METHODS

Self-adjoint ODEs (Slowly)

Periodic functions. Fourier series: definition and simple propteries; Parseval's theorem. Equations of second order. Self-adjoint differential operators. The Sturm-Liouville equation; eigenfunctions and eigenvalues; reality of eigenvalues and orthogonality of eigenfunctions; eigenfunctions expansion (Fourier series as prototype), approximation in mean square, statement of completeness.

PDEs on bounded domains: Separation of variables

Physical basis of Laplace's equation, the wave equation and the diffusion equation. General method of seperation of variables in Cartesian, cylinderical and spherical coordinates. Legendre's equation: derivation, solutions including explicit forms of P_0, P_1 and P_2, orthogonality. Bessel's equations of integer order as an example of a self-adjoint eigenvalue problem with non-trivial weight.

Examples including potentials on rectangular and circular domains on a spherical domain(~~asy~~ axisymmetric case only), waves on a finite string and heat flow down a semi-infinite rod.

Inhomogeneous ODEs: Green functions

Propteries of the Dirac delta function. Initial value problems and forced problems with two fixed end points; Solution using Green's functions. Eigenfunction expansions of the delta function and Green's function.

Fourier transforms

Fourier transforms: definition and simple propteries; inversion and convolution theorems. The discrete fourier transform. Examples of application ~~of~~ to linear systems. Relationship of transfer function to Green function for initial value problems.

PDEs on unbounded domains

Classification of PDE's in two independent variables. Well posedness.(not a very poised position huh!). Solution by the method of characterstics. Green's functions for PDEs in 1, 2 and 3 independent variables; fundemental solutions of the wave equation, Laplace's equation and the diffusion equation. The method of images. Application of the forced wave equation, Poission's equation and forced diffusion equation. Transient Solutions of diffusion problems; the error function (erf(x)).

Appropiate Books

G. B Arfken, H-J Weber & F. E Harris Mathematical Methods for Physicists. Elsevier 2013

M. L Boas Mathematical methods in the physical Sciences Weily 2005

J Mathews and R L Walker Mathematical Methods ~~and~~ of physicts. Benjamin/Cummings 1970

K. F Riley, M. P Hobson and S. J Bence Mathematical methods for Physics and engineering: a comprehensive guide. CUP 2002

Erwin Kreyszig Advanced Engineering Mathematics Wiley