VASAVI COLLEGE OF ENGINEERING

(Affiliated to Osmania University) Hyderabad - 500 031.

DEPARTMENT OF ECE

NAME OF THE LABORATORY : CEE

Name G. Sti Granga Panan Roll No. 1602-21-735-117 Page No.

Stability analysis using Bode plot

Aim: To analysis stability of a given control mystem using

Tools Required: - A P.C loaded with MATLAB

Theory:

Bode plots are fundamental tools in control systems engineering due to their ability to provide comprehensive insights into the frequency response characteristics of dynamic systems.

One significant espect of Bode puts is their capacity to reveal how a system responds to different frequencies of input signals. This is crucial because many

1500 1000 =

real-world systems operate within a range of frequence, and understanding now they behave across this spectrum is essential for effective control, and stability.

By examining Bode plots, engineers can analyze the stability and performance of control systems. They can identify regions of instability, adjust controller parameters, and optimize system performance to meet desired specifications. Moreover, Bode plots facilitate the design of compensators and filters to improve system stability and response

term !	Corner frequency	supe	change in slope
(jw)2		+40dbldec	
1 1+0,23w		-20db ldec	
1 1+0.02jw	0.02 =50	+20db/dec	10 20-20 to deldec
Similar W	astion white	a given a	raag(de) we

Magnitude plot:

0-1,0-2 - - - 1

$$W_1 = 5$$
 = 2 v log (w

100,200, - - 1k

phase :

ciw	7.60	0)	0.000	d
	zjw)			

-	2 11	1,00	(cu2)
-	20	wy	(W2)

48 idamental back in contra phitage 1511

W2 = 50 200 = 100

Σ'20 log (wh) + provinces

gain

exect how a system oras and ? Tan (w) + Tan (w) - Tan (0-20)

IW	phase
0-5	1740
Echard	168°,
150	1300
50	1000
100	300
- 00	. 06/14/13/3

wgc=tradisec & upc=0 radisec (from graph)

1

-12

28

48

Margnitude

50. 0409 1

200

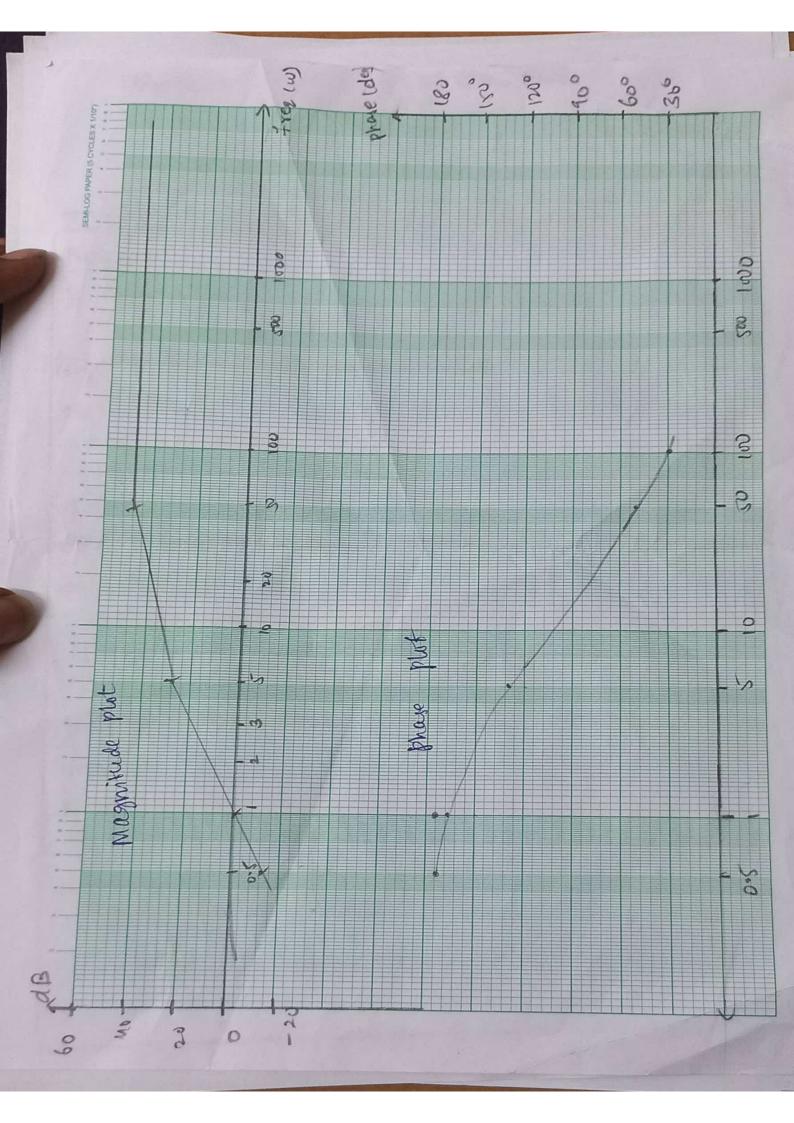
For k=1, wgc=1 radliec

But given, wgc=65 radlsec

For wgc to be 5 radisec, the magnitude at 5 radisec=ods

So, we need to shift graph by -28dB at wgc=sradls

k=0.0398



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:_ECE WI = 6 3U1

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Name Gr. Svi Cranga Pranav Roll No. 1602-21-735-117 Page No. Psuggam: Swith wet to fail % G1(8)= ks2 (HO.25)(HD.028) (sm.), mal = \$ 7. Determine & it wgc=5 radisec cle; - 90-10m (-)-10m/ 5) clear; close all; num = [1 0 0]; (30) (30) (30) (30) (30) den = conv([1 0.2],[1 0.02]); sys = tf (num, den); bode (syst; 1 cm. 1 ms (17 pase margin(sys) [GM, Pra, wc, wp]=margin (sys) Jan 800= 3 MAL grid on; figure; 2- wp = 0 = 3 wp = 02 num = [0.0398 0 0] sys = tf (num, den); 001 0 = 190 = 10 [M bode (sys ? VEVENS mougin (sys) Govern margin =

