COURSE OUTLINE

DIVISION: **Science, Technology, Engineering and Mathematics**

Course Title: **Linear Algebra**

Course Number: **MAT 215** Number of Credits: **3**

Developmental: **NO** Bilingual/ESL: **NO**

Is this course a major requirement for a degree or certificate program? **YES**

- If yes, which program(s) **SAM/Math Option**
  Science & Mathematics/Math Option

Is this course an approved major elective (*e.g. MAN elective, CSC elective*)? **YES**

Does this course fulfill a general education requirement or elective? **NO**

- If yes, which categories? (*e. g. Social Sciences elective, Math elective*) _____
  (*Please attach General Education Checklist*)

Pre-requisite(s): **MAT 112 Calculus II**

Co-requisite(s): **N/A**

Suggested Number of Students: **25**

Lecture Hours/Week: **3** Lab Hours/Week: **0**

Clinical/Externship/Internship/Fieldwork Hours/Week: **0**

Total Contact Hours/Week: **3**

Dr. Issam El-Achkar, *Professor of Mathematics*	**August 15, 2018**
Prepared by	Date
Dr. Salim Bendaoud	_____
Division Dean	Date Approved
_____	_____
Chief Academic Officer	Date Approved

A. CATALOG COURSE DESCRIPTION

Systems of linear equations, Gauss elimination, matrices, determinants, vector spaces of ordered n-tuples and functions, linear transformations, inner products, orthogonal basis, eigenvalues, eigenvectors, and related vectors. Machine computation will be used to illustrate and supplement mathematical ideas and concepts.

B. COURSE DESCRIPTION:

Systems of linear equations, Gauss elimination, matrices, determinants, systems of linear equations, vector spaces of ordered n-tuples and functions, linear transformations, inner products, orthogonal basis, eigenvalues, eigenvectors and related vectors. Machine computation will be used to illustrate and supplement mathematical ideas and concepts.

C. STUDENT OUTCOMES/OBJECTIVES:

By the end of this course, students should be able to:

1. Perform matrix operations: addition, scalar multiplication, dot product and multiplication of matrices; the determinant, inverse and transpose of a matrix.
2. Calculate determinants using row operations, column operations, and expansion down any column and across any row.
3. Define vector space, subspace, linear independence, spanning set and basis, and use the properties of each of these topics as well as the change of basis problem for vector spaces.
4. Prove algebraic statements about vector addition, scalar multiplication, inner products, projections, norms, orthogonal vectors, linear independence, spanning sets, subspaces, bases, and dimension for R^n and abstract vector spaces.
5. Use the Gram-Schmidt process to find an orthonormal basis $T = \{w_1, w_2, w_3, \cdots w_m\}$ for the subspace of R^n with basis $S = \{u_1, u_2, u_3, \cdots u_m\}$
6. Calculate eigenvalues and their corresponding eigenvectors.
7. Determine if a matrix is diagonalizable
8. Diagonalize symmetric matrices.
9. **Create orthogonal and orthonormal bases: Gram-Schmidt process and use bases and orthonormal bases to solve application problems**

D. COURSE OUTLINE

Week	Topic	Chapter & Homework Assignments
1	**Linear Equations in Linear Algebra** • Systems of Linear Equations • Row Reduction and Echelon Form • Vector equations	**Chapter 1** 1.1 - p. 10; # 4, 6, 10, 16, 20, 22, 24 1.2 - p. 21; # 2, 4, 8, 11, 13, 18, 20 1.3 - p. 32 # 2, 5, 9, 11, 13, 17, 24
2	**Linear Equations in Linear Algebra** • Matrix Equations • Solutions of Linear Systems • Linear Independence	**Chapter 1** 1.4 - p. 41; # 2, 4, 5, 9, 17 1.5 - p. 48; # 1, 4, 6, 8, 11, 15, 23 1.7 - p. 61; # 1, 4, 6, 7, 14, 16, 31

