國　立　清　華　大　學　命　題　紙

96 學年度 電機領域聯合招生 系（所） _____ 組碩士班入學考試

科目 控制系統 科目代碼 9910 共 2 頁第 1 頁 *請在【答案卷卡】內作答

1. Consider a unity-feedback system with open-loop transfer function
$G(s) = k(s^2 + 2s + 5)/s(s + 3)(s^2 + s + 1); k \geq 0$ (20%)
Sketch the root locus plot.

2. Please explain or define the following items:

(A) Using Nyquist plot to define gain margin (GM) and phase margin (PM)
(B) Stability robustness
(C) Minimum phase and non-minimum phase systems (20%)

3. An electomechanical system is modeled by
$G(s) = \frac{5}{(10^{-3}s+1)} \frac{0.05}{s(0.05s+1)} \frac{1}{1+(0.6/20\times10^3)s+(s/20\times10^3)^2}$ and it is cascaded with a PD controller of $G_c(s) = 400(s+1)$, Please
(A) plot the open loop Bode diagram of $G_c(s)G(s)$,
(B) plot the closed-loop Bode diagram under unity feedback,
(C) compare the performance of (A) and (B). (30%)

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4. A plant to be controlled has the following dynamic governing equations: (30%)

$$\frac{d}{dt}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t) + \begin{bmatrix} 0 \\ -0.1 \end{bmatrix} d(t)$$

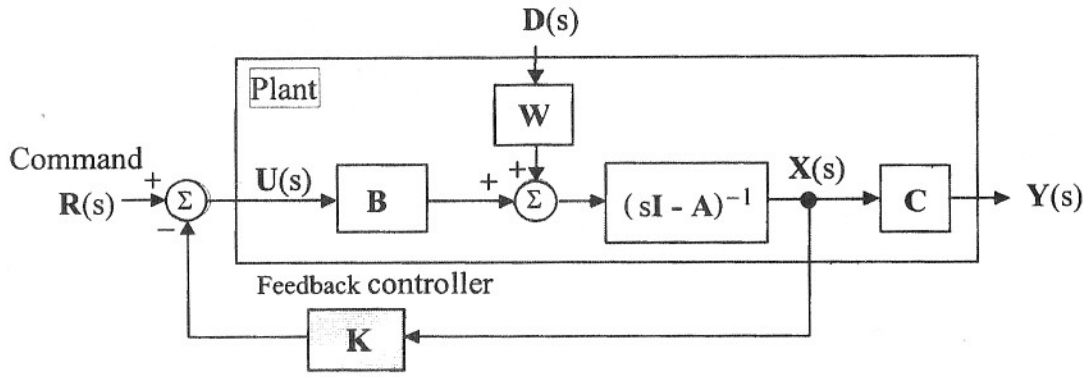
$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

(1) Let **K**= 0 and **D**(s)= 0, find the plant transfer function matrix: $\mathbf{H}_{p(s)}=\mathbf{C}(s\mathbf{I}-\mathbf{A})^{-1}\mathbf{B}$.

(2) If it is desired to assign the closed-loop poles at -17 and -26, find the state feedback gain matrix $\mathbf{K} = [k_1, k_2]$.

(3) Let **D**(s)= 0, find the closed-loop transfer function matrix.

(4) Find the steady-state value of output y(t) due to unit-step change of command input r(t).



(5) For the following first-order process, briefly describe how to estimate the parameters a and b from the step response test.