

**NEW RIVER COMMUNITY COLLEGE  
DUBLIN, VIRGINIA**

**COURSE PLAN**

Course Number and Title:     MTH 266 Linear Algebra    

Prepared by:     Mathematics Department         Fall 2022      
(Date)

Approved by:     *S. Tolbert-Hungz*         Fall 2022      
(Dean) (Date)

**I. Course Description**

Covers matrices, vector spaces, determinants, solutions of systems of linear equations, basis and dimension, eigenvalues, and eigenvectors. Features instruction for mathematical, physical and engineering science programs. Lecture 3 hours per week. 3 credits.

Prerequisite: Completion of MTH 263: Calculus I or equivalent with a grade of B or better or MTH 264: Calculus II or equivalent with a grade of C or better.

**II. Introduction**

The course satisfies a mathematics requirement for mathematical, computer, physical, and engineering science programs. The course is designed to develop skills and understanding of the basic operations and concepts of linear algebra.

**III. Student Learning Outcomes**

Upon successful completion of this course, the student will be able to:

- A. Matrices and Systems of Equations
  - a. Use correct matrix terminology to describes various types and features of matrices (triangular, symmetric, row echelon form, et.al.)
  - b. Use Gauss-Jordan elimination to transform a matrix into reduced row echelon form
  - c. Determine conditions such that a given system of equations will have no solution, exactly one solution, or infinitely many solutions
  - d. Write the solution set for a system of linear equations by interpreting the reduced row echelon form of the augmented matrix, including expressing infinitely many solutions in terms of free parameters
  - e. Write and solve a system of equations modeling real world situations such as electric circuits or traffic flow
- B. Matrix Operations and Matrix Inverses
  - a. Perform the operations of matrix-matrix addition, scalar-matrix multiplication, and matrix-matrix multiplication on real and complex valued matrices

- b. State and prove the algebraic properties of matrix operations
  - c. Find the transpose of a real valued matrix and the conjugate transpose of a complex valued matrix
  - d. Identify if a matrix is symmetric (real valued)
  - e. Find the inverse of a matrix, if it exists, and know conditions for invertibility.
  - f. Use inverses to solve a linear system of equations
- C. Determinants
- a. Compute the determinant of a square matrix using cofactor expansion
  - b. State, prove, and apply determinant properties, including determinant of a product, inverse, transpose, and diagonal matrix
  - c. Use the determinant to determine whether a matrix is singular or nonsingular
  - d. Use the determinant of a coefficient matrix to determine whether a system of equations has a unique solution
- D. Norm, Inner Product, and Vector Spaces
- a. Perform operations (addition, scalar multiplication, dot product) on vectors in  $\mathbb{R}^n$  and interpret in terms of the underlying geometry
  - b. Determine whether a given set with defined operations is a vector space
- E. Basis, Dimension, and Subspaces
- a. Determine whether a vector is a linear combination of a given set; express a vector as a linear combination of a given set of vectors
  - b. Determine whether a set of vectors is linearly dependent or independent
  - c. Determine bases for and dimension of vector spaces/subspaces and give the dimension of the space
  - d. Prove or disprove that a given subset is a subspace of  $\mathbb{R}^n$
  - e. Reduce a spanning set of vectors to a basis
  - f. Extend a linearly independent set of vectors to a basis
  - g. Find a basis for the column space or row space and the rank of a matrix
  - h. Make determinations concerning independence, spanning, basis, dimension, orthogonality and orthonormality with regards to vector spaces
- F. Linear Transformations
- a. Use matrix transformations to perform rotations, reflections, and dilations in  $\mathbb{R}^n$
  - b. Verify whether a transformation is linear
  - c. Perform operations on linear transformations including sum, difference and composition
  - d. Identify whether a linear transformation is one-to-one and/or onto and whether it has an inverse
  - e. Find the matrix corresponding to a given linear transformation  $T: \mathbb{R}^n \rightarrow \mathbb{R}^m$
  - f. Find the kernel and range of a linear transformation
  - g. State and apply the rank-nullity theorem
  - h. Compute the change of basis matrix needed to express a given vector as the coordinate vector with respect to a given basis
- G. Eigenvalues and Eigenvectors
- a. Calculate the eigenvalues of a square matrix, including complex eigenvalues.
  - b. Calculate the eigenvectors that correspond to a given eigenvalue, including complex eigenvalues and eigenvectors.
  - c. Compute singular values
  - d. Determine if a matrix is diagonalizable
  - e. Diagonalize a matrix

#### **IV. General Education Student Learning Outcomes Included in Course**

General education at NRCC provides the educational foundation necessary to promote intellectual and personal development. Upon completing the associate degree, graduates will demonstrate competency in student learning outcomes in 1) civic engagement, 2) critical thinking, 3) professional readiness, 4) quantitative literacy, 5) scientific literacy, and 6) written communication.

This course includes the following general education student learning outcomes:

- Explain numerical information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
- Convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).
- Accurately solve mathematical problems.
- Make judgements and draw relevant conclusions from quantitative analysis of data and predict future trends when appropriate.

