**MATH 12270-01** **Linear Algebra** **Spring 2015**

MWF, 9:00–9:50 am, SNOW 147

**Instructor:** Bryan Bornholdt **Office:** SNOW 138 **Phone:** 879–4256
**Email:** bornholdt@dixie.edu **Office Hours:** TR 10 am – Noon; 1 – 2 pm; or by appt

**REQUIRED TEXT:** *Linear Algebra, A Modern Introduction*, 3rd Ed., David Poole.

**COURSE PREREQUISITES:** C or better in Math 1210.

**COURSE DESCRIPTION:** This course is for Mathematics and pre-Engineering majors. Covers matrix and vector analysis, systems of equations with applications, linear dependence and independence, matrix algebra and invertibility, determinants and their applications, diagonalization, eigenvalues and eigenvectors, linear transformations (kernel and range), inner product, orthogonality, vector spaces and subspaces (including null and column spaces), bases as well as introducing basic proof theory. Applications will be a primary emphasis in the course.

**COURSE OBJECTIVES**

All classes in mathematics at Dixie State College of Utah support the general education goals of the college. Each mathematics class will:

- Require students to perform mathematical processes including fractions, percentages, decimals, proportions/ratios, algebraic equations, and/or calculus techniques
- Provide students with application problems that use a variety of methods including arithmetical, algebraic, and geometric methods
- Challenge students to make inferences from mathematical models that include formulas, graphs, and tables
- Provide students with real-life applications that use a variety of mathematical functions

Upon successful completion of Math 2270, a student will demonstrate meaningful understanding of the concepts of limit, continuity, differentiability, derivative, and definite integral. Additionally, such a student will demonstrate the ability to:

- Use matrices to solve linear systems of equations.
- Show a basic understanding of the general concepts of a vector space such as linear dependence, the span of a set of vectors, and the notion of subspace.
- Find standard and nonstandard inner-products of vectors.
- Obtain an orthonormal basis for an inner-products space.
- Compute the matrix of a linear transformation.
- Find the matrix of a linear transformation.
- Find the kernel and range of a linear transformation.
- Compute the eigenvalues, associated eigenvectors, and the characteristic polynomial for a square matrix.
- Carry out the procedure for diagonalizing a symmetric matrix.

**Click on this link** - http://www.dixie.edu/reg/syllabus/ - for comprehensive information on the Semester Dates, the Final Exam Schedule, University resources such as the library, Disability Resource Center, IT Student Help Desk, Online Writing Lab, Testing Center, Tutoring Center, and Writing Center. In addition, please review DSU policies and statements with regards to Academic Integrity, Disruptive Behavior and Absences related to university functions.

*If you are a student with a medical, psychological, or learning disability or think you might have a disability and would like accommodations, contact the Disability Resource Center (652-7516) in the North Plaza. The Disability Resource Center (http://dixie.edu/drcenter/) will determine eligibility of the student requesting special services and determine the appropriate accommodations related to their disability.*

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**EXAMINATIONS (60%)**: There will be 3 exams and a comprehensive final. All the exams are in class exams. Each student is expected to take the examinations as scheduled in the syllabus. **Make-up exams will be given at the discretion of instructor, and only if prior arrangements have been made.**

**HOMEWORK (30%): This is a major component of the course.** Homework assignments are to be done daily. Each assignment is due the next class period after the section is completed. **Late HW will not be accepted.** Your lowest FOUR assignments will be dropped. It is very important that you keep current on the assignments.

Homework will be assigned and collected daily with 10 points per assignment. **Your homework may not be graded unless the following criteria are met:**

- **Your name, 'Math 2270, text section, and 'Bornholdt'** clearly appear in the upper right corner of the front page.
- **No loose edges remain from a spiral notebook. Multiple pages are to be stapled together. No torn and folded corners.**
- **You are expected to use notation and terminology correctly at all times.** Misuse of notation reflects lack of understanding.
- **HW is expected to be neat and detailed like a final draft.** Write for understanding.
- **Your write up is to INCLUDE THE DIRECTIONS** (paraphrasing is fine for word problems) and the original statement of the problem with supporting work to justify your answer. Your completed HW should serve as a good study reference.
- **Answer ALL questions asked in a problem and include graphs when requested.**
- **ALWAYS specify the units** when referring to area, distance, work, etc.
- **Exact answers always refer to the use of symbols for irrational values** ($e$, $\pi$, etc.)**, fractions, or terminating decimals.** In such cases, decimal approximations will result in point reductions.

**PROJECTS (10%):** You are to complete three (3) projects during the course. There are seven projects from which to choose. Each project will ask you to self-read part of the text book and/or watch one of the MIT video lectures about an application of Linear Algebra in different fields. You are required to write a report of your understanding of the material with examples or demonstrations of implementations. The project is graded on a scale from 0-15.

**MIT LINEAR ALBEGBRA VIDEO SERIES**: We will utilize the archived videos by MIT professor Dr. Gilbert Strang. These videos are excellent and will serve you in developing and enhancing your understanding of course concepts. These are available at http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

**GRADES**: Grades will be based on: **Exams 45%, Final 15%, Homework 30%, Projects 10%.**
Letter grades will be assigned as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | 100 – 94% | **B** | 86 – 83% | **C** | 74 – 70% | **D** | 59 – 55% |
| **A-** | 93 – 90% | **B-** | 82 – 80% | **C-** | 69 – 65% | **D-** | 54 – 50% |
| **B+** | 89 – 87% | **C+** | 79 – 75% | **D+** | 64 – 60% | **F** | 49 – 0% |

**DMAIL:** All information sent from the college or the instructor will be sent to your Dmail account. You MUST check that email account frequently. You are responsible for knowing what is contained within those messages.

