Q1 : $\tau = 2$, P-P value = 100, DC = 300, & The period is 10s.

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$$x(t) = Dc + \frac{P\text{-}P}{2} \sin\left(\frac{2\pi}{T} t\right)$$

$$= 300 + 50 \sin\left(\frac{2\pi}{10} t\right)$$

$$y(t) = \frac{A}{\sqrt{1+(w\tau)^2}} * \sin\left(wt - \tan^{-1}(w\tau)\right) + DC$$

$$= \frac{50}{\sqrt{1+\left(\frac{\pi}{5}(2)\right)^2}} * \sin\left(\frac{2\pi}{10}t - \tan^{-1}\left(\frac{2\pi}{5}\right)\right) + 300$$

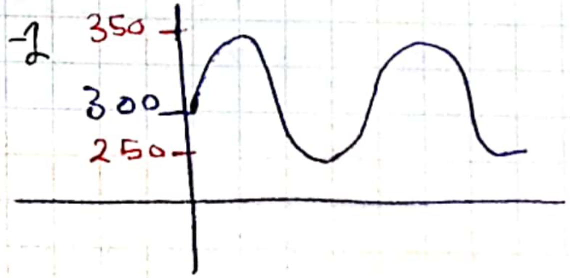
$$= 300 + 31.14 \sin\left(\frac{2\pi}{10}t - \underbrace{51.474}_{}\right)$$

Time shift.

So Maximum value :- $\boxed{331.14}$, when $\sin(\theta) = 1$

Minimum value :- 300 − 31.14 , when $\sin(\theta) = -1$

$= \boxed{268.86}$

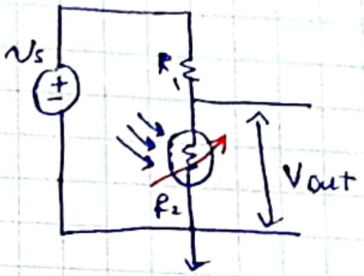


$$\text{Phase shift} = \frac{\text{Time Lag}}{\text{Period}} * 360 =$$

$$51.474 = \frac{\text{Time Lag}}{10} * 360 \Rightarrow \boxed{\text{Time Lag} = 1.43 \text{ sec}}$$

$\boxed{\Delta R = 309\%}$

$\overset{3}{Q}(4)$:- $R_1 = 10\Omega$, $V_{in} = 9V$, $R_2 \Rightarrow 500$ or 200 :-



* $V_0 R_2$ in Bright :-

$$V_0 = \frac{500l}{(500+10k} * 9 \Rightarrow \boxed{V_0 = 0.4285V}$$

* $V_0 R_2$ is Dark

$$V_0 = \frac{200k}{200k+10k} * 9 \Rightarrow \boxed{8.57V}$$

Q(4) :- $\tau = 38s$, $f = \frac{3}{60} \Rightarrow 0.05 = \frac{1}{20}\ s^{-1}$

$$w = 2\pi f \Rightarrow 0.314 \Rightarrow td = \frac{\tan^{-1}(w\tau)}{w} = \frac{\tan^{-1}\left(2\pi\left(\frac{1}{20}\right)(38)\right)}{2\pi\left(\frac{1}{20}\right)}$$

✓ rad

← rad

$$td = \frac{\tan^{-1}\left(\cancel{2\pi}\left(\frac{38}{20}\right)\cdot\frac{360}{\cancel{2\pi}}\right)}{\left(\frac{1}{20}\right)(\cancel{2\pi})\left(\frac{360}{\cancel{2\pi}}\right)}$$

← dgree

← dgree

$$\Rightarrow td = \frac{\tan^{-1}(684)}{18} \Rightarrow \boxed{td = 4.99\,sec}$$

← Answer.

Q (5):- Strain = 160 μm / M
GF for metalic guage = 2.13 &
GF for semiconductor = - 161

Assume that R = 120 Ω, Then ΔR

1. ΔR for meltalic ⇒ $GF = \dfrac{\Delta R / \overset{120}{R}}{\underbrace{\Delta L / L}_{\text{strain}}}$ ⇒ $\dfrac{2.13}{1} = \dfrac{\Delta R / 120}{160 \times 10^{-6}}$

⇒ ΔR = $\dfrac{\Delta R}{120} = 2.13(160 \times 10^{-6})$

⇒ $\boxed{\Delta R = 0.041 * 100\% = 4.1\%}$ ⇒ $\boxed{\Delta R = 0.041\ \Omega}$

2. ΔR for semiconductor ⇒ $GF = \dfrac{\Delta R / R}{\Delta L / L}$ ⇒ $\dfrac{-161}{1} = \dfrac{\Delta R^{*}(120)}{160 * 10^{-6}}$

⇒ $\boxed{\Delta R = 3.09 * 100\% \quad \Delta R = -309\%}$ ⇒ $\boxed{\Delta R = -3.09\ \Omega}$

Answers.