3	**Quiz #1** **Linear Equations in Linear Algebra** Introduction to Linear Transformations	**Chapter 1** 1.8 - p. 69; # 2, 4, 7, 9, 13, 15
4	**Matrix Algebra** • Matrix Operations • Inverse of a Matrix • Characterizations of Invertible Matrices	**Chapter 2** 2.1 - p. 102; # 4, 7, 9, 16, 23 2.2 - p. 111; # 3, 6, 9, 26, 29, 32 2.3 - p. 117; # 2, 6, 9, 11, 13, 14, 41
5	**Test #1** **Determinants** • Introductions to Determinants	**Chapter 3** 3.1 - p. 169; # 3, 8, 9, 12, 22, 24, 25
6	**Determinants** • Properties of Determinants • Cramer's Rule	**Chapter 3** 3.2 - p. 177; # 1, 4, 6, 9, 21, 22, 25 3.3 - p. 186; # 2, 5, 8, 11, 16
7	**Vector Spaces** • Vector Spaces and Subspaces • Null Spaces, Columns Spaces & Linear Transformations	**Chapter 4** 4.1- p. 197; # 8, 24, 30, 38 4.2 - p. 207; # 2, 4, 14, 20, 24
8	**Quiz #2** **Vector Spaces** • Linear Independent Sets, Bases	**Chapter 4** 4.3- p. 215; # 4, 5, 10, 14, 15, 21
9	**Vector Spaces** • The Dimension of a Vector space • Rank	**Chapter 4** 4.5 - p. 231; # 2, 4, 6, 9, 13, 15, 18 4.6 - p. 239; # 1, 2, 5, 9, 13, 17, 18
10	**Test Review** **Test #2**	
11	**Eigenvalues and Eigenvectors** • Eigenvalues and Eigenvectors • The Characteristic Equation	**Chapter 5** 5.1 - p. 273; # 3, 7, 9, 13, 15, 17, 20 5.2 - p. 281; # 4, 7, 9, 13, 15, 21
12	**Eigenvalues and Eigenvectors** • Diagonalization • Complex Eigenvalues	**Chapter 5** 5.3 – p. 288; # 2, 4, 6, 7, 8, 12, 17 5.5: 4, 5, 13, 14
13	**Quiz # 3** **Orthogonality and Least Squares** • Inner Product, Length, and Orthogonality • Orthogonal Sets	**Chapter 6** 6.1- p. 338; # 1, 8, 10, 12, 14, 15 6.2 - p. 346; # 1, 4, 8, 12, 16, 17
14	**Orthogonality and Least Squares** • Orthogonal Projections • The Gram-Schmidt Procedure	**Chapter 6** 6.3 - p. 354; # 2, 4, 6, 8, 10, 12, 14 6.4 - p. 360; # 1, 4, 8, 9, 12
15	**Final Exam**	

E. BIBLIOGRAPHY:

1. Background readings for materials for faculty teaching the course

Linear Algebra with Applications, 9th Edition
Steven J. Leon, University of Massachusetts, Dartmouth

©2016| Pearson
ISBN-13: 978-0321962218

Elementary Linear Algebra with Applications (Classic Version), 9th Edition
Bernard Kolman, David Hill
©2018| Pearson
ISBN-13: 978-0132296540

Elementary Linear Algebra, 8th Edition
Ron Larson
©2015| Cengage
ISBN-10: 1305658000 | ISBN-13: 9781305658004

Elementary Linear Algebra (Classic Version), 2nd Edition
Lawrence E Spence, Arnold J Insel, Stephen H Friedberg
©2016| Pearson
ISBN-13: 978-0134689470

Mathematica Manual (Download only) for Linear Algebra and Its Applications, Linear Algebra and Its Applications, 5th Edition
David C. Lay, Steven R. Lay and Judi L McDonald Hill
©2016| Pearson
ISBN-13: 9780321989758

MATLAB Manual for Linear Algebra and Its Applications, 5th Edition
David C. Lay, Steven R. Lay and Judi L McDonald Hill
©2016| Pearson
ISBN-13: 9780321989857

PowerPoint Slides for Linear Algebra and Its Applications, 5th Edition
David C. Lay, Steven R. Lay and Judi L McDonald Hill
©2016| Pearson
ISBN-13: 9780321982643

TI-83+/89 Manual for Linear Algebra and Its Applications, 5th Edition
David C. Lay, Steven R. Lay and Judi L McDonald Hill
©2016| Pearson
ISBN-13: 9780321989840

2. Textbook:

Linear Algebra and Its Applications (5th Edition)
David C. Lay, Steven R. Lay and Judi L McDonald Hill.
Pearson Publishing 2016
ISBN # 978-032198238.

