

# **Boundary and Eigen-Value Problems**

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# Introduction

- Most of the theoretical discussions and applications presented in the proceeding chapters involve initial value problems (IVP).
- This class of problems is characterized by auxiliary conditions all specified at a single value of the independent variable

- If the auxiliary conditions are specified at more than one point on the interval of interest, the resulting problem is called a boundary value problem (BVP).
- The differential equation associated with boundary value problems are therefore at least second order, since first order equations have only one auxiliary condition

- In general, initial value problems are well behaved in that they almost always lead to unique solutions.
- Unfortunately, the same is not true of boundary value problems.

- Moreover, in initial value problems, we talk of a point in an interval and that point can be anywhere
- but in boundary value problems points are at the end of the interval.

# Boundary Value Problems

Let us consider the second order linear equation

$$a_2(x)y'' + a_1(x)y' + a_0(x)y = f(x) \quad (1)$$

that satisfies the conditions

$$\left. \begin{aligned} y(a) &= A \\ y(b) &= B \end{aligned} \right\} \quad (2)$$

Equation (1) together with condition (2) is called boundary value problem (BVP)