

Math 241, Fall 2004
Outline for Midterm #1

1. Fourier Series

- (a) Terminology: periodic with period p , inner product, norm, orthogonal functions, orthogonal set.
- (b) Orthogonality, period and norm facts about $\sin \frac{n\pi}{L}x$ and $\cos \frac{n\pi}{L}x$.
- (c) Definition of the Fourier series of a function. Be able to compute the Fourier series of a function.
- (d) Convergence theorem concerning Fourier series. In particular what the Fourier series converges to (when it converges).
- (e) Solving inhomogeneous ordinary differential equations using Fourier series.
- (f) Odd and even functions. Facts about integrating odd and even functions.
- (g) Periodic extensions of a function. Odd and even periodic extensions of a function.
- (h) Half-range expansions of a function. Sine and Cosine series.

2. Generalized Fourier series and Sturm-Liouville problems.

- (a) Sturm-Liouville Problems
 - i. What is a Sturm-Liouville Problem
 - ii. Eigenvalues and Eigenfunctions of Sturm-Liouville Problems
 - iii. Solving Sturm-Liouville Problems
 - iv. Theorem concerning the eigenvalues and eigenfunctions of a Sturm-Liouville problem
 - v. Self-adjoint form of a second order ordinary differential equation
- (b) Generalized Fourier Series
 - i. Theorem concerning generalized Fourier series and Sturm-Liouville problems.
- (c) Legendre Series
 - i. Legendre polynomial
 - ii. Orthogonality relations and norm for Legendre polynomial
 - iii. Legendre Series

3. Series Solutions to Linear Ordinary Differential Equations

- (a) Ordinary and singular points of second order ordinary differential equations
- (b) Theorem on the convergence of power series solutions to ODE's at ordinary points
- (c) Recurrence relations
- (d) Be able to find power series solutions to ODE's at ordinary points.