Measurements Homework 4

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Number 1

We need to get a sensitivity from the table in the book.

Assuming the response is linear... which the book table seems to suggest that it isnt exactly linear.... I'll assume that if the CJT is zero, then sensitivity = 1mv/25 Degrees C

```
Sensitiviy = 1/25 #mV/Degrees C
CJT = 22.8 #degrees C
E_CJT_0 = Sensitiviy*CJT # mV


E_Tm_CJT = [-1.689 -1.108 -.113 3.198] # mV

E_Tm_0 = E_Tm_CJT .+ E_CJT_0
```

```
1×4 Array{Float64,2}:
 -0.777  -0.196  0.799  4.11
```

Now Ill convert those voltages into temperatures using sensitivity.

```
Tm = E_Tm_0/Sensitiviy # Degrees C
```

```
1×4 Array{Float64,2}:
 -19.425  -4.9  19.975  102.75
```

Number 2 Get the steady state response measured by the sensor

```
using SymPy
@vars t
omega_n = 1 * 2*pi #rad/s
zeta = .65

A1 = .5
omega1 = 3*pi
x_h_term1 = A1*sin(omega1*t) # cm
phi1 = atan(2*zeta*omega1/omega_n/(1-omega1/omega_n))

A2 = .8
omega2 = 10*pi
x_h_term2 = A2*sin(omega2*t) # cm
phi2 = atan(2*zeta*omega2/omega_n/(1-omega2/omega_n))


x_r_term1 =
A1*(omega1/omega_n)^2/sqrt((1-((omega1/omega_n)^2))+(2*zeta*omega1/omega_n)^2)*sin(omega1*t-phi1)
# cm
```

$$0.704157236914957 \sin \left(9.42477796076938t + 1.31979364015186\right)$$

```
x_r_term2 =
A2*(omega2/omega_n)^2/sqrt((1-((omega2/omega_n)^2))+(2*zeta*omega2/omega_n)^2)*sin(omega2*t-phi2)
# cm
```

$$4.68164588784522 \sin \left(31.4159265358979t + 1.01914134426635\right)$$

```
x_r = x_r_term1 + x_r_term2 # cm
```

$$0.704157236914957 \sin \left(9.42477796076938t + 1.31979364015186\right) + 4.68164588784522 \sin \left(31.415926535897$$

Number 3

```
omega_n = 1500 * 2*pi # rad/s
zeta = .707
x_r_mag = 2e-6; # m
omega = 1200 *2*pi # rad/s
```

```
7539.822368615503
```

a)

if omega « omega_n then...

```
Acc_amp = x_r_mag*omega_n^2 # m/s/s
```

```
177.65287921960842
```

b)

if omega « omega_n is NOT TRUE then...

```
Acc_amp_accurate =
x_r_mag/((1/omega_n)^2/sqrt((1-((omega/omega_n)^2))+(2*zeta*omega/omega_n)^2)) # m/s/s
```

```
227.47987728008155
```

Number 4

```
SPL1 = 120 # dB
SPL2 = 90 # dB
p_rms1 = .00002*10^(SPL1/20) # N/m/m
```

```
20.0
```

```
p_rms2 = .00002*10^(SPL2/20)
percent_reduction = (p_rms1-p_rms2)/p_rms1*100
```

```
96.83772233983163
```