ph260 Theoretical Physics 2 — toolbox

This table lists the tools covered in the lecture in order of first appearance. You should be able now add the solution strategies and solutions.

separable ODE
$\frac{\mathrm{d}y}{\mathrm{d}x} = f(x)$

linear 1st order ODE
$\frac{\mathrm{d}y}{\mathrm{d}x} + p(x)y = q(x)$

Bernoulli
$\frac{\mathrm{d}y}{\mathrm{d}x} + p(x)y = q(x)y^n$

homogeneous 1st order ODE
$p(x,y)\mathrm{d}x + q(x,y)\mathrm{d}y = 0$

Laplace
$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$

hom. lin. ODE with const. coeff.
$a_n \frac{\partial^{(n)} y}{\partial x^n} + \cdots + a_1 \frac{\mathrm{d}y}{\mathrm{d}x} + a_0 y = 0$

het. lin. ODE with const. coeff.
$a_n \frac{\partial^{(n)} y}{\partial x^n} + \cdots + a_1 \frac{\mathrm{d}y}{\mathrm{d}x} + a_0 y = f(x)$

Fourier sine series
$f(x) = \sum_{n=1}^{\infty} b_n \sin\frac{n\pi x}{l}; \qquad b_n = \frac{2}{l}\int_0^l f(x)\sin\frac{n\pi x}{l}\mathrm{d}x$

useful trigonometric and hyperbolic identities in this context:
$\sin nx = \frac{\mathrm{e}^{jnx} - \mathrm{e}^{-jnx}}{2j}; \qquad \cos nx = \frac{\mathrm{e}^{jnx} + \mathrm{e}^{-jnx}}{2}; \qquad \sinh nx = \frac{\mathrm{e}^{nx} - \mathrm{e}^{-nx}}{2}; \qquad \cosh nx = \frac{\mathrm{e}^{nx} + \mathrm{e}^{-nx}}{2}$

diffusion eq.
$\frac{\partial^2 z}{\partial x^2} = a\frac{\partial z}{\partial t}$

wave eq.
$\frac{\partial^2 z}{\partial x^2} = a\frac{\partial^2 z}{\partial t^2}$

Fourier transform
$f(x) = \int_{-\infty}^{\infty} g(q)\mathrm{e}^{jqx}\mathrm{d}q; \qquad g(q) = \frac{1}{2\pi}\int_{-\infty}^{\infty} f(x)\mathrm{e}^{-jqx}\mathrm{d}x$