LIBERTY UNIVERSITY
Math 221 – Applied Linear Algebra (3 Credit Hours)
Fall 2012

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DeMoss Hall 4051

Office Hours:

T-TR: 7:00-9:15 and 10:30-11:45

M: 3:45-5:45, W: 3:45-4:45

I.   Course Description

An elementary introduction to the essentials of linear algebra for SECS majors. Systems of linear equations and matrices, determinants, Euclidean vector spaces, eigenvectors, least-squares data fitting, diagonalization and numerical methods.

Credit is not allowed for both Math 221 and Math 321   (3 hours credit)

II. Rationale

Systems of linear equations are found in every quantitative discipline. The matrix notation allows us to collect many complicated equations together in a single linear system. It is crucial that the modern student of engineering become comfortable with matrix notation and learn how to apply it in their chosen field of study. Computations in the real world are often done with technology. We will explore how Matlab is used to treat numerical examples. Problem solving is a skill which is important to all technical majors. We will learn how to construct and analyze linear models for select real-world problems. Since not all linear problems have exact solutions it is important to understand how to find approximate solutions. We will see how the method of least squares provides an optimal approximation. Finally, the concept of eigenvalues and eigenvectors go hand-in-hand with the process of decoupling a linear system. Decoupling linear systems to reveal basic properties is a theme found across many disciplines. In summary, we study how the techniques of linear algebra allow for efficient and general solutions to linear problems.

III.   Prerequisite statement

MATH 132 and ENGR 133 with a minimum grade of C.

It is the student's responsibility to make up any prerequisite deficiencies, as stated in the Liberty University Catalog, which would prevent the successful completion of this course.

IV. Materials List

Required Text: *Elementary Linear Algebra: applications version,*

Howard Anton and Chris Rorres. 10th Edition.

CALCULATOR: A basic scientific calculator is recommended. A graphing or programmable calculator is not allowed on quizzes or exams. On tests and quizzes, the calculator may **not** be on a PDA, phone or computer.

V. Learning Outcomes

The student will be able to:

1.   perform row reduction of matrices and use the Gauss-Jordan algorithm to solve linear systems,
2.   perform basic matrix computations such as calculation of determinants or inverses for reasonably small matrices,
3.   apply theorems of linear algebra to answer conceptual questions,

4.   solve linear-least squares problems,

5.   compute eigenvalues and eigenvectors,
6.   use diagonalization to decouple linear systems,
7.   use Matlab to solve problems in linear algebra.

VI.   Assignments/Requirements

Homework from the required text will be assigned in each lecture and collected about once per week. The weekly quiz will reflect the assigned homework as well as the lectures given before the quiz. Typically the quiz will be given during the first class meeting of each week. However, on occasion an unannounced quiz may be offered to assess the diligence of the students. Matlab Projects will be assigned and the due-date will be given as the semester progresses. Three in-class, closed-book, closed-notes tests will be given. The schedule for the test and a tentative lecture schedule is given in Section X. of this syllabus. The final exam is comprehensive and its date and time can be found in the official schedule provided by the Registrar.

VII.   Grading Policies

- Homework must be turned in on or before the due date or no credit is generally awarded.
- **Tests and quizzes must be taken as scheduled.** No make-up tests/quizzes will be given after the scheduled time, except in the case of emergency (see Section X. below). If a test/quiz is missed due to an official university sponsored event, arrangements must be made with the instructor **in advance of departure** to take the test at an alternate time. For other excused absences, the student must contact the instructor by email at the earliest opportunity in order to make arrangements for make-up work. (See attendance policy below.)

Course Grade

Test 1	150 Points	15%
Test 2	150 Points	15%
Test 3	150 Points	15%
Weekly Homework	100 Points	10 %
Weekly Quizzes	100 Points	10 %
Matlab Projects	100 Points	10 %
Final Examination	250 Points	25%
Total	1000 Points	100%

•Missed Tests: If you have an emergency absence then the weight of the final may be increased. If your absence is known ahead of time then you need to notify me so we can make arrangements.

1. **Final Grade:** Your final course grade will be determined by using a ten point scale and is ultimately determined by your academic performance in this class.

    A: 900 or greater (90.0 % or greater)   **B**: 800 to 899 points (80 to 89.9%)
    C: 700 to 799 points (70 to 79.9%)   **D:** 600 to 699 points (60 to 69.9%)
    F: below 600 points (below 60%)

VIII.   Attendance Policies

Attendance is required. You are responsible for material covered and assignments given in class. If you are absent, please send your instructor an e-mail within two days of your absence explaining why you were absent.

Liberty University Policy: **In general, regular and punctual attendance in all classes is expected of all students.** At times, students will miss classes. These absences will be identified as either excused or unexcused and will be handled per the policy below.

Excused Absences

- Excused absences include all Liberty University sponsored events, to include athletic competition or other provost-approved event.
- Absences due to medical illness that are accompanied by a doctor's note will be excused.
- Absences due to family situations such as a death in the family or a severe medical condition will be excused
- Students will **not** be penalized for excused absences and will be permitted to make arrangements to complete missed work.

