UNIVERSITY OF SOUTHERN MAINE

Department of Engineering

EGN 498 – Differential Equations and Linear Algebra **Optional**

Instructor: Mariusz Jankowski, mjankowski@usm.maine.edu, JMC 127, ph. 780-5580 Updated 01.08.2013

Schedule: Lecture: 2 - 1hr and 40 min. lecture/laboratory per week, M&W, 9:05 - 10:45 AM, JMC-217, Spring 13

Course Description (Catalog):

Introduction to linear algebra and differential equations for engineering and science students. Standard methods for solving differential equations as they arise in engineering and science, linear algebra concepts needed to solve linear algebraic systems and linear systems of differential equations, and computational skills in matrix theory needed in computational linear algebra. Topics will include matrix algebra, determinants, linear independence, linear systems, linear transformations, eigenvalues and eigenvectors, vector spaces, first-order ODEs, higher-order linear ODEs, linear systems of ODEs, nonlinear systems, and numerical methods. Prerequisite: MAT 153. Credits: 4

Contribution to Professional Component:

75% Math and Basic Science, 25% Engineering Science

Textbook:

C.H. Edwards; D. E. Penney, Differential Equations & Linear Algebra, Third Edition, 2010. (required).

Topics:

1. Systems of linear equations, matrix algebra, determinants
2. Linear systems, linear independence, vector spaces
3. Eigenvalues and eigenvectors
4. First-order ordinary differential equations
5. Second and higher order DEs
6. Systems of first-order DEs
7. Nonlinear systems
8. Power series methods
9. Numerical methods and visualization

Course Objectives:

1. Students learn the standard methods for solving differential equations as they arise in engineering and science.
2. Students learn the linear algebra concepts which are needed to solve linear algebraic systems and linear systems of differential equations.
3. Students obtain the computational skills in matrix theory which are needed in computational linear algebra.

Assessment Methods:

1. Graded quizzes.
2. Graded exams.
3. Graded computer projects.

Grading Policy:

Students are expected to participate in class by being prepared for the lecture and laboratory sessions and engage in discussions.

Grade Distribution:

Weekly quizzes (6-9)	33%
Final exam	33%
Laboratory and computer projects (3-5)	33%

Summary of Course Changes Since the 2003 ABET Self-Study Report:

2013: New course

Academic Support for Students with Disabilities: Students who may need assistance due to a disability are encouraged to contact the Office of Academic Support for Students with Disabilities, Luther Bonney 242, ph. 780-4076, TTY 780-4395.

Tentative Schedule

Week 1 (01/14). Review: derivatives, integrals, complex numbers and functions; Mathematica basics; introduction to differential equations (DEs).
Reading: 1.1,2, notes.
Problems: 1.1 - 1, 3, 5, 11, 13, 14, 19, 21, 23, 34, 36, 37, 40, 42, 43, 44.
1.2 – 1, 2, 5, 10, 11, 15, 19, 23, 25, 29, 40.
Week 2 (01/21). First-order DEs: separable, linear; slope fields and solution curves.
Reading: 1.3-5.
Problems: 1.3 – 1, 2, 8, 10, 21, 26.
1.4 – 2, 4, 6, 8, 12, 20, 22, 33, 52.
1.5 – 1, 2, 3, 11, 13, 17, 19, 32, 43.
Week 3 (01/28). Applications of first order linear equations; linear, constant coefficient DEs; numerical methods.
Reading: 2.4,5.
Problems: 2.4 – 1, 2, 3, 11, 16, 27.
2.5 – 1, 6, 11, 16, 27.
Week 4 (02/04). Introduction to linear systems, matrices and Gaussian elimination.
Reading: 3.1-3.
Problems: 3.1 – 1, 13, 15, 24, 27, 30, 31.
3.2 – 11, 15, 24, 27, 30, 31.
3.3 – 1, 5, 9, 21, 25, 32, 33, 35.
Week 5 (02/11). Matrix algebra, matrix inverse and transpose, determinants, special matrices and applications.
Reading: 3.4-6.
Problems: 3.4 – 1, 4, 5, 8, 11, 13, 15, 23, 27, 28, 31.
3.5 - 11, 15, 24, 27, 30, 31
3.6 – 1, 5, 9, 21, 25, 32, 33, 35
Week 6 (02/25). Abstract vector spaces, linear independence.
Reading: 4.1-3.
Problems: 4.1 – 5, 7, 9, 14, 17, 19, 22, 30, 35.
4.2 – 1, 3, 7, 10, 14, 15, 19, 23.
4.3 – 1, 2, 3, 4, 5, 8, 9, 13, 15, 17, 28.
Week 7 (03/04). Bases and dimension of a vector space, orthogonal vectors, functional vector spaces.
Reading: 4.4, 6, 7.
Problems: 4.4 – 1, 2, 3, 4, 7, 8, 10, 15, 16.
4.6 - 1, 3, 5, 7, 9, 11, 23, 26.
4.7 – 5, 6, 13, 14, 16, 17, 30.
Week 8 (03/11). Second order linear equations, general solutions to linear DEs.
Reading: 5.1-2.
Problems: 5.1 – 1, 4, 5, 8, 11, 13, 15, 23, 27, 28, 31.
5.2 - 11, 15, 24, 27, 30, 31
Week 9 (03/18). Linear, constant-coefficient DEs, nonhomogeneous equations and undetermined coefficients.
Reading: 5.3, 5.
Problems: 5.3 – 1, 4, 5, 8, 10, 12, 20, 21, 23, 33, 39, 44, 50.
5.5 – 1, 3, 6, 13, 15, 31, 34, 35, 38, 47, 51, 55, 58.
Week 10 (04/1). Variation of parameters, response of linear constant-coefficient DEs.
Reading: 5.5-6.

Problems: 5.5 – 1, 3, 6, 13, 15, 31, 34, 35, 38, 47, 51, 55, 58.
5.6 – 1, 2, 3, 11.

Week 11 (04/08). Linear systems, eigenvalues and eigenvectors, diagonalization of matrices.

Reading: 6.1, 2.

Problems: 6.1 – 1, 4, 9, 13, 27, 36, 38.
6.2 – 1, 3, 5, 11, 13, 17, 34.

Week 12 (04/15). Systems of first and second-order linear DEs.

Reading: 7.1, 2, 3, 5, 6.

Problems: 7.1 – 1, 2, 6, 11, 12, 13, 17.
7.2 – 1, 3, 5, 10, 13-15, 19, 23, 24.
7.3 - 1, 3, 5, 9, 11, 17, 26, 38, 42, 50.
7.5 -

Week 13 (04/22). Matrix exponentials and nonhomogeneous linear systems.

Reading: 8.1,2.

Problems: 8.2 – 1, 2, 4, 9, 11, 12, 14, 17, 19

Week 14 (04/29). Wrap-up; Review.