Contents


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% Joel Lubinitsky - 02/04/15
% MAE 321 - HW 3.3

clear all
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clc
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Problem 4:

Calculate the natural frequency and damping ratio for the system in Figure P1.91 given the values m = 10 kg, c = 100 kgs, k_1 = 4000 N/m, k_2 = 200 N/m, and k_3 = 1000 N/m. Assume that no friction acts on the rollers. Is the system overdamped, critically damped, or underdamped?

Unknown: ζ

Known

```
mass = 10;
coefficientDamping = 100;
stiffness1 = 4000;
stiffness2 = 200;
stiffness3 = 1000;
```

Calculations

$$\zeta = \frac{c}{c_{cr}}$$

$$c_{cr} = 2\sqrt{k_{eff} m}$$

$$k_{eff} = k_1 + \frac{k_2 k_3}{k_2 + k_3}$$

Therefore,

$$\zeta = \frac{c}{2\sqrt{k_1 + \frac{k_2 k_3}{k_2 + k_3} m}}$$

```
stiffnessEffective = stiffness1 + stiffness2 * stiffness3 / (stiffness2 + stiffness3);
coefficientDampingCritical = 2 * sqrt(stiffnessEffective * mass);
ratioDamping = coefficientDamping / coefficientDampingCritical
```

```
ratioDamping =

    0.2449
```

Results

System is underdamped because $\zeta < 1$

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