Contents


```
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% MAE 321 - HW9.2
% 03/25/15

clear all
close all
clc
```

Problem 2:

The damping coefficient for a particular accelerometer of the type illustrated in figure 2.26 of the book is 45 N s/m. It is desired to accurately measure accelerations in a frequency range of 0 to 75 Hz with a maximum error of only 3%. Design the rest of the device (m and k) to achieve this.

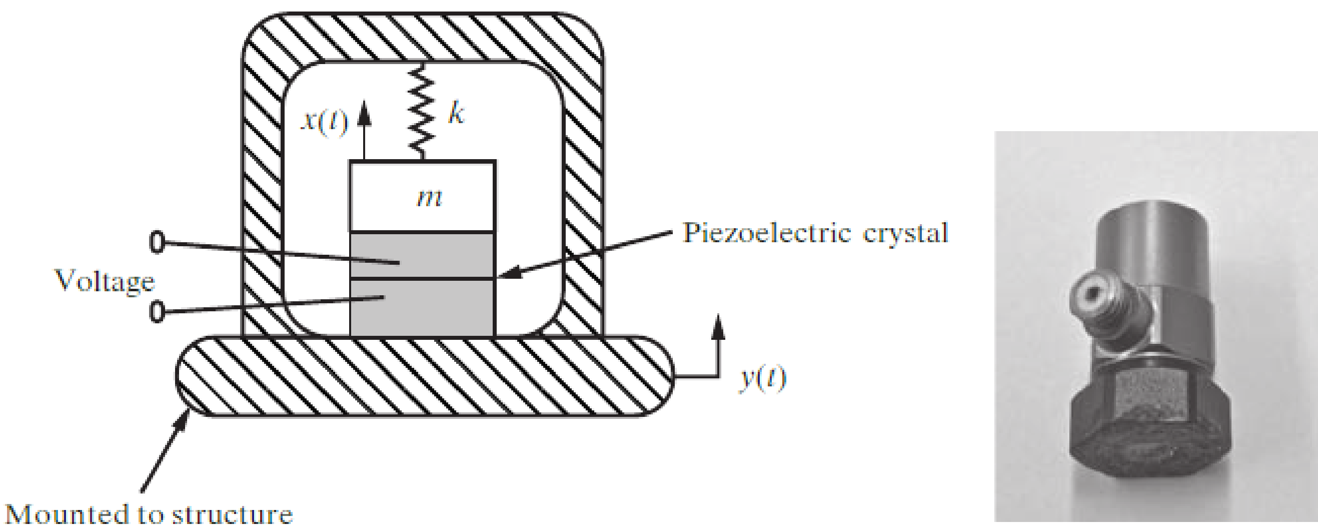

Figure 2.26 A schematic of a piezoelectric accelerometer and a photograph of a commercially available version.

Find: $m, \; k$

Known

$c, \; f_m$

```
coefficientDamping = 45;    % Ns/m
frequencyMaxHz     = 75;    % Hz
errorMax           = 0.03;
```

Calculations

For max error of 3% @ r = 0.2:

$$0.97 < \frac{1}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} < 1.03$$

$$0.97 < \frac{1}{\sqrt{0.9216 + 0.16\zeta^2}} < 1.03$$

$$0.867 + 0.15\zeta^2 < 1 < 0.978 + 0.17\zeta^2$$

$$0.36 < \zeta < 0.94$$

$$\frac{c}{2\sqrt{km}} = 0.5 -> \ km = c^2$$

$$r = \frac{\omega_m}{\omega_n} -> \ \frac{k}{m} = \left(\frac{\omega_n}{r}\right)^2$$

Solving simultaneous equations:

$$k = \frac{\omega_m}{r} c$$

$$m = \frac{c^2}{k}$$

```
frequencyMaxRad = frequencyMaxHz .* 2 .* pi;
ratioFrequency  = 0.2;
stiffness       = (frequencyMaxRad .* coefficientDamping) ./ ratioFrequency
mass            = (coefficientDamping .^ 2) ./ stiffness
```

```
stiffness =

   1.0603e+05


mass =

    0.0191
```

Results

The required system can be designed using a 0.0191 kg mass and a spring of stiffness 106030 N/m.

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