i) $G_{TS} = \frac{K(s+3)}{(s+4)(s^2+4s+5)}$

ii) $\sigma_a = [-4 \quad -2+j \quad -2-j] - (-3) = -5$; $\theta_q = \frac{72}{3-1} = 36°$

iii)

B) 10% OS , ξ 0.59 $\omega_n = 4.08$

i) closed loop poles dominant ;

CL poles $= -\xi\omega_n + j\omega\sqrt{1-\xi^2}$

$= -2.41 + j\ 3.29$

ii) K ;

sub CL into OS ; $\frac{1}{G_{TS}}$; K=1

$$\frac{(s+4)(s^2+4s+5)}{(s+3)}$$

$K = 18.96$

iii) validity

iv) $T_S = \frac{4}{2.41}$

$= 0.83$

$T_P = \frac{\pi}{3.29}$

$= 0.95$

$e_{ss} =$

Question 2

$$G(s) = \frac{K(s^2 - 2 + 8)}{(s+3)(s^2+4s+5)}$$

dominant pole : $-0.88 \pm j1.72$ @ 20% overshoot

$$Ts = \frac{4}{|Real|}$$

$$= \frac{4}{0.88}$$

$$= 4.55\,s$$

$$Ts_{new} = \frac{3}{5} 4.55 \quad \text{4 specification}$$

$$= 2.73$$

$$\zeta = \frac{-\ln(0.2)}{\sqrt{\pi^2 + \ln(0.2)^2}}$$

$$= 0.46$$

$$Ts\ new = \frac{4}{\zeta \omega_n}$$

$$\omega_n = \frac{4}{0.46 \times 2.73}$$

$$= 3.18$$

Real CL poles $= -0.46 \times 3.18$

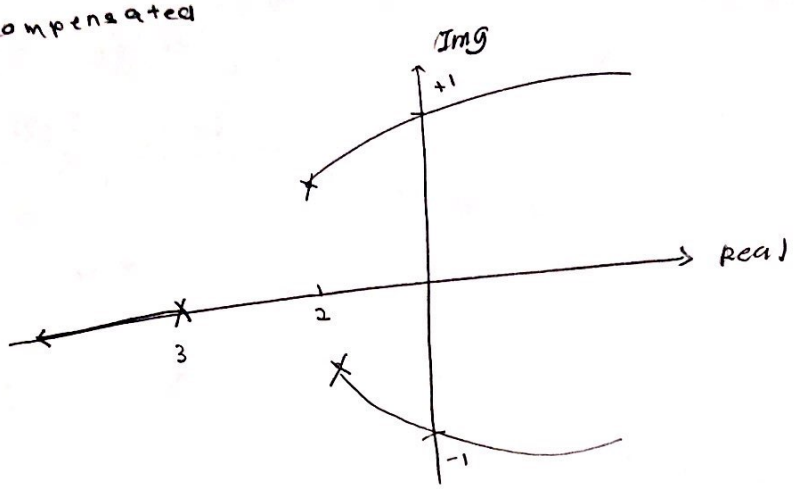
$$= -1.46$$

Img CL poles $= j\,3.18\sqrt{1 - 0.46^2}$

$$= j2.82$$

CL poles $= -1.46 + j2.82$

uncompensated



$$G(s) = \frac{12}{s(s+6)}$$

$$|G(j\omega)| \quad \frac{21.58}{(-20\log\omega)(\sqrt{\omega^2+6})}$$

ii) 20 rads

$$\frac{21.58}{(-20\log 20)(\sqrt{20^2+6})}$$

$$= 0.04$$