Syllabus for MATH 322

Complex numbers and functions — 3 ½ weeks

- 13.1 Complex numbers. Complex plane
- 13.2 Polar form of complex numbers. Powers and roots
- 13.3 Derivative. Analytic function
- 13.4 Cauchy-Riemann equations. Laplace's equation
- 13.5 Exponential function
- 13.6 Trigonometric and hyperbolic functions
- 13.7 Logarithm. General power

Review of Linear Algebra — 3 ½ weeks

- 7.1 Matrices, vectors: Addition and scalar multiplication
- 7.2 Matrix multiplication
- 7.4 Linear independence. Rank of a matrix, vector space

[Midterm 1]

- 7.5 Solutions of linear systems: Existence, uniqueness
- 7.8 Inverse of a matrix
- 8.1 Eigenvalues and eigenvectors

Review of ordinary differential equations — 1 week

- 1.1 Basic concepts
- 1.7 Existence and uniqueness of solutions
- 2.2 Homogeneous linear ODEs with constant coefficients
- 2.6 Existence and uniqueness of solutions. Wronskian
- 2.7 Nonhomogeneous ODEs
- 4.2 Basic theory of systems of ODEs
- 4.3 Constant coefficient systems

Expansions — 1 ½ weeks

- 5.1 Power series method
- 5.2 Theory of the power series method
- 5.7 Sturm-Liouville problems. Orthogonal functions.
- 5.8 Orthogonal eigenfunction expansions.

[Midterm 2]

Fourier series, integrals and transforms — 1 ½ weeks

- 11.1 Fourier series
- 11.2 Functions of any period $p = 2L$
- 11.3 Even and odd functions. Half-range expansions
- 11.4 Complex Fourier series
- 11.5 Forced oscillations
- 11.9 Fourier transforms
- 11.8 Fourier sine and cosine transforms
- Discuss convolution

Partial differential equations — 2 weeks

- 12.1 Basic concepts
- 12.3 Separation of variables
- 12.4 D'Alembert's solution of the wave equation
- 12.8 Rectangular membranes. Double Fourier series
- 12.9 Circular membrane
- 12.5 Heat equation: solution by Fourier series
- 12.6: Heat equation: solution by Fourier integrals and transforms

Laplace Transforms — 1 week

- 6.1 Laplace transforms. Inverse transform. Linearity. s-shifting
- 6.2 Transforms of derivatives and integrals. ODEs
- 6.3 Unit step function. t-shifting
- 6.4 Dirac's delta function. Partial fractions
- 6.6 Differentiation and integration of transforms
- 6.7 Systems of ODEs