Trig functions and sinh/cosh (Laplacean in rectangular coordinates)

Before tackling Bessel, Legendre... Review how $\sin x, \cos x, \sinh x, \cosh x$ arise in considering $D^2$ in rectangular coordinates.

We did a number of problems:

1. $d=1$ Diffusion Eqn, separated variables

$$D \frac{d^2 \psi}{dx^2} = \frac{d \psi}{dt} = e^{ikx - Dk^2 t}$$

$$\sin kx$$
$$\cos kx$$

2. $d=1$ Wave Eqn

$$\frac{d^2 \psi}{dx^2} = \frac{1}{v^2} \frac{d \psi}{dt} = f(x \pm vt)$$

But $\sin (kx \pm wt)$
$\cos (kx \pm wt)$

When considering $k \to \infty$
(3) $d = 2$ Diffusion Eqn. (Square cross section)

$$D \left( \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \lambda \right) \psi = \frac{\partial \psi}{\partial t} \quad \psi = 0 \text{ on } b \times a$$

$$\psi \sim \cos k x \cos k y \exp(-\alpha t) \quad \alpha = -\lambda + D(k_x^2 + k_y^2)$$

(4) $d = 2$ Laplace Eqn., (Rectangular cross-section)

$$\left( \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right) \psi = 0$$

$$\psi \sim \sin k x \sinh k y$$

Much familiar about

- $\sin x / \cos x$
- $\sinh x / \cosh x$

1) General functional form
2) Series expansions

Less familiar, perhaps

1) Orthogonality
2) Completeness

\{ Fourier series, etc. \}

\{ Goal: \}

We want to develop some concepts and familiarize ourselves with Bessel, Legendre, etc.