ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 01.235 - Mathematics for Engineering Analysis

CATALOG DESCRIPTION:

Math 01.235 Mathematics for Engineering Analysis, 4 s.h.
Prerequisite: A grade C- or better in MATH 01.230 (Calculus III)

This course is intended to provide for engineering students a comprehensive introduction to Linear Algebra and Ordinary Differential Equations. Topics in Linear Algebra include: matrices, systems of linear equations, nonsingular matrices, determinants, vector spaces, eigenvalues, eigenvectors, symmetric matrices and orthogonality. The ODE part consists of materials: separable equations, exact equations, linear differential equations of first, second and higher orders, systems of linear differential equations, numerical methods, and applications.

OBJECTIVES:

This course is designed to help engineering majors acquire a mathematical background necessary for the studies in their areas. Emphasis is on the applied aspects of the topics, in particular the techniques and applications useful for engineers.

CONTENTS:

1. **Linear Algebra**
   - Matrices: Basic Concepts and Notations
   - Matrix Algebra: Matrix Addition, Scalar Multiplication, Matrix Multiplication and Transpose
   - Systems of Linear Equations, Gauss Elimination, (Reduced) Row Echelon Forms, Structures of Solutions
   - Nonsingular Matrices, Inverses of Nonsingular Matrices, Determinants, Cramer's Rule
   - Vector Spaces, Subspaces, Linear Combinations, Linear Spans, Linear Independence, Basis
   - Bases of Subspaces Associated with a Matrix, Rank and Nullity of a Matrix, Dimension Theorem
   - Eigenvalues and Eigenvectors, Properties of Eigenvectors, Eigenspaces, Diagonalization, Applications of Eigenvalues
   - Symmetric Matrices, Gram-Schmidt Process, Diagonalization by Orthogonal Matrices, Positive Definite Matrices, and Complex Generalizations
   - Numerical Methods: LU-Factorization, Doolittle’s Method, Cholesky’s Method

2. **First-Order Differential Equations**
   - Separable Differential Equations
   - Modeling: Newton's Law of Cooling and Heating
   - Exact Differential Equations
   - Integrating Factors
   - Linear Differential Equations
   - Modeling: Electric Circuits
   - Power Series Method
   - Numerical Methods for First Order Differential Equations

3. **Second and Higher-Order Linear Differential Equations**
    - Basic Theory on Solutions to Linear Differential Equations, Principle of Superposition
    - Homogeneous Equations with Constant Coefficients
    - Complex Exponential Function, Homogeneous Equations with Complex Characteristic Roots.
    - Modeling: Free Oscillations (Mass-Spring Systems)
    - Euler-Cauchy Equation
    - Nonhomogeneous Equations: Solution by Undetermined Coefficients
    - Nonhomogeneous Equations: Solution by Variation of Parameters
    - Modeling: Forced Oscillations, Resonance, Electric Circuits

4. **Systems of Differential Equations**
    - Introductory Examples in Electric Circuits and Mass-Spring Systems
    - Basic Concepts and Theory
    - Homogeneous Linear Systems with Constant Coefficients
    - Critical Points and Stability
    - Qualitative Methods for Nonlinear Systems
    - Nonhomogeneous Linear Systems

POSSIBLE TEXTBOOK(S):

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition*, 2011, John Wiley
- C. Henry Edward & David Penney, Differential Equations & Linear Algebra, 3rd ed., Pearson
- Seymour Lipschutz & Marc Lipson, Schaum's Outlines of Linear Algebra, 6th ed., McGraw Hill
- Richard Bronson & Gabriel Costa, Schaum's Outlines of Differential Equations, 4th ed., McGraw Hill
- Dennis Zill & Warren Wright, Advanced Engineering Mathematics, 4th ed., John & Barllet