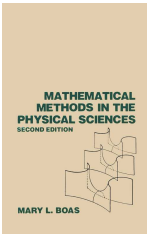
This course surveys **some of the mathematical techniques** that ***every undergraduate physics and engineering student should know (or at least be exposed to) before graduating.*** The more of this you know, the better able you will to understand and appreciate the junior and senior level courses in the major, and the wider your options will be for doing advanced projects. ***To graduate, you must be able to calculate!***

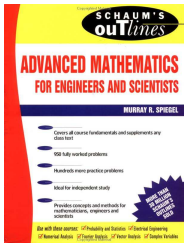
We can't do all of the topics in the description in one semester. I chose the essential topics.

Note that MAT 201-203 are prerequisites, and their material will be used extensively. *(At a bare minimum, you need to have mastery in geometry, algebra, trig, and calculus.)* ***Whether or not you covered the various topics in MAT 201-203, you need to take responsibility and review that material now.*** *[Get the Schaum's Outline, if necessary.]*

Required Textbooks:

"Mathematical Methods in the Physical Sciences, 2nd Edition" by Mary L Boas
(published by Wiley: ISBN: 0471044091)
(Optional) Highly-recommended supplement:
"Schaum's Outline of Advanced Mathematics for Engineers and Scientists" by Murray Spiegel
(published by McGraw-Hill: ISBN 0-07-060216-6)





Electronic Materials:

I will maintain a website (for now: **`http://physics.syr.edu/~salgado/341/`**) that lists the assigned problems and solutions. I will also try to make available the whiteboard/PowerPoint notes and any computer source code (e.g., Python, Maple) that I use for simulations or computations.

Classroom Rules:

Come to class **ON TIME**. Attendance is **REQUIRED.**
"Academic dishonesty will not be tolerated." (2003-2005 University Catalog, page 15)
Come to class PREPARED and EQUIPPED, having read or written any assignments. Bring your HOMEWORK NOTEBOOK and TEXT.
Limit all discussions to the PHYSICS topic under discussion.
Turn OFF all phones, pagers, radios, and other disruptive devices.
Use of computers in the classroom are restricted to PHY 341 computations.
Do all of your printing, emailing, websurfing outside of class. I will not hesitate to power down the computers.

Grades (for the lecture portion):

25% HOMEWORK NOTEBOOK
25% TAKE HOME EXAMS (FORMAT: several short homework-type problems)
25% IN-CLASS MIDTERM EXAM (FORMAT: several short homework-type problems)
25% FINAL EXAM (FORMAT: like two regular exams but cumulative)
A≥88%, B≥76%, C≥64%, D≥50%, F<50%. This class is not graded on a curve.
Borderline cases (between two letter grades): If your exams show an upward trend, your grade may be nudged upwards.

Exams: At an appropriate point, we will have a TAKE-HOME EXAM on the recent material (although it may rely on previous material).
There is a cumulative one-hour *in-class* MIDTERM and a cumulative two-hour *in-class FINAL*.

Missed exams: There are **no** makeup exams. There are **no** exceptions.
If you are absent for an exam, *within one week*, you must present to me a written excuse from Division of Natural Sciences.
Only if that excuse is valid, **your final exam will carry the weight of your missed exam**.
Otherwise, you will get no credit for the missed exam or quiz.

***HOMEWORK will be assigned (See HOMEWORK NOTEBOOK below.)**
HOMEWORK solutions will be discussed only during a weekly Special Session of Office Hours (submit your schedules to me.)

Sequence of PHY 341 topics that I will emphasize and the Learning Objectives:
[For background, you may have to read other sections in your text that are not listed. You should also consult your MAT 201-203 texts.]

Infinite Series: Definitions (1.2), Power Series (1.11-13,15), applications (1.16)
Calculate series approximations of elementary functions. Use "small-angle approximations" in physics applications.
Complex Numbers: basics (2.1-5), elementary functions (2.8-15), applications (2.16-17)
Analyze and interpret operations with complex numbers. Use the complex-exponential function in physics applications.
Linear Algebra: Determinants (3.3), Vectors (3.4), Lines and Planes (3.5), Matrices and Linear Operators (3.6-3.9)
Analyze and interpret operations with vectors and matrices. Solve systems of equations in physics applications.
Partial Differentiation: basics (4.1-7), change-of-variables (4.11), differentiating integrals (4.12), applications (4.13)
Calculate and interpret the partial derivative of a multivariable function. Analyze the dependence of physical variables.
Multiple Integrals: basics (5.1-3), change-of-variables [Jacobians and coordinate systems] (5.4), surface integrals (5.5)
Calculate and interpret multiple integrals. Analyze non-uniform mass and charge distributions in physics.
Vector Analysis: vector algebra (6.1-3), vector calculus (6.4-6.8), Stokes Theorems (6.9-6.11), applications (6.12)
Calculate and interpret vectorial operations. Analyze the variation of vector fields in electromagnetism and gravitation.
Fourier Series: periodic functions (7.2), Fourier Series (7.3-9), applications (7.10-12)
Analyze and interpret the Fourier representation of period functions. Perform elementary signal processing.
Ordinary Differential Equations: basics (8.1-4), linear with constant-coefficients (8.5-6)
Formulate, solve, and interpret ordinary differential equations. Use ODEs to study the damped oscillator.
Series solutions and some Special Functions:
Legendre (12.2-5), Orthogonal and Normalized Functions (12.6-8), Power Series method (12.11,21), Bessel (12.12-19), Hermite (12.22)
Analyze and solve special types of ODEs, which arise in important physical systems.
***Partial Differential Equations: Laplace (13.2), Diffusion (13.3), Wave (13.4), Poisson (13.8)**
Formulate the prototypical partial differential equations in physics.
***Integral Transforms: Laplace Transforms (15.1-3), Fourier Transforms (15.4)**
Calculate integral transforms. Use these transforms to turn a hard math problem into an easier math problem.
**Time Permitting*