#### **V. Instructional Methods**

The instructional procedures will include lectures, discussions, in class work, homework, reviews and tests.

#### **VI. Instructional Materials**

Textbook: Linear Algebra and its applications (4<sup>th</sup> ed), David Lay, Addison Wesley 2012

Calculator: See instructor.

Other: Pencils and paper

#### **VII. Course Content**

- Matrices: including operations, Gauss-Jordan elimination, reduced row-echelon form, inverses, solutions to linear systems and determinants
- Vectors and Vector Spaces
- Basis and dimension
- Eigenvalues and Eigenvectors, including complex
- Linear Transformations

#### **VIII. Evaluation**

The grade for the course will be calculated from Tests, online homework, a final exam and other work as deemed appropriate by the instructor. See individual syllabus for details on percentages/points.

#### **IX. Attendance**

Regular attendance at classes is required. When absence from a class becomes necessary, it is the responsibility of the student to inform the instructor prior to the absence whenever possible. The student is responsible for the subsequent completion of all study missed during an absence. Any instruction missed and not subsequently completed will necessarily affect the grade of the student regardless of the reason for the absence.

## **X. Cheating Policy**

The giving or receiving of any help from another student or unauthorized individual on any graded portion of the course is considered cheating and will not be tolerated. The use of books, notes, electronic devices or any other unauthorized material during tests is considered cheating, and will not be tolerated. Any student found cheating will receive a grade of “0” on that assignment and may receive an “F” for the course. This “0” cannot be replaced by any other score. Mobile phones are not permitted to be used as calculators.

## **XI. Withdrawal Policy**

### **Student Initiated Withdrawal Policy**

A student may drop or withdraw from a class without academic penalty during the first 60 percent of a session. For purposes of enrollment reporting, the following procedures apply:

- a. If a student withdraws from a class prior to the termination of the add/drop period for the session, the student will be removed from the class roll and no grade will be awarded.
- b. After the add/drop period, but prior to completion of 60 percent of a session, a student who withdraws from a class will be assigned a grade of “W.” A grade of “W” implies that the student was making satisfactory progress in the class at the time of withdrawal, that the withdrawal was officially made before the deadline published in the college calendar, or that the student was administratively transferred to a different program.
- c. After that time, if a student withdraws from a class, a grade of “F” or “U” will be assigned. Exceptions to this policy may be made under documented mitigating circumstances if the student was passing the course at the last date of attendance.

A retroactive grade of “W” may be awarded only if the student would have been eligible under the previously stated policy to receive a “W” on the last date of class attendance. The last date of attendance for a distance education course will be the last date that work was submitted.

Late withdrawal appeals will be reviewed and a decision made by the Coordinator of Admissions and Records.

### **No-Show Policy**

A student must either attend face-to-face courses or demonstrate participation in online courses by the last date to drop for a refund. A student who does not meet this deadline will be reported to the Admissions and Records Office and will be withdrawn as a no-show student. No refund will be applicable, and the student will not be allowed to

attend/participate in the class or submit assignments. Failure to attend or participate in a course will adversely impact a student's financial aid award.

### **Instructor Initiated Withdrawal**

A student who adds a class or registers after the first day of class is counted absent from all class meetings missed. Each instructor is responsible for keeping a record of student attendance (face-to-face classes) or performance/participation (online classes) in each class throughout the semester.

When a student's absences equal twice the number of weekly meetings of a class (equivalent amount of time for summer session), the student may be dropped for unsatisfactory attendance in the class by the instructor.

Since attendance is not a valid measurement for online courses, a student may be withdrawn due to non-performance. A student should refer to his/her online course plan for the instructor's policy.

When an instructor withdraws a student for unsatisfactory attendance (face-to-face class) or non-performance (online class), the last date of attendance/participation will be documented. Withdrawal must be completed within five days of a student's meeting the withdrawal criteria. A grade of "W" will be recorded during the first sixty percent (60%) period of a course. A student withdrawn after the sixty percent (60%) period will receive a grade of "F" or "U" except under documented mitigating circumstances when a letter of appeal has been submitted by the student. A copy of this documentation must be placed in the student's academic file.

The student will be notified of the withdrawal by the Admissions and Records Office. An appeal of reinstatement into the class may be approved only by the instructor.

## **XII. Disability and Non-Discrimination Statements**

If you are a student with a documented disability who will require accommodation in this course, please register with the Disability Services Office located in the Advising Center for assistance in developing a plan to address your academic needs.

This College promotes and maintains educational opportunities without regard to race, color, national origin, religion, disability, sex, sexual orientation, gender identity, ethnicity, marital status, pregnancy, childbirth or related medical conditions including lactation, age (except when age is a bona fide occupational qualification), veteran status, or other non-merit factors.

## **XIII. Evacuation Procedure**

Evacuation Procedure: Please note the evacuation route posted at the classroom doorway. Two routes are marked in case one route might be blocked.