3. Supplementary Readings for Students

Lay:Stud Stud Guid Line Alge SSP_5, 5th Edition
David C. Lay, Steven R. Lay and Judi L McDonald Hill
©2016| Pearson
ISBN-13: 9780321982575

Digital Lessons Provided by The Instructor on Canvas
Clear and concise PowerPoint slides to enhance the student's understanding of the

topics covered in this course. The student can print them out for reference or view them on his/her computer.

Graphing Calculator Guide: Easy Steps to Success
http://www.kirkwood.edu/pdf/uploaded/119/graphing_calculator.pdf
Easy Steps to Success gives step-by-step keystrokes and instructions for the TI-series calculators, along with examples using these keystrokes and instructions to solve problems.

4. Audiovisual Materials and Computer Software

Wolfram Mathematica Software. It is available for students and faculty at the STEM building PC Labs.

F. LIBRARY COMPONENT:

N/A

G. WRITING COMPONENT:

N/A

H. TECHNOLOGY COMPONENT:

Students will be required to purchase an online MyMathLab access code to do the online homework and have a graphic calculator (preferably the TI-83 or TI-84).

The students will be required to use the software package Wolfram Mathematica to do some of the homework assignments. Wolfram Mathematica is available for students' use at the STEM building PC Labs. These assignments must be done independently according to the instructions included in the assignments and in accordance with the HCCC Honor Code.

I. EVALUATION CRITERIA AND METHODS:

Students grades will be based on: three quizzes, two tests, online homework, attendance & class participation and a comprehensive final exam.

Three Quizzes (5 % each)---------- 15%
Two Tests (25 % each) ---------- 50%
Final Exam ---------- 25%
Online MyMathLab Homework ---------- 10%

Last updated: _____2005_____

Date of course creation: _____

ACADEMIC INTEGRITY

Academic integrity is central to the pursuit of education. For students at HCCC, this means maintaining the highest ethical standards in completing their academic work. In doing so, students *earn* college credits by their honest efforts. When they are awarded a certificate or degree, they have attained a goal representing genuine achievement and can reflect with pride on their accomplishment. This is what gives college education its essential value.

Violations of the principle of academic integrity include:

- Cheating on exams.
- Reporting false research data or experimental results.
- Allowing other students to copy one's work to submit to instructors.
- Communicating the contents of an exam to other students who will be taking the same test.
- Submitting the same project in more than one course, without discussing this first with instructors.
- Submitting *plagiarized* work. *Plagiarism* is the use of another writer's words or ideas without properly crediting that person. This unacknowledged use may be from published books or articles, the Internet, or another student's work.

When students act dishonestly in meeting their course requirements, they lower the value of education for all students. Students who violate the college's policy on academic integrity are subject to failing grades on exams or projects, or for the entire course. In some cases, serious or repeated instances of academic integrity violations may warrant further disciplinary action.

Disability Support Services

Students with disabilities who believe that they might need accommodations in this class are encouraged to contact the Disability Support Services at 201-360-4157 as soon as possible to better ensure that such assistance can be implemented in a timely fashion. All disabilities must be documented by a qualified professional such as a physician, licensed learning disability teacher (LDTC), psychologist, psychiatric nurse, licensed social worker or licensed professional counselor, who is qualified to assess the disability that the student claims to have and note recommendations on accommodations for the student. All information provided to the Disability Support Services Program will be confidential between the program, professors involved with the student, and the individual student.