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## Math 2270 Approximate Daily Schedule

| Date | Section | MIT Video | Problems |
|---|---|---|---|
| Jan 12 | 1.1 The Geometry and Algebra of Vectors | | 1,2,4,5ac,8,9,12,13,14adf,18,19,21,22 |
| 14 | 1.2 Length and Angle: The Dot Product | | 2,3,5,9,19,20,22,25,28,39,40,43,66,67 |
| 16 | 1.3 Lines and Planes | | 6,10,11,12,13,14,16,18,22,23,24,28,29,32 |
| **Jan 19** | **Martin Luther King Day - No Classes ☹** | | |
| 21 | 1.4 Applications | | 1,3,6,7,9,11,13,14,27,28 |
| 23 | Problem Solving / Extension | | |
| Jan 26 | 2.1 Systems of Linear Equations | #1 | 2.1: 8,9,10,12,14,15,17,23,28,31 |
| 28 | 2.2 Solving Systems of Linear Equations | #2 | 2.2: 9,14,19,21,23,25,27,31,33,45,46 |
| 30 | 2.3 Spanning Sets, Linear Independence | | 1,3,4,5,8,10,12,15, 16,23,26,28,29 |
| Feb 2 | 4.2 Determinants (Intro) | #18, 19 | 4.2: 1, 4, 8, 14 |
| 4 | 2.4 Applications | | 1,5,8,9,11,15,16,19 |
| 6 | Review | **Exam #1 Chaps 1, 2, & Sec 4.2 In Testing Center** | |
| Feb 9 | 3.1 Matrix Operations | | 1,2,4,5,7,8,13,14,16,19,24,35,36 |
| 11 | 3.2 Matrix Algebra | #3 | 1, 2, 5, 6, 10, 14, 22, 24, 26, 37, 38 |
| 13 | 3.3 The Inverse of a Matrix | | 1,2,3,5,11,12,17,21,22,25,26,28,52,53,57 |
| **Feb 16** | **President's Day – No Classes ☹** | | |
| 18 | 3.4 The *LU* Factorization | #4 | 3, 5, 9, 11, 19, 20, 23, 25 |
| 20 | 3.4 (cont) | | |
| Feb 23 | 3.5 Subspaces, Bases, Dimension, Rank | | 1,2,3,4,5,7,11,16,19,22,28,31,39,47 |
| 25 | 3.5 (cont) | | |
| 27 | 3.6 Intro to Linear Transformations | | 2,3,4,7,9,12,14,18,20,22,31,36 |
| Mar 2 | 3.6 (cont) | | |
| 4 | Review | **Exam #2 Chapter 3 in Testing Center** | |
| 6 | 4.1 Intro to Eigenvalues | | 4.1: 2-6, 7, 10, 16, 23, 24, 27, 29 |
| **Mar 9 - 13** | **Spring Break – No Classes ☺** | | |
| Mar 16 | 4.2 Determinants | #18, 19 | 4.2: 1, 4, 8, 14, 26, 27, 28, 32, 34, 35, 37, 40 |
| 18 | 4.3 Eigenvalues and Eigenvectors | #21 | 2, 4, 6, 9, 10, 15, 16, 17, 20, 21, 26, 27 |
| 20 | 4.3 (cont) | | |
| Mar 23 | 4.4 Similarity and Diagonalization | #22 | 2, 3, 5 ,6, 7, 8, 9, 11, 13, 24, 30, 34 |
| 25 | 5.1 Orthogonality in $R^n$ | #14 | 1, 2, 4, 6, 7-10, 13, 14, 18, 19, 20, 28, 33 |
| 27 | 5.2 Orthog. Complements and Projections | #15 | 2, 4, 7, 9, 13, 16, 18, 20, 21 |
| Mar 30 | 5.3 Gram-Schmidt and *QR* Factorization | #17 | 2, 3, 6, 7, 11, 14, 16 |
| Apr 1 | Supplemental Day | | |
| 3 | 5.4 Orthog Diagonalization of Sym Matrices | #25 | 2, 4, 8, 18, 20, 23, 24 |
| Apr 6 | Review | **Exam #3 Chapters 4 and 5 In Testing Center** | |
| 8 | 6.1 Generalized Vector Spaces and Subsp. | | 7, 8, 15, 26, 28, 33, 34, 38, 53, 54, 60 |
| 10 | 6.2 Lin. Indep, Basis, Dim., Revisited | | 2, 4, 7, 8, 10, 13, 19, 22, 23, 28, 34, 37, 45, 46 |
| Apr 13 | Supplemental Day | | |
| 15 | 6.3 Change of Basis | | 2, 3, 4, 5, 8, 10, 12, 15, 16 |
| 17 | 6.4 Linear Transformations | | 3, 5, 10, 14, 20, 24, 26, 29, 30 |
| Apr 20 | Supplemental Day | | |
| 22 | 6.5 Kernel and Range of a Lin Trans | | 1, 2, 3, 4, 9, 10, 14, 17, 18, 20, 21, 22 |
| 24 | 6.6 The Matrix of a Lin. Transform. | | 1, 4, 5, 7, 9, 12, 13, 15, 22, 23, 27, 29, 46 |
| Apr 27 | Review for Final Exam | | |
| Apr 29 | Review for Final Exam | | |
| **May 6** | **FINAL EXAM 10:00 am – 12:00 pm** | | |