Contents


```
% Joel Lubinitsky
% MAE 321 - HW9.1
% 03/25/15

clear all
close all
clc
```

Problem 1:

A lathe can be modeled as an electric motor mounted on a steel table. The table plus the motor have a mass of 60 kg. The rotating parts of the lathe have a mass of 5 kg at a distance 0.12 m from the center. The damping ratio of the system is measured to be ζ = 0.07, and its natural frequency is 7 Hz. Calculate the amplitude of the steady-state displacement of the motor for lathe frequencies of f_r = 20, 25, 30, 35, 40 Hz.

Find: X when f_r = 20, 25, 30, 35, 40 Hz

Known

$m,\ m_0,\ e,\ \zeta,\ f_n,\ f_r$

```
massT              = 60;                    % kg
massR              = 5;                     % kg
radiusR            = 0.12;                  % m
ratioDamping       = 0.07;
frequencyNaturalHz = 7;                     % Hz
frequencyLathe     = [20, 25, 30, 35, 40]; % Hz
```

Calculations

$r = \omega_r / \omega_n$

$$X = \frac{m_0 e}{m} \frac{r^2}{\sqrt{(1 - r^2)^2 + (2\zeta r)^2}}$$

```
frequencyNaturalRad = frequencyNaturalHz .* 2 .* pi;
frequencyLatheRad   = frequencyLathe .* 2 .* pi;
ratioFrequency      = frequencyLatheRad ./ frequencyNaturalRad;

amplitudeSS         = (massR .* radiusR ./ massT) .* ((ratioFrequency .^ 2) ./ ...
                      (sqrt((1 - ratioFrequency .^ 2) .^ 2 + ...
                      (2 .* ratioDamping .* ratioFrequency) .^ 2)))
```

```
amplitudeSS =

    0.0114    0.0108    0.0106    0.0104    0.0103
```

Results

The steady-state displacement amplitudes corresponding to the given lathe frequencies are:

0.0114 m @ 20 Hz

0.0108 m @ 25 Hz

0.0106 m @ 30 Hz

0.0104 m @ 35 Hz

0.0103 m @ 40 Hz

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