Unexcused Absences

- Classes that meet:
  - Three times per week will permit three unexcused absences per semester.
  - Twice per week will permit two unexcused absences per semester.
  - Once per week will permit one unexcused absence per semester.
- Any student who has more than 3 excused absences is not allowed any unexcused absences.
- Questions regarding unexcused absences must be resolved by the student with the faculty member within one week of the absence.
- Extraordinary circumstances regarding excessive absences will be addressed by the student with the faculty member, department chair, and dean as required.
- Penalties for each unexcused absence over the permitted number per semester will be as follows:
  - 50 points for classes that meet 3 times per week
  - 75 points for classes that meet 2 times per week
  - 150 points for classes that meet once per week
- Students who are late for class 10 minutes or less are considered tardy but present for the class. If a student misses in-class work due to tardiness, the faculty member may choose not to allow the student to make up this work. Three class tardies will be counted as one unexcused absence.
- Students who are more than 10 minutes late for class are considered absent

IX. Other Policies

Dress Code

Students are expected to come to class dressed in a manner consistent with The Liberty Way.

Honor Code

We, the students, faculty, and staff of Liberty University, have a responsibility to uphold the moral and ethical standards of this institution and personally confront those who do not.

Academic Misconduct

Academic misconduct includes: academic dishonesty, plagiarism, and falsification. See The Liberty Way for specific definitions, penalties, and processes for reporting.

Disability Statement

Students with a documented disability may contact the Office of Disability Academic Support (ODAS) in DH 2016 to make arrangements for academic accommodations. For all disability testing accommodation requests (i.e. quieter environment, extended time, oral testing, etc.) the Tutoring/Testing Center is the officially designated place for all tests administered outside of the regular classroom.

Drop /Add Policy

See university website for current policy.

Classroom Policies

The inappropriate use of technology, such as cell phones, iPods, laptops, calculators, etc. in the classroom is not tolerated. Other disruptive behavior in the classroom is not tolerated. Students who engage in such misconduct will be subject to the penalties and processes as written in the Liberty Way**.**

OTHER EXPECTATIONS:

- Arrive on time and stay for the entire class.

- Bring lecture notes, notes, paper, pencil, calculator, and homework.
- Phones, beepers, iPods, computers, etc. should be turned off while in the classroom and they should be placed in your bag.
- Any behavior that disrupts the class or interferes with learning is unacceptable.

X. Calendar for the semester/term

Note: the topics covered by lecture, homework or quizzes are most probable for tests.

Date	Topics	Text	My notes	Due at start of lecture
T/8-21	Linear Equations	1.1	9-12	
	Gaussian elimination	1.2	12-26	
	Matrices and matrix operations	1.3	27-37	
T/8-28	Algebraic properties of matrices	1.4	27-37, 47-51	Problem Set 1 from 1.1-1.3
	Elementary matrices, finding the inverse	1.5	41-47	
	More on linear systems	1.6	38-41	
	Diagonal, triangular, symmetric matrices	1.7	51-59	
	Applications of linear systems & matrices	1.8	60-63	
T/9-4	Cofactor expansion of determinant	2.1	65-66, 69-74	Problem Set 2 from 1.4-1.8
	Row-reduction and determinants	2.2	74-81	
	Properties of det, Kramer's Rule, apps	2.3	66-68, 82-95	
T/9-11	Additional examples/ Review for Test 1			Problem Set 3 from 2.1-2.3
TH/9-13	Test I (1.1-2.3)	1.1-1.8	9-95	
T/9-18	Geometry in Euclidean space.	3.1-3.5	97-104	
	spanning	4.2	105-109	
	linear independence	4.3	110-117	
	Vector space, subspace, bases	4.1,4.2,4.4	117-123	
T/9-25	More about the structure of solutions to a linear system, rank-nullity theorem	4.7-4.8	124-133	Problem Set 4 from 4.1-4.5
T/10-2	Linear transformations	4.9-4.12	137-151	Problem Set 5 from 4.7-4.9
	Coordinates and Change of basis	4.4-4.6	152-160	
T/10-9	Additional examples/ Review for Test 2			Problem Set 6 from 4.5, 4.9-4.12
TH/10-11	Fall Break, no class Thursday			
T/10-16	Test 2 (3.1-4.12)		97-165	
TH/10-18	Eigenvectors and diagonalization	5.1-5.2	167-190	
T/10-23	complex vector space	5.3	196-202	Problem Set 7 from 5.1-5.2
	Differential equations	5.4	190-193, 269-293	
T/10-30	Projections and Gram-Schmidt	6.1-6.3	205-226	Problem Set 8 from 5.3-5.4
	Best approximation by least squares	6.4	227-230	
	Least squares data fitting	6.5	230-237	
	Fourier analysis	6.6	261-268	
T/11-6	Orthogonal matrices and diagonalization	7.1-7.2	238-242	Problem Set 9 from 6.1-6.4
	Quadratic forms and optimization	7.3-7.4	243-257	
T/11-13	Numerical methods week			Problem Set 10 from 6.5-7.4
T/11-20	Thanksgiving Break			
T/11-22	Thanksgiving Break			
T/11-27	Additional Examples/ Review for Test 3			
TH/11-29	Test 3 (5.1-7.4)		167-293	
T/12-4	An applications section, tba.			Matlab Project(s) Due
TH/12-6	Reading Day			
Tbd	Final Exam (covers the whole course)			

Note: Homework should be clearly written one-sided with problems numbered and answers boxed. Your name should be on the front page and the back page with a metal staple in the upper left-corner. Format is 10% of your homework grade.