MEEN 5140
Advanced Mathematical Methods for Engineers
Syllabus - Fall 2014

**Catalog Description:** This course provides an introduction to advanced mathematical methods used in engineering science, such as vector calculus, integral transforms, partial differential equations and numerical methods.

**Prerequisite(s):** None. (Graduate students assumed to have an undergraduate engineering math education)

**Course Times:** TTh 5:30-6:50 NTDP D201

**Instructor:** Mark Wasikowski, PhD, Adjunct Lecturer. **Office:** F101T  **Hours:** TTh 4 – 5


**Course Description:** This is a first semester graduate course appropriate for students in mechanical and energy engineering. This course provides the student a strong introduction, at the graduate level, to the mathematical principles and practices that engineers need to understand. Mathematical concepts are approached from a practical use perspective with numerous physical applications to illustrate how the concepts are used in mechanical and energy engineering. The mathematical concepts include ordinary and differential equations, vector calculus, Fourier series, partial differential equations, Laplace transforms, complex variables, and numerical methods. Practical examples will be provided that illustrate applications to a wide variety of topics in mechanical and energy engineering practice, including thermodynamics, heat transfer, dynamics, hydraulics and fluid mechanics, solid mechanics, energy management, electricity, electromagnetic, and optics.

**Course Format:** Course lectures are provided using powerpoint to present new theory. Lectures are available on BB prior to each class. Students should download and read the lectures, along with the textbook, prior to class. Come to class with questions. Each class presents new theory and then solves practical problems on the whiteboard. Course announcements, grading, lectures, and homework assignments are all communicated via BB, so please ensure that UNT has your correct email address on file. Homework problems are assigned frequently. Group problem solving for homework encouraged. Homework is not graded. Homework solutions are solved in class and/or posted to BB. In class quizzes are given most every Thursday. One term project presentation is required, along with a final exam

**Tentative Outline (each subject approximately 2 weeks duration):**

- Ordinary Differential Equations – power series and Laplace transform solutions
- Numerical methods for ODE and Qualitative Methods
- Vector Calculus – Multi-variable Calculus Review
- Fourier series Methods and Partial Differential Equations
- Diffusion equation with applications
- Wave equation with applications
- Laplace equation with applications
**Grade Assessment:** Grades are assigned on a straight 90/80/70/60 scale

- **Homework:** assigned and reviewed together in class - but not graded
- **Quizzes:** 50% - 10 quizzes @ 100 points each. – no midterm exams
- **Term Project:** 25%
- **Final Exam:** 25%

**Tentative Course Topics and Schedule:** The course schedule, content, and assignments are subject to minor modification when circumstances dictate and as the course progresses and develop. If changes are made, students will be given due notice.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 26, 28</td>
<td>Introduction / ODE’s</td>
<td>ODE’s, Power Series Solution</td>
</tr>
<tr>
<td>2</td>
<td>Sept 2,4</td>
<td>Power Series Solution</td>
<td>Laplace Transform Quiz 1 – ODE’s</td>
</tr>
<tr>
<td>3</td>
<td>Sept 9,11</td>
<td>Laplace Transform</td>
<td>Laplace Transform Quiz 2 – Power Series</td>
</tr>
<tr>
<td>5</td>
<td>Sept 23,25</td>
<td>Qualitative Methods</td>
<td>Qualitative Methods Quiz 4 – Numerical Solutions</td>
</tr>
<tr>
<td>6</td>
<td>Sept 30, Oct 2</td>
<td>Multi-variable Calculus Vectors in 3-Space</td>
<td>Partial Differential Equations Quiz 5 – Qualitative Methods</td>
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<tr>
<td>7</td>
<td>Oct 7,9</td>
<td>Partial Differential Equations</td>
<td>Fourier Methods Interim Project Presentations</td>
</tr>
<tr>
<td>8</td>
<td>Oct 14,16</td>
<td>Fourier Methods</td>
<td>Diffusion Equation Interim Project Presentations</td>
</tr>
<tr>
<td>9</td>
<td>Oct 21,23</td>
<td>Diffusion Equation</td>
<td>Diffusion Equation Quiz 6 – PDE’s</td>
</tr>
<tr>
<td>10</td>
<td>Oct 28,30</td>
<td>Diffusion Equation</td>
<td>Wave Equation Quiz 7 – Fourier Methods</td>
</tr>
<tr>
<td>11</td>
<td>Nov 4,6</td>
<td>Wave Equation</td>
<td>Wave Equation Quiz 8 – Diffusion Equation</td>
</tr>
<tr>
<td>12</td>
<td>Nov 11,13</td>
<td>Laplace Equation</td>
<td>Laplace Equation Quiz 9 – Wave Equation</td>
</tr>
<tr>
<td>13</td>
<td>Nov 18,20</td>
<td>Laplace Equation</td>
<td>Problem Solving &amp; Review Quiz 10 – Laplace Equation</td>
</tr>
<tr>
<td>14</td>
<td>Nov 25,27</td>
<td><strong>Project Presentations</strong></td>
<td>Thanksgiving Break</td>
</tr>
<tr>
<td>15</td>
<td>Dec 2,4</td>
<td>Final Exam Review</td>
<td>Final Exam</td>
</tr>
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<td>16</td>
<td>Dec 8,12</td>
<td><strong>No Final Exam during University Scheduled Time</strong></td>
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Disability Accommodations: If you need academic accommodations for disability you must have a document that verifies the disability and makes you eligible for accommodations. If you have any concerns regarding disability accommodations please schedule an appointment with the instructor at your earliest convenience. “Qualified Students” must notify the instructor that special accommodations will be needed.

ADA Statement: The University of North Texas is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 – The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act of 1990 (ADA) as amended, pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As a faculty member, I am required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels. Information regarding specific diagnostic criteria and policies for obtaining academic accommodations can be found at www.unt.edu/oda. Also, you may visit the Office of Disability Accommodation in the University Union (room 321) or call (940) 565-4323.

Dishonesty: Students caught cheating or plagiarizing will receive a "0" for that particular assignment or exam. Additionally, the incident will be reported to the Office of Student Rights and Responsibilities, which may impose for further penalty. NO EXCEPTIONS. Please avoid cheating (such as copying homework, cheating in the exams, etc) or any other form of misconduct. If you are having problems, talk to the instructor.

Per the UNT catalog, the term "cheating" includes, but is not limited to:

1) use of any unauthorized assistance in taking quizzes, tests, or examinations
2) dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments
3) the acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university
4) dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s)
5) any other act designed to give a student an unfair advantage.

The term "plagiarism" includes, but is not limited to:

1) Knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment
2) Knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.
Term Project

1. Opportunity to develop presentation skills while also learning about practical application of advanced math techniques to mechanical and energy engineering problems.

2. Small teams – 2 people – work together during the course of semester - one 3 person team if we have an odd number of students. Pick your team during the first two weeks of class, based on identifying common interests in applications. Attempt to work with someone you do not know if possible.

3. Investigate how engineers use the mathematical techniques learned in this class in research, technology, and clinical practice in the mechanical and/or energy fields.
   a. Internet searches, interviews with faculty or practicing engineers
   b. Spend the first half of the term doing preliminary investigation and give a 5 minute overview presentation to the class on progress on 9 October

4. Spend second half of term applying at least 2 different analytical methods to the problem. Write a program (matlab, computer code, etc.) to solve the application problem.

5. Create a powerpoint presentation on the results of your work. Make a 25 minute presentation on the results to the class on 25 November.

6. Turn in your powerpoint presentation and computer code with results as a written report by 8 December.