

# Department Master Syllabus

**Camden County College**

**Blackwood, New Jersey**

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| **Course Number:**  MTH-261 | | **Course Title:**  Introduction to Mathematical Modeling | | | |
| **Department/Program:** Mathematics | | | | | |
| **Date of Review:** | |  | | | |
| (This Department Master Syllabus has been examined by the program/department faculty members and it is decided that no revision is necessary at this time.) | | | | | |
| **Date of Revision:** February | | | | 2024 | |
| (This Department Master Syllabus has been examined by the program/department faculty members and it is decided a change requiring a revision is necessary at this time.) | | | | | |
| N.B. A change to the course materials alone (textbooks and/or supplementary materials) may not constitute a revision. Any other change to the items listed below on this form is considered a revision and requires approval by the department/program faculty at a department/program meeting and by the division at a Chairs and Coordinator meeting. | | | | | |
| **Credits:**3 | | | | | |
| **Contact Hours** | **Lecture:** 3 | | **Lab:** 0 | | **Other:** 0 |
| Prerequisites: MTH-150 (Calculus II) | | | | | |
| Co-requisites: None | | | | | |
| Course Description: This course introduces relevant concepts from Calculus III and Linear Algebra for linear modeling and optimization, providing mathematical foundations as they are needed and motivated by applications. The focus is neither on proof nor excessive hand computations; instead, it is on employing and relating mathematics to real-world ideas. Concepts are made concrete through numerical computation. Topics covered include vectors, dot product, distance, projection, matrix algebra, techniques of solving linear algebra systems, the derivative of multivariate functions and its applications, optimization and gradient method of steepest descent, and matrix factorization. | | | | | |
| **Student Learning Outcomes (SLOs)**  Course specific student learning outcomes  Upon completion of this course the student will be able to:   * Model real-word phenomena with functions (e.g. linear, polynomial, exponential, etc.) as assessed by homework, tests, quizzes, and projects. * Evaluate optimization functions and interpret the results as assessed by homework, tests, quizzes, and projects. * Carry out matrix algebra and analyze higher dimensional models as assessed by homework, tests, quizzes, and projects. * Generate models for varied applications, using a diversity of tools as assessed by homework, tests, quizzes, and projects. * Analyze the sensitivity of models to small changes in the inputs as assessed by homework, tests, quizzes, and projects.   As assessed by:  Homework, tests, quizzes, and projects | | | | | |
| **General Education Student Learning Outcomes**  If this course has applied for General Education Elective Status the general education student learning outcomes listed below must exactly match those the sponsor has identified on the General Education Request form.  General Education SLOs:  N/A  As assessed by:  N/A | | | | | |
| **Program Learning Outcomes**  List all course level student learning outcomes that interconnect to a particular program learning outcome.   1. All CSLOs are connected to DSC.AAS PSLO 2 (Develop solid analytical reasoning, critical thinking and technical skills in order to extract, mangle, analyze and present data for multiple disciplines to broad audiences that follow professional standards to enhance understanding and decision-making.)   Describe the assessment of the interconnected program learning outcome(s).  Various course level assessment instruments will be used to target specific program learning outcomes. | | | | | |
| **Course Outline:**  **Unit I Introduction to Modeling**   1. What is Modeling and What Are Its Objectives? 2. Stages of Modeling, Building, Studying, Testing, and Use 3. Conceptual Model Diagrams 4. Classification of Models:    1. Deterministic vs. Stochastic    2. Empirical vs. Mechanistic    3. Static vs. Dynamic    4. Continuous vs. Discrete    5. Individual vs. Structured 5. Limitations of Mathematical Models   **Unit II. Derivatives**   1. Plane Equations and Multivariate Functions 2. Partial Derivatives 3. Multivariate Chain Rule 4. Linear Approximation   **Unit III. Linear Algebra**   1. Intro to Vectors 2. Systems of Equations and row reduction 3. Vector Equations 4. The Matrix Equation 5. Homogeneous Systems 6. Applications   **Unit IV. Solving Linear Systems of Equations**   1. Matrix Algebra and Inverses 2. Geometric Approach to the Determinant as a Measure of Area and Volume 3. Dot Product and Projections 4. Directional Derivatives and Gradient 5. Extreme Values and Saddle Points 6. Optimization and Gradient Method of Steepest Descent   **Unit V. Matrix Factorizations**   1. LU and QR Factorizations 2. Linear Transformations 3. Eigenvalues, Eigenvectors, and Diagonalization 4. Orthogonality and Least Squares Regression | | | | | |
| **Course Activities:**    The classroom activities will include formal and informal lectures where new material and assigned problems will be explained. Students will be encouraged to participate in discussion during the presentation and at times present problems on the whiteboard. Time will be set aside to answer specific questions concerning homework problems and other previous material. Software and/or calculators (TI 83, 84, 89) exercises will be given and methods of analysis will be discussed. | | | | | |
| **Course Materials:**  Textbook(s): OER  Supplemental Materials: OER  Software Licenses: Free software tools  Computers: Students will need access to computers for homework and projects. | | | | | |
| **Course Assessment Plan**  How often and by what means will the effectiveness of this course as part of the curriculum be assessed?    Assessment cycle to be determined by the members of the Mathematics department. Students will be evaluated on the degree to which student learning outcomes are achieved. Assessment instruments may be in the form of tests and/or projects. | | | | | |