ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 01235 Mathematics for Engineering Analysis

CATALOG DESCRIPTION:

MATH 01235: Mathematics for Engineering Analysis 4 S.H.
Prerequisite: A grade C- or better in MATH 01230 Calculus III

This course provides 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 separable equations, exact equations, linear differential equations of first, second and higher orders, systems of linear differential equations, numerical methods, and applications.

CONTENTS:

1. **Linear Algebra**

- Basic Concepts and Notations of Matrices
- 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: Separable Equations
- 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 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