REGIS UNIVERSITY

COLLEGE OF COMPUTER & INFORMATION SCIENCES

Syllabus

Course Number: MT 445
Course Title: Advanced Linear Algebra

Course Description:

MT 445 continues the study of matrices, determinants, systems of equations, eigenvalues, characteristics matrices, and space matrices.

Prerequisite Courses:

MT 415

Course Outcomes:

Upon completion of this course, learners should be able to:

1. Use matrix row reduction as well as inverses, where possible, to find all possible solutions to systems of linear equations, linear combinations of vectors, solutions to matrix equations, and linear transformations. This is partially a review outcome.
2. Apply techniques such as partitioned matrices, matrix factorization, diagonalized matrices, and single value decomposition to simplify computations.
3. Apply matrix methods to solve application problems such as: Leontief models, computer graphics, change of base calculations, constrained optimization, iterated or continuous dynamic models, and difference equations.
4. Define and apply formal properties of vector spaces and subspaces to synthesize an integrated understanding of linear algebra. This is partially a review outcome.
5. Apply the definition of orthogonality to determine orthogonal bases. Use orthogonality in order to apply the Gram-Schmidt process to solve least square problems, approximate analysis of linear models, as well as inner product spaces.
6. Define, classify, and visually interpret quadratic forms as expressed in quadratic forms matrices.
7. Analyze geometric objects defined by two or more variables, using affine combinations, and determine how affine independence and convex sets can be applied to computer graphics.
8. Explain, show, or prove Linear Algebra facts and relationships.

Course Materials:

Required Texts:

Lay, D. C. (2012). *Linear algebra and its applications* (4th Ed.). Boston, MA: Addison-Wesley (Pearson). ISBN13: 978-0-321-83614-4 or 0-321-83614-6 hardcover (text with MyMathLab).

Technology Tools:

A graphing calculator with matrix capability is required. The TI-83 (any version) or TI-84 (any version) are strongly recommended. Generally, minimal instruction will be provided for the calculators. More advanced tools such as TI-89, TI-Nspire, Matlab, MathCAD, Mathematica, or Maple may be used for homework. However, these advanced tools may not be permitted on exams, at the instructors' discretion.

Optional Materials:

Lipschutz, Seymour, (1989). *3000 Solved Problems in Linear Algebra*, New York, NY: McGraw Hill Professional Publishing; ISBN10: 0-07-038023-6 or ISBN13: 9780070380233.

Pre-Assignment:

- Define and provide an example for the following terms:
  - Row reduction.
  - Parametric descriptions of solution sets to systems of equations.
  - Vectors.
  - Linear independence.
  - Basis.
  - Spanning set of vectors.
  - Matrix equations.

- Write a 1 or 2 paragraph essay linking geometric ideas to linear algebra. Be sure to cite any sources used.

Pre-Assignment Due Dates:

The instructor will specify the due date for this assignment.

Course Assignments and Activities:

(Syllabus Author: fill in Week, Topics, Readings, Activities, Assignments Due, and Points or % of Grade)

	Topics	Activities	Readings	Activities Assignments and Associated Points
1	1. Systems of linear equations and solution by elimination using matrices. 2. Vectors and sets of vectors, including linear independence spanning sets and basis sets. 3. Matrices, matrix operations, inverses, and matrix equations. 4. Linear transformations.	Class Discussion: • Introductions • Review of first night assignment. Lecture	Text: Review chapter 1 focusing on sections: 1.1, 1.2, 1.3, 1.4, 1.5, 1.7, 1.8, 1.9. Chapter 2: 2.1, 2.2, 2.3, 2.4.	Online Assignment in Pearson MyLabs: • Week 1 homework. • Quiz 1.
2	1. Determine LU factorization of matrices 2. Solve and interpret Leontief input / output problems. 3. Use matrices to transform graphic objects. 4. Review vector spaces and subspaces, including column space, null space, basis sets, dimension, and coordinate systems.	Discussion of previous week's homework and quiz as needed. Lecture	Text: Chapter 2: 2.5, 2.6, 2.7, 2.8. Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5.	Online Assignment in Pearson MyLabs: • Week 2 homework. • Quiz 2.
3	1. Rank of a matrix. 2. Change of basis matrices. 3. Solve recurrence equations. 4. Markov chains and iterative models. 5. Review the concepts of eigenspaces, characteristic equations, and diagonalization.	Discussion of previous week's homework and quiz as needed. Lecture	Text: Chapter 4: 4.6, 4.7, 4.8.	Online Assignment in Pearson MyLabs: • Week 3 homework. • Quiz 3.