Question #6: $I_f = 300\ \mu m$, $I_m = 280\ \mu m$, $n = 100$, $d_f = 2\ \mu m$, $\varepsilon_r = 7$, $\Delta C = 50.34\ pF$

find θ in dgree.

$$\text{since } \Delta C \simeq \frac{n \varepsilon_0 \varepsilon_r I_f}{d_f}(2 I_m + I_f)\theta$$

$$\frac{50.34 \times 10^{-12}}{2} = \frac{100 * (2) * 7}{2 \times \cancel{10^{-6}}}\left(\underline{2(\overset{560}{280}} \times \cancel{10^{-6}} + \overset{300}{300} \times \cancel{10^{-6}}\right)\theta \times 300 \times 10^{-6}$$

~~50.34 * 10^-12~~ = [illegible] ~~8.362 × 10^-11~~

$$50.34 * 10^{-12} = 180.6\,\theta \Rightarrow \boxed{\theta = 2.787 \times 10^{-13}}$$

$$\Rightarrow \boxed{\theta = 0.2787\ p^{\circ}}$$

Q7: $f = 200 Hz$, $\zeta = 0.6$, $|\text{Dynamic error} = \pm 5\%|$

$$B(\omega) = \frac{A}{\sqrt{\left(1-\left(\frac{\omega}{\omega_n}\right)^2\right)^2 + \left(2\frac{\zeta\omega}{\omega_n}\right)^2}}$$

let $x = \frac{\omega}{\omega_n}$

$$B(\omega) = \frac{A}{\sqrt{(1-x^2)^2 + (1.4x)^2}}$$ → with dynamic error ±5% :-

$$0.95 A \leq \frac{A}{\sqrt{(1-x^2)^2 + (1.4x)^2}} \leq 1.05A$$

$$\frac{1}{1.05} \leq \sqrt{(1-x^2)^2 + (1.4x)^2} \leq \frac{1}{0.95}$$

$$\left(\frac{1}{1.05}\right)^2 \leq 1 - 2\cancel{P}x^2 + x^4 + 1.96x^2 \leq \left(\frac{1}{0.95}\right)^2$$

$$\left(\frac{1}{1.05}\right)^2 - 1 \leq x^2(x^2 - 0.04) \leq \left(\frac{1}{0.95}\right)^2 - 1$$

