Engineering Analysis I
UEA – 540G KSU – ME 760

Prerequisites: ME 400 (K-State) or senior standing

Description: Methods of analysis employed in the solution of problems selected from various branches of engineering, Emphasis is on discrete systems.

Instructor

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Required Text

Riley, Hobson and Bence, Mathematical Methods for Physics and Engineering, 3rd Ed., Cambridge University Press.

Course Description and Goals

After completing this course, you should be able to:

1. Use linear algebra to perform a variety of analyses of linear discrete systems
2. Use the concept of abstract vector spaces to describe both discrete and continuous systems
3. Calculate analytic and numerical solutions of arbitrary sets of linear equations
4. Use the properties and describe the importance of matrices of various types: diagonal, symmetric, skew symmetric, normal, orthogonal, permutation, complex, unitary, Hermitian, etc.
5. Calculate matrix eigenvalues and eigenvectors
6. Use similarity transformations
7. Estimate spectral radii of various types of matrices and use iteration techniques for solving linear algebraic equations
8. Use and describe the physical meaning of dot and cross products, the divergence, curl and gradient operators
9. Apply important multidimensional integral theorems; e.g., Stokes's, Green's, and Gauss' theorems
10. Use the taxonomy and classification of differential/integral equations
11. Derive analytical solutions for general linear first-order ode's

12. Analyze the behavior of a set of coupled first order differential equations
13. Derive series solutions for second order linear ode's
14. Describe the use of Sturm-Liouville theory for treating second order differential equations and the importance of the completeness and orthogonality of its eigenfunctions
15. Explain the origins and properties of important functions of mathematical analysis, e.g., Bessel, Legendre, Hermite, Gauss, Tschebyscheff, Jacobi, Mathieu, Laguerre, and other functions

Topics:

1. Introduction (1 week)
2. Linear Algebra (2 weeks)
3. Vector Calculus (2 weeks)
4. Integral Theorems and Applications (2 weeks)
5. First-Order differential equations (2 weeks)
6. Second-order differential equations and Sturm-Liouville Theory (4 weeks)
7. Applications of Special Functions (1 weeks)

Student Evaluation:

1. **Homework:** Problem sets will be assigned throughout the course, typically every two weeks. This homework is intended to allow you to master the concepts discussed in class by applying them to specific problems. You are encouraged to help one another learn, and as such, I view these problem assignments as proof that you can apply the needed techniques when called upon in class or on the examination. I expect all students to complete each problem correctly either with the help of your colleagues or from me. I want you to understand how to do each problem. Copying another's solution is not acceptable. If I find two problem write-ups are virtually identical, credit will not be given to either student for the problem. Your write-up is to demonstrate you can explain the steps needed to obtain the solution. The problem assignments are not a test, and, therefore, contribute little to your overall course grade. Rather they are an indication of your mastery of the solution techniques. If you understand how to do all of your homework problems, you should have little difficulty with the final exam. I expect each write-up to be done in a professional manner – proper paper (no torn out pages), statement of the problem, key words and phrases of explanation for important steps in the solution, and a layout that facilitates the understanding of your solution. Written communication skills are critical for an engineer!
2. **Midterm Examination**: A one-hour inclass examination (open books and notes) will be given halfway through the semester. The date will be announced.
3. **Final Examination**: An 24-hour, open-book, take-home final examination will be given during the final examination week. You may elect what day to wish to pick up your exam.
4. Grades will be assigned on the basis of a weighted average of scores from homework and the final examination. Typically 80% of your grade will be from the examinations.

Classroom Conduct:

All student activities in the University, including this course, are governed by the Student Judicial Conduct Code as outlined in the Student Governing Association By Laws, Article VI, Section 3, number 2. Students who engage in behavior that disrupts the learning environment may be asked to leave the class.

Relationship of Course to Professional Component:

This course strengthens and extends the analysis and design tools unique to the nuclear engineering profession. It hones both the analytical and numerical skills of the students as well as introduce them to important technical concepts for neutrons in a diffusing and multiplying media. Professional presentation of technical material is emphasized in the biweekly homework assignments, and use of a wide variety of data sources, particularly through the internet, is required.

Evaluations:
You will be assigned to a small group with which you will participate in (1) completing the bi-weekly homework assignments and (2) completing the exercises assigned in class. Each group will submit a single report for each assignment signed by all members of the group.

There will be short (15 minute) in-class quizzes on the days homework assignments are due. These quizzes will generally be on some topic related to the homework or to a recently assigned exercise. In addition, there will be two examinations, the midterm and the final.

Grades will be assigned on the basis of a weighted average of scores from group assignments and individual efforts (exams and quizzes). Typically 50-70% of your grade will be from your individual scores and the remainder from the greater of your group scores or your individual scores.

Honor System:
Kansas State University has an Honor System based on personal integrity, which is presumed to be sufficient assurance that, in academic matters, one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor System. The policies and procedures of the Honor System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off- campus, and via distance learning. The honor system website can be reached via the following URL: www.ksu.edu/honor. A component vital to the Honor System is the inclusion of the Honor Pledge

which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

Students with Disabilities:

Any student with a disability who needs a classroom accommodation, access to technology or other academic assistance in this course should contact the Student Access Center and/or the instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety. If you are a student enrolled in on-campus/online courses through the Manhattan or Olathe campus, contact accesscenter@k-state.edu, 785-532-6441.