If the space provided for an answer is not sufficient, please continue on the back or attach an additional sheet.

Name: .....

Term: ..... **Subject:** ..... **System Modeling & Control** .....

Teacher: A. Mhamdi

Do not write in this table.

Question:	1	Total
Points:	1	1
Score:		

1. (1 point) ***

content...

$$\frac{d^2y}{dt^2} + 2 \times m \times \omega_0 \frac{dy}{dt} + \omega_0^2 y(t) = k\omega_0^2 u(t), \quad \text{where: } y(0) = 0 \ \& \ \dot{y}(0) = 0$$

[1]:
```
                    ##########################
k, m, o = 1, 1, 1.5 # SIMULATION'S SETTINGS #
                    ##########################
```

[2]:
```
import numpy as np
import matplotlib.pyplot as plt

from scipy.signal import step
```

Numeric Integration: ODE

[3]:
```
def mySys(x, t):
    u = 1
    dotx = [x[1], -o**2*x[0]-2*m*o*x[1] + k*o**2*u]
    return dotx
```

[4]:
```
from scipy.integrate import odeint
```

[5]:
```
tspan = np.linspace(0.0, 10.0, 100)
vect = odeint(mySys, [0, 0], tspan)
y1 = vect[:, 0]
```

Transfer Function

[6]:
```
from scipy.signal import TransferFunction as tf
```

[7]:
```
hTF = tf([k*o**2], [1, 2*m*o, o**2])
_, y2 = step(hTF, T=tspan)
```

State Space

[8]:
```
from scipy.signal import StateSpace as ss
```

[9]:
```
A = np.array([[0, 1], [-o**2, -2*m*o]])
B = np.array([[0], [k*o**2]])
C = np.array([[1, 0]])
D = np.array([[0]])

hSS = ss(A, B, C, D)
_, y3 = step(hSS, T=tspan)
```

[10]:
```
plt.plot(tspan, y1, 'r--', linewidth=2, label='ODE')
plt.plot(tspan, y2, 'g--', linewidth=2, label='TF')
plt.plot(tspan, y3, 'b--', linewidth=2, label='SS')

plt.title('Step response of 2nd order LTI plant')
plt.xlabel('t (sec)')
plt.ylabel('y(t)')
plt.grid()
plt.legend(loc='best')
plt.show()
```