

1.1 $\frac{2 \cdot 10^3 s^2}{(s+1)(s+10)^3}$

1.2 $y(t) = \phi + 7.03 \cos(10t + 15^\circ - 39.2^\circ) - 1.5 \times 0.147 \sin(100t - 45^\circ - 162.2^\circ)$

1.3 $C(s) = K \frac{(s+1)^2}{s^4}$ margin $C(s) \cdot G(s)$
 $K \in [0, 10^{GM/20}] = (0, 3.31)$ $10.4 \text{ dB @ } 4.91 \text{ rad/sec}$

2.1 $\frac{G(s)}{1+G(s)} = \frac{10}{s^2+2s+1} \rightarrow G(s) = \frac{10}{s^2+2s+1}$

2.2 $C(s) = K \frac{(s^2+2s+1)}{s(s+p)}$ $\frac{CG}{1+CG} = \frac{10K}{s^2+p s+10K}$ $4 < 10K < 9$
 i.e. $K = 0.625$, $p = 2\sqrt{2.5} = 5\sqrt{}$ $P = 2\sqrt{10K}$

3.1 $\dot{X}_1 = X_2$ $\dot{X}_2 = e^{X_1} + u$
 $X_{1,op} = \phi$ $X_{2,op} = \phi$ $u_{op} = -e^{X_{1,op}}$
 IF $\gamma = 0.2 \in [0.1, 0.3]$ $C(s) = 0.625 \frac{s+1}{s}$

$\dot{X}_{1,op} + \Delta \dot{X}_1 = (X_{2,op} + \Delta X_2)^2 \approx \phi$
 $\dot{X}_{2,op} + \Delta \dot{X}_2 = e^{(X_{1,op} + \Delta X_1)} + (u_{op} + \Delta u_1)$
 $\approx e^{X_{1,op}} (1 + \Delta X_1) + (u_{op} + \Delta u_1)$
 $= e^{X_{1,op}} \Delta X_1 + \Delta u_1$

$\begin{bmatrix} \Delta \dot{X}_1 \\ \Delta \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ e^{X_{1,op}} & 0 \end{bmatrix} \begin{bmatrix} \Delta X_1 \\ \Delta X_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \Delta u_1 = A \begin{bmatrix} \Delta X_1 \\ \Delta X_2 \end{bmatrix} + B \Delta u_1$

3.2 $\text{eig} \begin{bmatrix} 0 & 0 \\ e^{X_{1,op}} & 0 \end{bmatrix} = \phi, \phi \rightarrow \text{op, ana twn wres / ab wres}$

3.3 $\Delta u_1 = [k_1 \quad k_2] \begin{bmatrix} \Delta X_1 \\ \Delta X_2 \end{bmatrix} \rightarrow \begin{cases} \Delta \dot{X}_1 = 0 \Delta X_1 \\ \Delta \dot{X}_2 = (e^{X_{1,op}} + k_1) \Delta X_1 + k_2 \Delta X_2 \end{cases}$

Av $k_2 = -1 \rightarrow \text{eig}(A+BK) = d, -1$