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       January
Su Mo Tu We Th Fr Sa
      11    13          SERIES
   [] 18    20          COMPLEX NUMBERS
      25    27          LINEAR ALGEBRA

      February
       1     3          PARTIAL DIFFERENTIATION
   [      ] 10          MULTIPLE INTEGRALS
      15    17          VECTOR ANALYSIS
      MID-T-E-R-M
   [
        March
                ]
       8 [] 10          FOURIER SERIES
      15    17          ORDINARY DIFFRENTIAL EQUATIONS
      22    24 []
      29    31          SPECIAL FUNCTIONS
        April

       5     7
      12    14          PARTIAL DIFFERENTIAL EQUATIONS
      19    21          INTEGRAL TRANSFORMS
      26       F
         May
    I--N--A--L
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Dates of which you should be aware:
AAPT Winter 2005 Meeting (Mon, Jan 10 – Wed, Jan 12 **special arrangements will be made**)
Martin Luther King, Jr. Holiday (Mon, Jan 17 ** no class **)
Mardi Gras Holidays Labor Day (Mon, Feb 7 – Wed, Feb 9 ** no class **)
Midterm Period (Tue, Feb 22 – Fri, Feb 25) [Grades due Feb 28]
Spring Break (Mon, Feb 28 – Fri, Mar 4 ** no class **)
Academic Advising Day (Wed, Mar 9 ** no class **)
Easter Holiday (Fri, Mar 25 ** no class **)
Seniors: Last Day (Thu, Apr 14), Exam Period: (Mon, Apr 18 - Wed, Apr 20)
Last Day to Withdraw (Wed, Apr 20)
Last Day of Classes: (Wed, Apr 27)
Exam Period: (Fri, Apr 29 - Thu, May 5) [Grades due Mon, May 9] - the final will be given on the assigned date and time. No exceptions.

HOMEWORK NOTEBOOK:

Homework will be assigned periodically. The bulk of Exam and quiz problems are generally based on homework problems, textbook problems, and textbook examples.

Most of the learning you do in this course is done by **your doing homework problems outside of class!**

However, be sure that you can do the problems *by yourself* since you'll be working on many exams *by yourself.*

If you need help with your homework, please visit me (with your textbook and your notebooks and with proof that you have tried the problems) during Office Hours… the sooner the better.

** In addition to the regular notebook you use for this class, you must maintain a dedicated "**HOMEWORK NOTEBOOK**" for this class. (spiral-bound notebook with at least 180 sheets). It will be periodically collected, browsed over, graded-for-effort, and promptly returned. You must bring the notebook to each class and to office hours.

How you will use this: (the essential points---a detailed description will be provided on another sheet.)

- You are basically creating your own personal "solution manual" to the assigned homework problems.
- You should want to WRITE DOWN A CLEAR (i.e., logical and legible) AND COMPLETE SOLUTION that you really understand.
  - Start a new problem on a new sheet with the problem number in the upper-right corner…*for organizational purposes*.
  - Try your best to solve the problems by yourself *since this will be an indication of how well you understand the material*.
  - Write down your thoughts on the problem. *What is it really asking? What is it trying to get me to do? What is it trying to teach me?*
    It's okay if you don't understand at first, but you can understand it if you give it a good and honest try.
  - If you're stuck, work together with others in a group. *Don't blindly copy the work of others. Try to understand what you write down.*
    To help make this your work, add your own comments and fill in any missing steps to the group effort.
  - If you're still stuck, raise questions during class or office hours *then try again*.
- It is possible that you (with possibly the help of your group) were unable to solve the assigned problem by the due date. In that case, you should obtain a copy of my solutions (made available on the web). You must TRANSCRIBE [in your own handwriting] the solution *(adding your own comments and filling in any missing steps)* into your notebook.
- The notebook is expected to be in your handwriting. There should be no loose pages in your notebook.

How I will evaluate your notebook:

- I may or may not announce when I collect the notebooks. (It will be at least once every two weeks.)
- I will be looking to see that you are keeping the notebook up to date. I will only spot-check, not grade, your work.
- I will be looking to see that you are following the rules regarding organization. *(Again, start a new problem on a new sheet.)*
- I will assign a score (to form part of your final grade) and make comments on any deficiencies. You are expected to resolve any deficiencies (including rewriting, if necessary) to avoid further penalties. The original score will not be adjusted.
- Some examples of deficiencies: *missing problems, incomplete problems after solutions are made available, improper format (improper labeling, more than one problem on a sheet, etc.), illegibility, and inclusion of anything other than this course's homework problems.*

Comments will be written on the last sheet. Do not destroy that last sheet!