Topic 8

$s_{1,2} = -\zeta\omega_n \pm j\omega_n\sqrt{1-\zeta^2}$; $\angle KG(s) = \cos^{-1}\zeta$; $r = \deg(P) - \deg(N)$; angle $= \frac{\pi}{r}(2k+1)$

intersection $= \frac{\Sigma p - \Sigma z}{r}$; breakaway: $\frac{dG(s)}{ds} = 0$ $\left(\frac{-1}{G(s)}\Big|_{s=} = K > 0\right)$

to get int with jω axis use RH : $D(s) = 0$

Topic 9

C.L.T: $\frac{Ke^{-Ls}}{Ts+1}$ (lag at inf pt) ; $1 + KG = 0 \Rightarrow K_{cr}$ & P_{cr}

Topic 10

eg: $\hat{K}_v = \hat{K}_c \beta K_v \simeq 1$ Lead-Lag: $K_v = \lim_{s\to 0} s K_c \frac{\beta}{\gamma} G(s)$

$$\left| K_c \frac{s+\frac{1}{T_1}}{s+\frac{\gamma}{T_1}}\Big|_{s_1} \right| = 1 \quad \& \quad \left| \frac{s_1 \frac{1}{T_2}}{s+\frac{1}{\beta T_2}}\Big|_{s_1} \right| = 1$$

$-5 < \text{angle}\uparrow < 0$

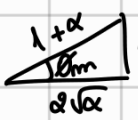
Topic 11

$\omega_r = \omega_n\sqrt{1-2\zeta^2}$; $M_r = \frac{1}{2\zeta\sqrt{1-\zeta^2}}$; $\angle G(j\omega_n) = -\tan^{-1}\frac{\sqrt{1-\zeta^2}}{\zeta} = -90^\circ + \sin^{-1}\frac{\zeta}{\sqrt{1-\zeta^2}}$

0: DC gain: $20\log K_p$ 1: intersection with 1st jω with $\omega = 1$: $20\log K_v$

or // Odrs : $\omega_1 = K_v$

Topic 12

$\omega_m = \frac{1}{\sqrt{\alpha}T}$ $G_1(s) = KG(s)$ 

at new freq : $|G_1(j\omega)| = -20\log\frac{1}{\sqrt{\alpha}}$

12/ lead: $K_v = \lim_{s\to 0} sG(s) \Rightarrow$ get K

$G_1(j\omega) = KG \Rightarrow$ plot $\Rightarrow PM \Rightarrow \phi$

$\alpha = \frac{1-\sin\phi}{1+\sin\phi} \longrightarrow K_c = \frac{K}{\alpha}$

$-20\log\frac{1}{\sqrt{\alpha}} \Rightarrow$ at which freq? $\omega_c = \frac{1}{\sqrt{\alpha}T} \Rightarrow$ get T

lag: get K from $K_v \Rightarrow G_1 = KG \Rightarrow$ plot

from req PM: add $\phi \Rightarrow -180 + PM_{max} = 0 \Rightarrow$ at which ω in graph?

get ω then $\frac{\omega}{10} < \frac{1}{T} < \frac{\omega}{2}$

look at the mag at ω of G : this mag $= 20\log\beta$

13) 1.1: $K = [K_1\ K_2\ K_3]$; $u = -Kx \Rightarrow |\lambda I - (A - BK)| = \ldots$ compare to charac eq

1.2: $K = [0 \ldots 0\ 1] P_c^{-1} q(A)$; $P_c = [B\ AB \ldots A^{n-1}B]$; $q(A) = A^n + \alpha_{n-1}A^{n-1} + \ldots + \alpha_1 A + \alpha_0 I$ (from)

2.1: $L = \begin{bmatrix} L_1 \\ L_2 \\ L_3 \end{bmatrix}$; $\dot{e} = (A - LC)e$; $|\lambda I - (A - LC)| = \ldots$ compare

2.2: $L = P(A) P_o^{-1} \begin{bmatrix} 0 \\ \vdots \\ 0 \\ 1 \end{bmatrix}$; $P(A) = A^n + \beta_{n-1}A^{n-1} + \ldots + \beta_1 A + \beta_0 I$; $P_o = \begin{bmatrix} C \\ CA \\ \vdots \\ CA^{n-1} \end{bmatrix}$