Tarek Shawak ENCS4380 30/3/2021

1181404 HW2 Tuesday

Q1) $\tau = 2\,s$, $P\text{-}P = 50$, $Dc = 325$, Period $= 20s$

$$X(t) = 325 + 25 \sin\left(\frac{2\pi}{20} t\right)$$

where $w = 2\pi f = \frac{2\pi}{20} = \frac{\pi}{10}$

$$y(t) = \frac{A}{\sqrt{1+(w\tau)^2}} \sin\left(wt - \tan^{-1}(w\tau)\right) + 325$$

$$= \frac{25}{\sqrt{1+\left(\left(\frac{\pi}{10}\right)(2)\right)^2}} \sin\left(\frac{\pi}{10}t - \tan^{-1}\left(\frac{2\pi}{10}\right)\right) + 325$$

$$= 325 + 21.17 \sin\left(\frac{\pi}{10}t - 32.14\right)$$

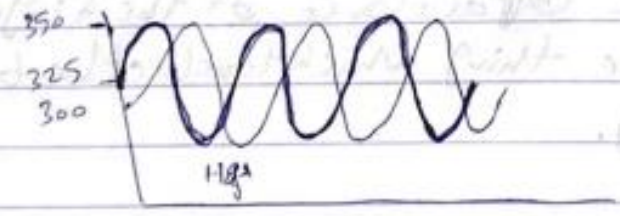
Max. Value $= 325 + 21.17 = \boxed{346.17}$

Min. Value $= 325 - 21.17 = \boxed{303.83}$

$$\text{Phase shift} = \frac{\text{time lag} \times 360}{\text{Period}}$$

$$32.14 = \frac{360}{20} \text{ time lag}$$

$$\boxed{\text{time lag} = 1.79\,s}$$



(Q2) $\tau = 28\,s$, $f = \frac{2}{60} = \frac{1}{30}\,Hz$

$$t_d = \frac{\tan^{-1}(\omega\tau)}{\omega} = \frac{\tan^{-1}(2\pi f \tau)}{2\pi f}$$

$$= \frac{\tan^{-1}\left(2\pi\left(\frac{1}{30}\right)(28)\right)}{2\pi\left(\frac{1}{30}\right)}$$

$$= \frac{\tan^{-1}\left(2\pi\left(\frac{28}{30}\right)\text{rad}\right)}{2\pi\left(\frac{1}{30}\right)\text{ rad/s}}$$

$$= \frac{\tan^{-1}\left(\left(\frac{28}{30}\right)(2\pi)\left(\frac{360}{2\pi}\right)\text{degree}\right)}{\left(\frac{1}{30}\right)(2\pi)\left(\frac{360}{2\pi}\right)\text{degree/s}}$$

$$= \frac{\tan^{-1}(336^\circ)}{12}\ \text{seconds}$$

$t_d = 7.486$ seconds

(Q3) $f = 100Hz$, $\zeta = 0.7$, $|\text{Dynamic Error}| = \pm 5\%$

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

let $R = \frac{w}{w_n}$

$$B(w) = \frac{A}{\sqrt{(1-R^2)^2 + (1.4R)^2}}$$

with dynamic error $\pm 5\%$:

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

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

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

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

$R^2(R-0.2)(R+0.2) \geq -0.093$ No solution

$R^2(R-0.2)(R+0.2) \leq 0.10803$

$\Rightarrow (R + 0.591005)(R - 0.591005) \leq 0$

$R \leq -0.591005, 0.591005$ R is Positive

$\times$ $\checkmark$

$\frac{w}{w_n} \leq 0.591005 \Rightarrow w_n \geq \frac{2\pi(100)}{0.591005}$

$w_n \geq 1063$ rad/s nearly.

