CALIFORNIA STATE UNIVERSITY, SACRAMENTO
Department of Mathematics and Statistics
SYLLABUS

Math 105A: Advanced Mathematics for Science and Engineering I
Prerequisite: Math 32 and Math 45
Survey of matrices, linear algebra, vector differential and integral calculus.

Math 105B: Advanced Mathematics for Science and Engineering II
Prerequisite: Math 105A
Fourier series and transforms, partial differential equations, functions of a complex variable.

OUTLINE: Math 105A

I. Matrices (2-3 weeks)
1. Complex Numbers and Complex Plane
2. Systems of Linear Equations and Gaussian Elimination
3. Matrix Operations (Addition, Subtraction, Multiplication)
4. Inverse of a Matrix
5. Determinants

II. Linear Algebra (5-6 weeks)
1. Vector Spaces
2. Linear Independence, Basis, Dimension
3. Linear Transformations
4. Eigenvalues and Eigenvectors
5. Inner Product Spaces; Orthogonality
6. Symmetric, Skew-Symmetric, Orthogonal, Hermitian, and Unitary Matrices
7. Diagonalizing a Quadratic Form; Rayleigh's Principle
8. Systems of Ordinary Differential Equations
9. The Phase Plane; Stability

III. Vector Calculus (5-6 weeks)
1. Review of Parts of Math 32
    i. Dot and Cross Product
    ii. Curves; Tangents, Arc Length; Velocity; Acceleration
    iii. Double and Triple Integrals
    iv. Vector and Scalar Fields
    v. Gradient and Directional Derivative of a Scalar Field
    vi. Divergence and Curl of a Vector Field
2. Line Integrals
3. Conservative Vector Fields
4. Green's Theorem
5. Surface Integrals; Divergence Theorem; Stokes' Theorem

OUTLINE: Math 105B

I. Fourier Series and Transforms (4-5 weeks)

1. Periodic Functions, Trigonometric Series
2. Fourier Series
3. Functions of Arbitrary Period
4. Even and Odd Functions; Half Range Expansions
5. Complex Fourier Series
6. Forced Oscillations
7. Fourier Transform

II. Partial Differential Equations (8-9 weeks)

1. Vibrating String; 1D Wave Equation
2. Solution of the 1D Wave Equation by Separation of Variables
3. D'Alembert Solution of the Wave Equation
4. 1D Heat Equation; Solution by separation of variable and Fourier Transform
5. 2D Heat, Wave, and Laplace's Equation on rectangular domains
6. 2D Heat, Wave, and Laplace's Equation on disks
7. Laplacian in cylindrical and spherical coordinates, and applications

III. Complex Functions (as time allows)

1. Derivative of Complex Functions; Analytic Functions
2. Cauchy-Riemann Equations
3. Complex Integration, Residue Theorem, and applications

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