NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTE AFFILIATED TO VTU, BELAGAVI)

6th Mid-Semester Examination BE Degree

(MSE- 2 Scheme)

Department of Electronics and Communication Engineering

Semester: 6	Course Name: Control Systems		
Course code: 21ECG62	Faculty Names Section A:	Section B:	Section C:
Date: 5/6/24	Max. Marks	30	

Q.No.	Scheme	Marks	CO;BL
1. a)	→ Root locus is a graphical representations of roots of the characteristic equations. Time domain analysis for finding the system stability. →(1M) → Bode plot is the method useful in analyzing magnitude & phase changes introduced by a system. frequency domain analysis for finding the system stability →(1M)	2.	
b)	After tabulating the co-efficients of characteristic equation, the necessary condition for s/s to be stable is → All the terms in the first column of Routh's array must have same sign.	2	

→ There should not be any sign change.

c) Angle condition:

We have. $G(s).H(s) = -1 + j0$

$\angle G(s).H(s) = \pm(2q+1)180°$ where $q = 0, 1, 2 ..$

$\Rightarrow \pm 180°; \pm 540°; \pm 900°$

(odd multiple of $180°$)

→ Any point to lie on root locus must satisfy angle condition. The angle must be odd multiple of $\pm 180°$. (1M)

} (2M)

Magnitude condition:

$|G(s)\, H(s)| = 1$

→ The value of 'k' can be found by magnitude condition for which known point on root locus is the root of characteristic equation.

(1M)

Unit - III

2) a) step ①: $P = 3$; $Z = 0$; $P - Z = 3$. (1M)

step ②: Existence of breakaway pt (1M)

step ③: Angle of asymptotes $\theta = \frac{(2q+1)180}{P-Z}$

$\theta_1 = 60°$ $\theta_2 = 180°$; $\theta_3 = 300$

(1M)

step 4: Centroid $\sigma = -2.667$.

step 5: Breakaway pt: (2M)

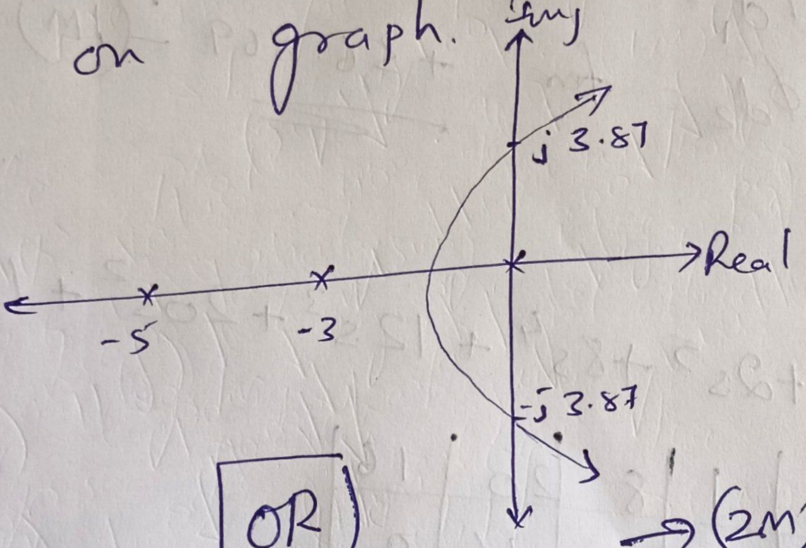
$s = -12.13$

step 6: Point of intersection. (2M)

$0 < K < 120$

$s = \pm j\,3.87$ rad/sec (1M) (10M)

step 7: Draw the root locus on graph.



$\rightarrow$ (2M)

OR

(b) SP = 0, $-3+4j$, $-3-4j$ $\rightarrow$ (2M)

SZ = 0

Angle of departure at complex poles $(-3 \pm 4j)$ $\rightarrow$ (1M)

$\tan\theta = \frac{4}{3} \Rightarrow \theta = 53.13^\circ \rightarrow (1M)$

$\phi p_1 = 180 - 53.13 = 126.87 \rightarrow (1M)$

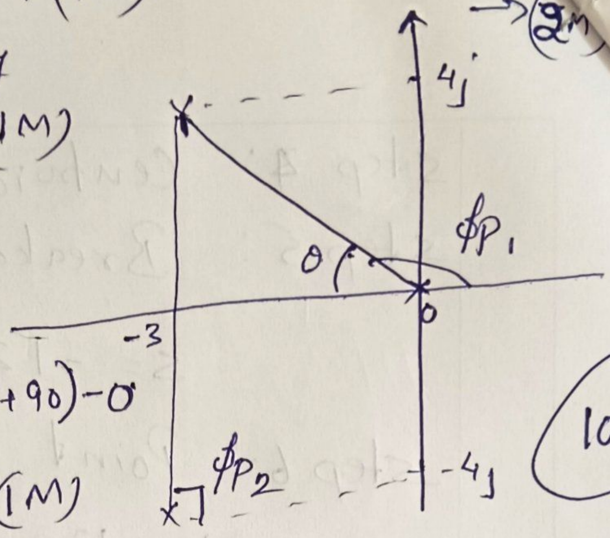
$\phi p_2 = 90^\circ$

$\Sigma \phi p = \phi p_1 + \phi p_2 \rightarrow (1M)$

$\phi_2 = 0.$

$\therefore \phi = \phi p + \phi_2 = (126.87 + 90) - 0$

$\phi = 216.87 \rightarrow (1M)$



10M

$\therefore \phi d$ for $-3 \pm 4j$

$\Rightarrow \phi d_1 = 180 - \phi = 180 - 216.87 = -36.869 \rightarrow (1M)$

$\therefore \phi d_2 = ~~for~~ +36.869$

$\rightarrow (3M)$

3) a) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

s^6	1	8	20	16
s^5	2	12	16	0
s^4	2	12	16	
s^3	0	0	0	0
s^2		16	0	0
s^1		0	0	0
s^0	16	0	0	0

A(s) → (3M)

$A(s) = 2s^4 + 12s^2 + 16$

$\frac{dA(s)}{d(s)} = 8s^3 + 24s \rightarrow (1M)$

s^6	1	8	20	16
s^5	2	12	16	0
s^4	2	12	16	
s^3	8	24	0	
s^2	6	16		
s^1	2.67	0		
s^0	16			

→ (3M)

To obtain stability, solve $A(s)=0$

$s = \pm j(1.414)$ → (2M)

since roots are complex conjugates

system is marginally stable. → (1M)

$\boxed{\text{OR}}$

b) $G(s)H(s) = \dfrac{20}{s(1+0.1s)}$

→ Replace $s \to j\omega$ → (1M)

$G(j\omega)\,H(j\omega) = \dfrac{20}{(j\omega)(1+0.1j\omega)}$

→ (1M)

→ factors $K = 20$

$\therefore K = 20\log 20 = 26.02\,dB$

$\frac{K}{j\omega} = 46.02\ dB$ → (2M)

$\frac{1}{(1+0.1j\omega)}$ → Roll off is -20 dB/dec. → (1M)

$\omega_c = \frac{1}{0.1} = 10$ rad/sec → (1M)

(10M)

Bode plot in semilog sheet → (4M)

4) Angle condition.

$\angle G(s).H(s) \Big|_{s=-0.75} = \pm(2q+1)180^\circ$ → (1M)

(4M)

$q = 0, 1, 2 \ldots$

$G(s).H(s) = -180^\circ$ ⇒ (2M)

→ since it is odd multiple of $\pm 180^\circ$, the point $s = -0.75$ lie on root locus. → (1M)