Editor - D:\Program Files\Polyspace\R2019b\bin\ENCS4380\HW2_Q3.m

HW2_Q3.m

```
1     %Tareq Shannak - 1181404 - HW2 - Q3
2     %transfar function & response of a 2nd order system
3     % zeta is tha damping factor
4     %wn is natural frequency
5 -   zeta=input('enter zeta ');
6 -   wn=input('enter wn in rad/sec ');
7 -   num=[wn^2];
8 -   den=[1 2*zeta*wn wn^2];
9 -   G = tf(num,den) %% get transfar function
10 -  ltiview(G)%% various plots to show response
```

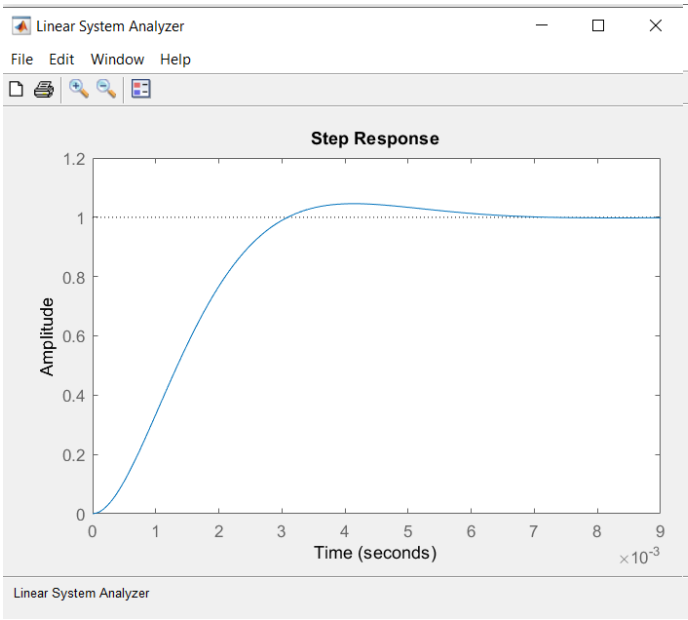
Command Window

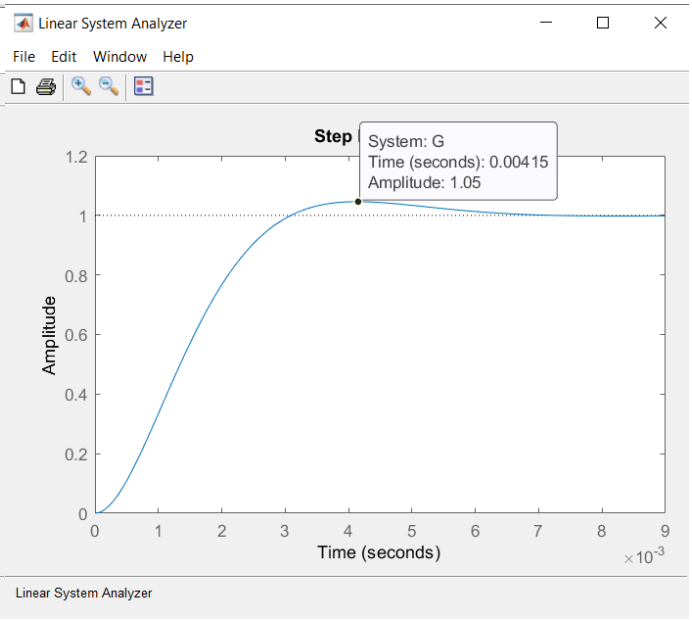
```
enter zeta 0.7
enter wn in rad/sec 1063

G =

         1.13e06
  ----------------------
  s^2 + 1488 s + 1.13e06

Continuous-time transfer function.
```





Qu)

Accelerometer :=

Can detect Tilt or Orientation of the phone. It Can detect Vibration and acceleration. It helps to determine whether the plone is in Portrait or Landscape orientation. It use a technology Called Microelectromechanical systems Devices

Gyroscopes :=

It works as we said in accelerometer, but the gyroscope sensor measures the angular rotational velocity even if both sensors measure rate of change. It also use a Microelectomechanical systems devices.

Finger Prints=

It Can read and store biometric data of our fingers and Can be used to unlock the Phone. Also it Can use the capacitance of the finger to detect that the thing which touches the button is a humanly thing.