

Initial value problem ; ODE with initial conditions at initial of time $t = 0$

$$\frac{dy}{dx} - 2y = 0, y(0) = 2$$

$$\ddot{x} + 5\dot{x} + x(t) = 0, x(0) = x_0, \dot{x}(0) = \dot{x}_0$$

General form: Governing equation

$$a_0(x)y^{(n)} + a_1(x)y^{(n-1)} + \cdots + a_{n-1}(x)y'(x) + a_n(x)y = f(x)$$

Initial conditions

$$y(x_0) = k_0, y'(x_0) = k_1, \cdots, y^{(n-1)}(x_0) = k_{n-1}$$

Boundary value value problem : ODE with boundary conditions at boundary of space $x = 0, l$

string subjected to loading

$$\frac{d^2y}{dx^2} = 1, y(0) = 0, y(1) = 0$$

beam subjected to loading

$$\frac{d^4y}{dx^4} = 1, y(0) = 0, y''(0) = 0, y(1) = 0, y''(1) = 0$$

Sturm-Liouville problem : ODE with boundary conditions at boundary of space $x = a, b$

Governing equation

$$a_0(x)y''(x) + a_1(x)y'(x) + a_2(x)y(x) = f(x)$$

Boundary conditions

$$\alpha_1 y(a) - \alpha_2 y'(a) = 0$$

$$\beta_1 y(b) - \beta_2 y'(b) = 0$$

where $\alpha_1^2 + \alpha_2^2 \neq 0, \beta_1^2 + \beta_2^2 \neq 0$.

No. of conditions = No. of undetermined coefficient of complementary parts