$$x^2(x-0.2)(x+0.2) \geq -0.093 \rightarrow \text{no solution.}$$

$$x^2(x-0.2)(x+0.2) \leq 0.1083$$

$$\Rightarrow \cancel{x}(x+0.591005)(x-0591005) \leq 0$$

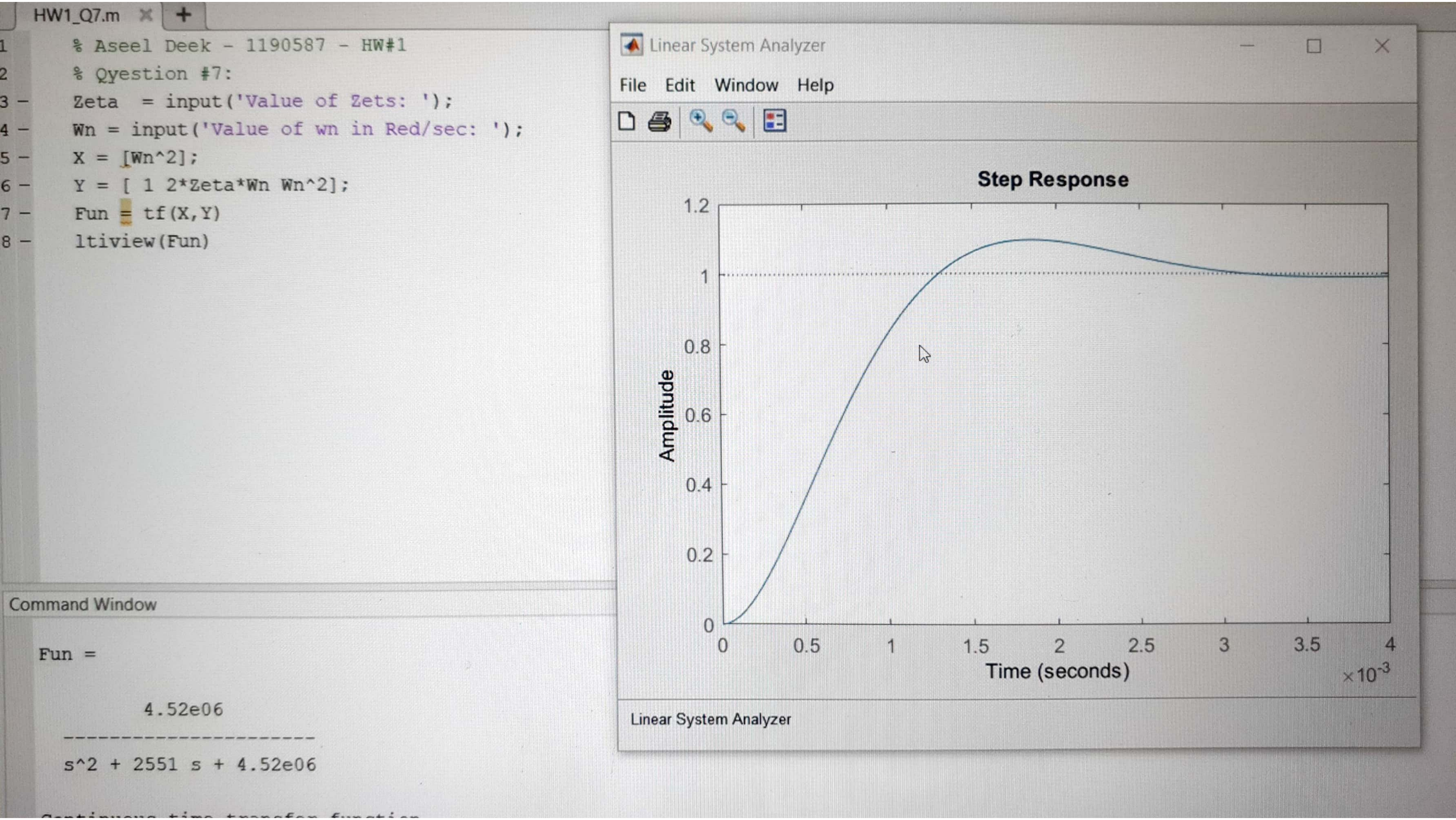
$$\Rightarrow x \leq -0.591005 \rightarrow \text{mininus values are no allowed.}$$

$$x \leq 0.591005 \rightarrow \text{accepted.}$$

$$\frac{\omega}{\omega_n} \leq 0.591005 \Rightarrow \omega_n \geq \frac{2\pi(200)}{0.591005}$$

almost This value →

$$\boxed{\omega_n \geq 2126 \text{ ned}/s}$$



```
% Aseel Deek - 1190587 - HW#1
% Qyestion #7:
Zeta  = input('Value of Zets: ');
Wn = input('Value of wn in Red/sec: ');
X = [Wn^2];
Y = [ 1 2*Zeta*Wn Wn^2];
Fun = tf(X,Y)
ltiview(Fun)
```

```
Fun =

        4.52e06
  ----------------------
  s^2 + 2551 s + 4.52e06

Continuous-time transfer function.
```

Q8 :-

* **Accelerometers:-** 1. These sensiors can detect Vibration & acceleration or The orientation of The phone.

2. It use techology called " Microelectromechine systess Deives "

3. it helps to identifies . whether the phone is portraint or handcape orientation.

4. it uses The value of XYZ,

* The **characterstic:-** 1. Adjusts the screen orientation from Landscape/horizontal to portrait/vertical & vice versa.

2. changing the orientation, it makes photo viewing & web browsing better

3. by Turning the mobile decices facing downward users can mute the incompe call.

2. Gyroscopes sensors :- 1. enables to sense linear orientation of the phone to auto rotate the mobile screen

2. Change the angular displacment while the current is generated Through the vibrating action

3. add additional dimension to the information supplied by the accelerometer by Tracking rotation or twist.

4. characterstics of the Gyroscopes sensor includes scale factor, Temperature, frequency cofficeint, compact size, shock resistance, stability & noise

* An accelerometer measure Linear acceleration of movment, while a gyro on the other hands measures The angular rotational velocity. Both sensors measure rate of change, They Just measure The rate of change for different Things .