21/12-21 = (MO) pol 00 = 3

[GM, PM, Wc, wp] = margin (sys) grid on;

G(3) H(3) = 1 s(st1)(st2) Put s=jw Grijw) Hijw? = 100 jwjux1) (jwx2) and (significanted Lead and End Magnitude = 100 Jw2 J Hw2 Jeptw2 12 (1 (6) = 1 3° \$ = Tan (sing (2000) (2000) = - Tanil () - Tanil () - Tanil () 2010 = -90'-Tan ()-Tan () 0 (((03)) - 180° = -90° Tan-1 (wpc) - Tam- (wpc) (0 0 1) = MIDIN den = conv([1 0.2 90°= Tan 1/wpc) + Tan (upc) 28 = tf (necon) den); = Tom/writhsupe pode (1883); margin (342) D grid on; figuse; 2-wpc2 = 0 => wpc= 52 MICH = [0.0398 0 0) 375 = to (event, deer); $M = w_{pcz} \sqrt{2} \sqrt{3} \sqrt{6} = \frac{100}{6}$ = $\frac{100}{6}$ = may sin (191) Grain margin = 1 [Mlw=upe] = 100. grid on; 6 m in dB = 20 log(6m)=15.56dB

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i) Limiting value of

ii) k if GM = ludB

111) k if PM = 50°

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Name Gr-Szi Ganga Peranav Roll No. 1602-21-735-117 Page No. 16 - Gots) - 1919 - 1919 of 1919 of 1919 - 1919 - 1919 (+ 0 = 103 Question 2: " gbutupiam % Cols) HIS) = 100 0 1 / Harre - (180) Bay De DC = 101 1000 - day 863+17(3+2 % Détermine we, upe, com, pra dc: (is / war - (on / wor - ob - 2 wayd clear; grup - oxy = non close all: 5=E+ (3); 4-11 - : (3) 1 mil - (N) mil 20 = = 10 4 : (2) +3= & 845 = 100/ (84 (3+1) + (3+2)) 081 = 3 800 1-081 = M bode (141): margin(+ys) [Gm, pra, wc, wp) = margin (sys) grid on: om: Odb- Pacin we come austion 3: value - (squier), galue - (1) palud o : % G(s) = K = 26 olb. 813+2)(5+20) tor marginally state of gain margin = Delermine:k for system to be stable

```
(i) Limiting value: marginally stable.
   G(3) = 6
       5x2[1t ] ]x2v[it 1]
                  magnitudes values : L4 db, -6db, -26db, -46db
   mg = 0.5
   WC1=2
                 Magnitude:
   WG= 20
                 20 log ( tog 1) - 20 log ( \situ \for g) - 20 log ( \situ \for g) = 0
   Wh = 200
                 By equating magnitude to 0, we get wige =1 radisee
 phase? -90°- rant(w) - rant(w)
      PM = 180°+ pwgc
      φως c = -90°- ταπ ( /2) - ταπ ( /20) = -119.42 = -1200.
mpc: w/d=-180°= w/c
                                         margin(ays)
       -90°- Tan-/wpc) - Tam-/wpc) = -180° = ) wp &= 46.4 radfs
6M = 0 db - brain | w = upc

= 0 - polog ( dpc) - 20 log ( Trupe ) - 20 log ( Trupe )
For marginally stable, gain margin = odb
so, we need to shift graph upwards by 26db.
20 log b 1 = 26
            K 12 10 (6/20) = 12
                                      111) K FF PM = 50
                                     =) F = 798
```

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Cii) brain margin = 10db

Shift graph upwards by 16db

(°:26db-16db=10db)

20 log k 1 = 16

b1=1016/20

= K = 40×10°-8

= 282

cili) Phase margin = 50°

\$wgc = -180°+50°=-130°

wat -130° = wgc new = 2 radlsec

Wginew = [magnitude = vdb]

(magnitude at 2 rad/sec = 5=5db)

20 log 101=5.5

k=40×105.5120

= 95

-1200

P.m=502

cir=uzc

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clc; clear; close all; る=tfl's1); 345 = 1/(3#(3+2)#(3+20)) bode (sys) margin (sys) [Crm, PM, WC, Wp]=margin(1441) grid on; figure; sys 1=252/8 & (s+2) * (s+20)) bode (sysi) margin (+481) [GM, PM, wc, wp] = margin(sys) grid on; figure; 3482 = 75/(3@(3+2) @(3+20)) bode (1412) margin (sy12) [GM, PM, WC, W] = margin (+4) and on;

Result: Analyzed the stability of given system using bade plot