Contents


```
% Joel Lubinitsky - 02/04/15
% MAE 321 - HW 3.2

clear all
close all
clc
```

Problem 2:

Springs are available in stiffness values of 10, 100, and 1000 N/m. Design a spring system using these values only, so that a 150 kg mass is connected to ground with an undamped natural frequency of about 1.5 rad/s.

Unknown: Number/position of springs

Known

```
mass            = 150;  % kg
frequencyNatural = 1.5;  % rad/s
stiffness1      = 10;   % kg/s^2
stiffness2      = 100;  % kg/s^2
stiffness3      = 1000; % kg/s^2
stiffness       = [stiffness1 stiffness2 stiffness3];
```

Calculations

$$w_n = \sqrt{\frac{k}{m}}$$

$$k = m w_n^2$$

```
stiffnessTotal = mass * frequencyNatural ^ 2;

stiffness = sort(stiffness, 'descend');
nSpringsParallel = zeros(1, length(stiffness));
stiffnessRemaining = stiffnessTotal;
for k = stiffness

    if k > stiffnessRemaining
        continue
    end

    indexSpring = find(k == stiffness);
    nSpringsParallel(indexSpring) = floor(stiffnessRemaining / k);
```

```
    stiffnessRemaining = stiffnessRemaining - k * nSpringsParallel(indexSpring);
end

nSpringsSeries = zeros(1, length(stiffness));
[minSpring, indexSpring] = min(stiffness);
if stiffnessRemaining ~= 0
    for n = [1 : 1 : 10]
        nSpringsSeries(n, indexSpring) = ceil(minSpring / stiffnessRemaining);
        stiffnessRemaining = stiffnessRemaining - minSpring / nSpringsSeries(n, indexSpring);

        if stiffnessRemaining == 0
            break
        end

        nSpringsSeries = [nSpringsSeries; zeros(1, length(stiffness))];
    end
end

nSpringsParallel = [stiffness; nSpringsParallel]
nSpringsSeries = [stiffness; nSpringsSeries]
```

```
nSpringsParallel =

        1000         100          10
           0           3           3


nSpringsSeries =

        1000         100          10
           0           0           2
           0           0           4
```

Results

System with required behavior can be designed with 3 100 N/m and 3 10 N/m springs in parallel, with 2 10 N/m springs in series, and with 4 10 N/m springs in series.

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