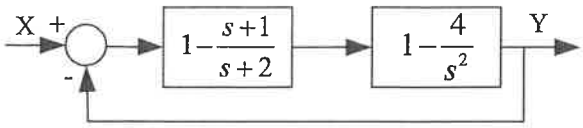
國立中正大學 114 學年度碩士班招生考試試題

科目名稱：自動控制　　本科目共 1 頁　第 1 頁

系所組別：機械工程學系光機電整合工程

1. (10%) The output of the following system has a transfer function *Y/X*. Find the poles and zeros of the closed-loop system.



2. (20%) Consider the following transfer functions. Transform the state equations into the controllability canonical form and observability canonical form.

(a) (10%) $\dfrac{s^2-1}{s^2(s^2-2)}$

(b) (10%) $\dfrac{2s+1}{s^2+4s+4}$

3. (20%) Determine the controllability of the following systems:

(a) (10%) $A=\begin{bmatrix}-1 & 0 & 0\\ 0 & -1 & 0\\ 0 & 0 & -1\end{bmatrix}$ $B=\begin{bmatrix}1\\1\\1\end{bmatrix}$

(b) (10%) $A=\begin{bmatrix}-1 & 0 & 0\\ 0 & -2 & 0\\ 0 & 0 & -3\end{bmatrix}$ $B=\begin{bmatrix}1\\1\\1\end{bmatrix}$

4. (25%) Consider the first-order dynamics *G* described by the following differential equation:

$$\dot{y}+y=\dot{u},$$

where y is the output and u is the input.

(a) (10%) Calculate the response of y as *G* is submitted to homogeneously initial conditions and a sinusoidal input:

$$u(t)=\sin(\omega t)\equiv Im(e^{j\omega t}),$$

where ω is the input frequency.

(b) (5%) Based on (a), what is the frequency response of *G*?

(c) (5%) Based on (b), sketch the Bode plot of *G*.

(d) (5%) Based on (c), sketch the Nyquist plot of *G*.

5. (25%) This problem is about the realization of Proportional-Integral-Derivative (PID) control from the perspective of frequency response.

(a) (15%) Explain that PI-control is with dual purpose of phase-lag compensation and low-pass filtering.

(b) (10%) Does PD-control behave like phase-lead compensation jointly with high-pass filtering? Why or why not?