

```
!pip install control
```

```
Collecting control
  Downloading control-0.10.1-py3-none-any.whl.metadata (7.6 kB)
Requirement already satisfied: numpy>=1.23 in /usr/local/lib/python3.11/dist-packages (from control) (2.0.2)
Requirement already satisfied: scipy>=1.8 in /usr/local/lib/python3.11/dist-packages (from control) (1.15.3)
Requirement already satisfied: matplotlib>=3.6 in /usr/local/lib/python3.11/dist-packages (from control) (3.10.0)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (1.1.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (4.53.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (1.4.7)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (24.1)
Requirement already satisfied: pillow>=8 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (11.0.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (3.1.4)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.6->control) (2.9.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.7->matplotlib) (1.17.0)
Downloading control-0.10.1-py3-none-any.whl (549 kB)
549.6/549.6 kB 15.1 MB/s eta 0:00:00

Installing collected packages: control
Successfully installed control-0.10.1
```

```
import numpy as np
import matplotlib.pyplot as plt
from control import TransferFunction, step_response
from ipywidgets import interact, FloatSlider
```

```
def plot_step_response(zeta=0.7, omega_n=2.0, K=10):
    a = 2 * zeta * omega_n
    b = omega_n**2

    num = [K]
    den = [1, a, b]

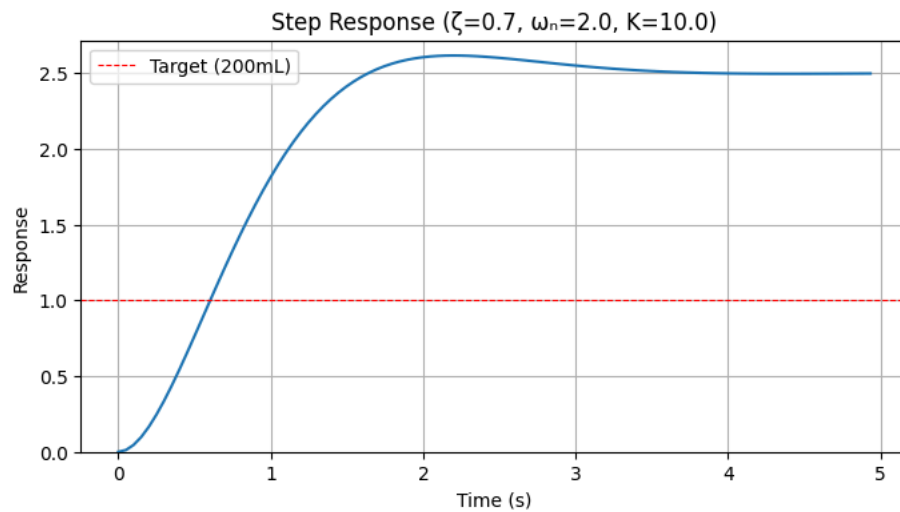
    sys = TransferFunction(num, den)
    t, y = step_response(sys)

    plt.figure(figsize=(8, 4))
    plt.plot(t, y)
    plt.title(f'Step Response ( $\zeta$ = {zeta},  $\omega_n$ = {omega_n}, K= {K})')
    plt.xlabel('Time (s)')
    plt.ylabel('Response')
    plt.grid(True)
    plt.ylim(0, max(1.5, max(y) + 0.1))
    plt.axhline(1, color='r', linestyle='--', linewidth=0.8, label='Target (200mL)')
    plt.legend()
    plt.show()
```

```
interact(
    plot_step_response,
    zeta=FloatSlider(value=0.7, min=0, max=2, step=0.05, description='ζ'),
    omega_n=FloatSlider(value=2.0, min=0.1, max=10, step=0.1, description='ωn'),
    K=FloatSlider(value=10, min=1, max=20, step=1, description='K')
)
```



ζ 0.70
 ω_n 2.00
K 10.00



plot_step_response

```
def plot_step_response(zeta=0.7, omega_n=2.0, K=10):
```