Mathematical Methods in Engineering and Physics II - ENGN 2020
Meeting place: Barus & Holley 141 – TR 10:30 am - 11:50 am
Range date: Jan 22, 2014 - May 16, 2014

Instructor: Marcelo A. Dias
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Office Hours: by appointment

Teaching Assistant: Madison Ski Krieger will be the teaching assistant for this course. He will hold office hours (TBA). His email address is:
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Course Description. An introduction to methods of mathematical analysis in physical science and engineering. This is the second course in a two-semester sequence. The second semester course includes: Probability Theory; Linear Algebra; Eigenvalue Problems; Calculus of Variations and Extremum Principles.

1. **Probability Theory and Statistics:**
   - Probability, permutations, and combinatorics.
   - Random variables and distributions.
   - Generating functions.
   - Discrete & Continuous distributions.
   - Central limit theorem.
   - Statistics: experiment, samples, and populations
   - Mean, variance, standard deviation, moments, covariances, and correlations.
2. **Linear Algebra & Eigenvalue Problems:**
   - Matrices and vector spaces.
   - Eigenvalue and eigenvectors.
   - Applications to normal modes.
   - Sturm-Liouville problems.
3. **Calculus of Variations and Extremum Principles:**
   - Calculus of variations.
   - The Euler-Lagrange equations.
   - Constraint variations.
   - Fermat's and Hamilton's principle.
   - Eigenvalue problems.

Requirements and prerequisites. EN2010, the first course in this two-semester sequence, is not officially required for EN2020, but will prove useful.

MATLAB®. We will make use of MATLAB® in some parts of the course.

Textbook:

- K. F. Riley, M. P. Hobson, and S. J. Bence, *Mathematical Methods for Physics and Engineering: A Comprehensive Guide*, Cambridge University Press, 3 edition (2006).

Useful books that you should know about:

1. F. W. Byron Jr. and R. W. Fuller, *Mathematics of Classical and Quantum Physics*, Dover Publications (1992).
2. K. Cahill, *Physical Mathematics*, Cambridge University Press (2013).
3. R. Courant and D. Hilbert, *Methods of Mathematical Physics*, Volume I, Wiley-VCH, John Wiley & Sons (1989).
4. W. Feller, *An Introduction to Probability Theory and Its Applications* , Vol. I & II, John Wiley & Sons, 3rd edition (1968).
5. I. M. Gelfand and S. V. Fomin, *Calculus of variations*, Dover Publications (1991).
6. C. M. Grinstead and J. L. Snell, *Introduction to probability*, American Mathematical Society (1997).
7. E. T. Jaynes, G. L. Bretthorst, *Probability Theory: The Logic of Science*, Cambridge University Press (2003).
8. S. Otto, J. P. Denier, *An Introduction to Programming and Numerical Methods in MATLAB*, Springer-Verlag, (2005).
9. A. Quarteroni, F. Saleri, and P. Gervasio, *Scientific Computing with MATLAB and Octave*, Springer-Verlag, 3 Edition (2010).

Grading. Homework: 30%. Midterm: 30%. Final project/take-home exam: 40%. During the midterm exam you will not be permitted to bring in notes, books, or any other material for this exam. Calculators are permitted for doing arithmetic. For the final project/take-home exam, no collaboration is permitted, and you may only use your own notes and books (NO Internet!). This project will be scheduled for near the end of the term. Collaboration on the homeworks in encouraged, but each student must write up and hand in her or his own solutions. Likewise, collaboration is allowed on computing exercises, but each student must write and debug his or her own code. Homework exercises will be available on the course website on Tuesday and due the following Tuesday. Please, hand in your homework in class. There are no exceptions to these rules. To deal with unexpected circumstances such as family emergencies and serious illnesses, the lowest homework grade will not count toward the final grade.