**ME304 Advanced Engineering Analysis I – Fall 2001**

**Course Syllabus**

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**Office Hours:** MW 3:30-5:30 p.m.

**Lecture Hours:** MWF 9:05-9:55 p.m.

**Textbooks:** *Partial Differential Equations and Boundary Value Problems* by N. Asmar, Prentice-Hall

**Prerequisites:** graduate standing in engineering, or permission of instructor

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**Course Overview**

This is the first part of a two-semester course intended as an intensive coverage of partial differential equations relevant to the engineering sciences. Specific equations to be considered include the Laplace’s equation, the diffusion (heat) equation; the wave equation and the biharmonic equation. The approach that will be taken in lecture is to develop the mathematical structure and tools *within the physical context* of classical problems arising in engineering and physics. Put another way, topics will always be introduced first through physics and the mathematics developed thereafter. As the solution to partial differential equations ultimately leads back to ordinary differential equations, a good working knowledge of ordinary differential equations should be considered as an additional “unofficial” prerequisite for this course. A tentative breakdown of the topics is listed below; there is some flexibility in the material based upon the interests of the class.

- The diffusion/heat equation
- Laplace’s equation (rectangular, polar, spherical coordinates)
- The wave equation
- The elastic wave equation
- The biharmonic equation
- Fourier series analysis
- Elements of Sturm-Liouville theory for ordinary differential equations
- Special and orthogonal functions: Bessel functions, Legendre polynomials

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**Course Schedule and Readings**

As we proceed through the semester an updated weekly schedule will be posted on the course web site [http://prometheus.emba.uvm.edu/~hitt/me304/](http://prometheus.emba.uvm.edu/~hitt/me304/) (see the section entitled *Online Resources* below). This schedule will list the readings from the text which best correspond with material to be presented in lecture. You should note that lecture will occasionally feature topics and/or approaches not found in the text and vice versa; the two and should be considered complementary to each other. It is best to regard the readings as unofficial homework and it is strongly encouraged that you keep up with them to get the most out of lecture.

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**About the Textbook**

You will notice that the primary text for this course is one written about partial differential equations. This will be the focus of this semester: solving classical PDEs. The Asmar text does a good job on covering the solution to the diffusion and wave equations in different geometries; however, some of the hardcore details and properties of the special functions encountered are occasionally lacking. The text also lacks sections on some additional engineering PDEs (e.g., the biharmonic equation). Where appropriate, supplementary materials will be provided.

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**Homework Projects**

The bulk of the coursework will be composed of a number of homework projects which will be assigned roughly every 10 days. The term ‘projects’ is used because the problems will be more
involved than typical homework problems found at the ends of textbook chapters. Some problems will be drawn directly from the text or based upon those found in the text; still others will be drawn from other sources. The homework projects will occasionally feature a computational component that would require the use of a scientific computing package. Some recommended packages are Matlab and Mathematica, which are available as part of the Engineering & Mathematics Computing Facility; Maple and Mathcad are also excellent packages. If you prefer writing your own computer program in Fortran or C, this is also fine; in that case I would recommend linking to 'canned' numerical subroutines such as Numerical Recipes.

- **Group Collaboration.** Collaboration on the homework is perfectly acceptable and strongly encouraged; however, each student is required to submit their own solution set which is to be written with their own explanations.
- **Format.** Solution sets must be neatly written and documented. Explanations of problem-solving approaches and key assumptions made should be provided.
- **Due Dates.** At the time at which it is assigned, a deadline for the homework will also be given. An assignment is considered on-time provided that it is in my mailbox or under my office door prior to my arrival (usually by 8-8:15 am) on the day following the due date. Assignments submitted after the due date will be assessed a late penalty of 10% for each business day; documented extenuating circumstances may result in the lifting or reduction of the penalty.

In general, one problem in the assignment will be selected for detail grading; the remainder of the assignment will be reviewed for completeness and effort.

**Class Presentation**

One of the most important components of this course will be an individual class presentation by each student at the end of the semester. This presentation will deal with an approved topic of the student's choosing. The presentation may involve a topic not being covered in this course or, alternatively, may examine a course topic but in greater depth and detail. The length of each presentation will be approximately 20-25 minutes, which includes 5 minutes allocated for questions and answer. The class presentations will be scheduled during the final two weeks of the semester and will be open to the Engineering faculty. A professional and 'polished' technical presentation will be required. An overhead projector will be available for transparencies, as will a LCD panel video projector if you prefer to use Microsoft PowerPoint. Guidelines for preparing the presentation and will provided as will criteria on how the presentation will be evaluated. A list of possible topics will be distributed in early October, and you must have selected and have had approved a topic by **Friday, October 26.**

**Grading Policy**

Final grades will be issued according to the traditional grading scheme: A - 90%, B - 80%, C - 70%, and so on. I do reserve the right to modify this scheme at my discretion, but any such modification will only be in a way to lessen the requirements for a particular grade. The relative weights of the exams, homework projects, and class presentation are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm and Final Exams</td>
<td>60%</td>
</tr>
<tr>
<td>Homework Projects</td>
<td>20%</td>
</tr>
<tr>
<td>Class presentation</td>
<td>20%</td>
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</tbody>
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**Online Resources**

A web site for this course will be maintained at the URL address [http://prometheus.emba.uvm.edu/me304/](http://prometheus.emba.uvm.edu/me304/) and will serve primarily as a bulletin board and class archive. In addition, a list of resources will be maintained which features suggested readings and reference texts as well as links to other relevant Internet sites. You are encouraged to check the web site on a regular basis to look for updated schedules, suggested reading assignments, and miscellaneous class announcements.