4	1. Linear transformation matrices. 2. Similar matrices. 3. Complex eigenvectors and eigenvalues.	Discussion of previous week's homework and midterm examination as needed. Lecture	Text: Chapter 4: 4.9 Chapter 5: 5.1, 5.2, 5.3, Read and review 5.4, 5.5 (The problems are in week 5). Review for the midterm examination.	Online Assignment in Pearson MyLabs: • Week 4 homework. • Midterm Exam.
5	1. Discrete dynamical systems. 2. Application to differential equations. 3. Estimating eigenvalues.	Discussion of previous week's homework and midterm examination as needed. Lecture	Text: Chapter 5: 5.4, 5.5, 5.6, 5.7, 5.8.	Online Assignment in Pearson MyLabs: • Week 5 homework. • Quiz 5.
6	1. Orthogonality and the Gram-Schmidt process. 2. Applications of least squares.	Discussion of previous week's homework and quiz as needed. Lecture	Text: Chapter 6: Review 6.1 – 6.3 as needed, 6.4, 6.5, 6.6.	Online Assignment in Pearson MyLabs: • Week 6 homework. • Quiz 6.
7	1. Inner product spaces. 2. Weighted averages and trend analysis. 3. Spectral Theorem. 4. Quadratic Forms.	Discussion of previous week's homework and quiz as needed. Lecture	Text: Chapter 6: 6.7, 6.8. Chapter 7: 7.1, 7.2, 7.3. .	Online Assignment in Pearson MyLabs: • Week 7 homework. • Quiz 7.
8	1. Constrained optimization. 2. Affine combinations and affine independence. 3. Barycentric coordinates.	Discussion of previous week's homework and quiz as needed. Lecture	Text: Chapter 8: 8.1, 8.2. Review for the final examination.	Online Assignment in Pearson MyLabs: • Week 8 homework. • Final Examination.

Course Policies and Procedures:

59T

CC&IS Grading Scale

Letter Grade	Percentage	Grade Point
A	93 to 100	4.00
A–	90 to less than 93	3.67
B+	87 to less than 90	3.33
B	83 to less than 87	3.00
B–	80 to less than 83	2.67
C+	77 to less than 80	2.33
C	73 to less than 77	2.00
C–	70 to less than 73	1.67
D+	67 to less than 70	1.33
D	63 to less than 67	1.00
D-	60 to less than 63	.67
F	Less than 60	0

Additional information about grading can be found in the latest edition of the University Catalog, available at http://www.regis.edu/Academics/Course%20Catalog.aspx.

CC&IS Policies and Procedures

Each of the following CC&IS Policies & Procedures is incorporated here by reference. Students are expected to review this information each term, and agree to the policies and procedures as identified here and specified in the latest edition of the University Catalog, available at http://www.regis.edu/Academics/Course%20Catalog.aspx or at the link provided.

- The CC&IS Academic Integrity Policy.
- The Student Honor Code and Student Standards of Conduct.
- Incomplete Grade Policy, Pass / No Pass Grades, Grade Reports.
- The Information Privacy policy and FERPA. For more information regarding FERPA, visit the U.S. Department of Education.
- The HIPPA policies for protected health information. The complete Regis University HIPAA Privacy & Security policy can be found here: http://www.regis.edu/About-Regis-University/University-Offices-and-Services/Auxiliary-Business/HIPAA.aspx.
- The Human Subjects Institutional Review Board (IRB) procedures. More information about the IRB and its processes can be found here: http://regis.edu/Academics/Academic-Grants/Proposals/Regis-Information/IRB.aspx.

The CC&IS Policies & Procedures Syllabus Addendum summarizes additional important policies including, Diversity, Equal Access, Disability Services, and Attendance & Participation that apply to every course offered by the College of Computer & Information Sciences at Regis University. A copy of the CC&IS Policies & Procedures Syllabus Addendum can be found here: https://in2.regis.edu/sites/ccis/policies/Repository/CCIS%20Syllabus%20Addendum.docx.