

## Problem 4

In each of Problems 1 through 4, transform the given equation into a system of first order equations.

$$u^{(4)} - u = 0$$

---

### Solution

Let  $u = x_1$ .

$$x_1^{(4)} - x_1 = 0$$

Let  $x_2 = x_1'$ .

$$x_2''' - x_1 = 0$$

Let  $x_3 = x_2'$ .

$$x_3'' - x_1 = 0$$

Finally, let  $x_4 = x_3'$ .

$$x_4' - x_1 = 0$$

By making these substitutions, the original fourth-order ODE has become a system of first-order ODEs.

$$\begin{cases} x_1' = x_2 \\ x_2' = x_3 \\ x_3' = x_4 \\ x_4' = x_1 \end{cases}$$