國立臺北科技大學

九十三學年度機電整合研究所入學考試

自動控制試題

填准考證號碼

注意事項：

1. 本試題共 5 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

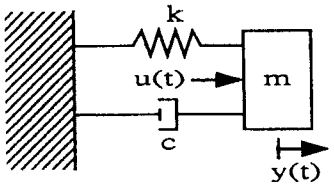
1. 20% A mass-spring-damper system is shown below, where m, k, c are the mass, spring constant, and damping coefficient, respectively. A force u(t) is applied to the mass, resulting in mass displacement of y(t).

(a) Derive the equation of motion of the system and find the transfer function $G(s)=\frac{Y(s)}{U(s)}$.

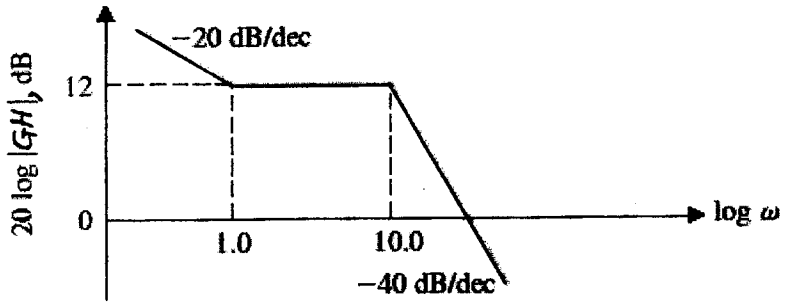
(b) Determine the state space equation of the system $\dot{X}$=AX+Bu, y=CX+Du

(c) Let m=1, k=c=2，find the natural frequency ω_n and damping ratio ς of the system.

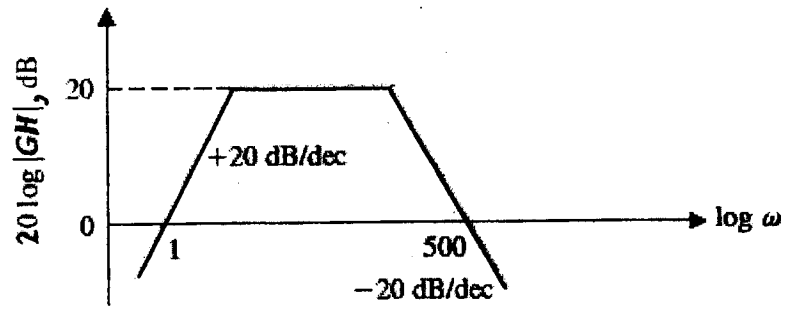
(d) Let m=1, k=c=2. If input force u(t)=2sin(t)，and the resulting steady state response $y_{ss}(t)=Y_0\sin(t+\theta)$，find Y_0 and θ ?



2. 20% The asymptotic log-magnitude curves for two transfer functions are given below. Determine the transfer function for each system. Assume for case (a) the transfer function is $\frac{a(1+bs)}{s(1+cs)^2}$, and for case (b) the transfer function is $\frac{as}{(1+bs)(1+cs)}$



(a)



(b)

3. 25% A single loop negative feedback control system with loop transfer function

$$GH(s) = \frac{\sqrt{10}}{(s+1)(s+2)}$$

(a) Determine the gain crossover frequency ω_g and phase margin pm.

(b) Determine the phase crossover frequency ω_p and gain margin gm.

(c) Discuss the system stability.

(d) If pure time delay e^{-Ts} is cascaded to the loop, determine the delay time T such that the system becomes marginally stable.

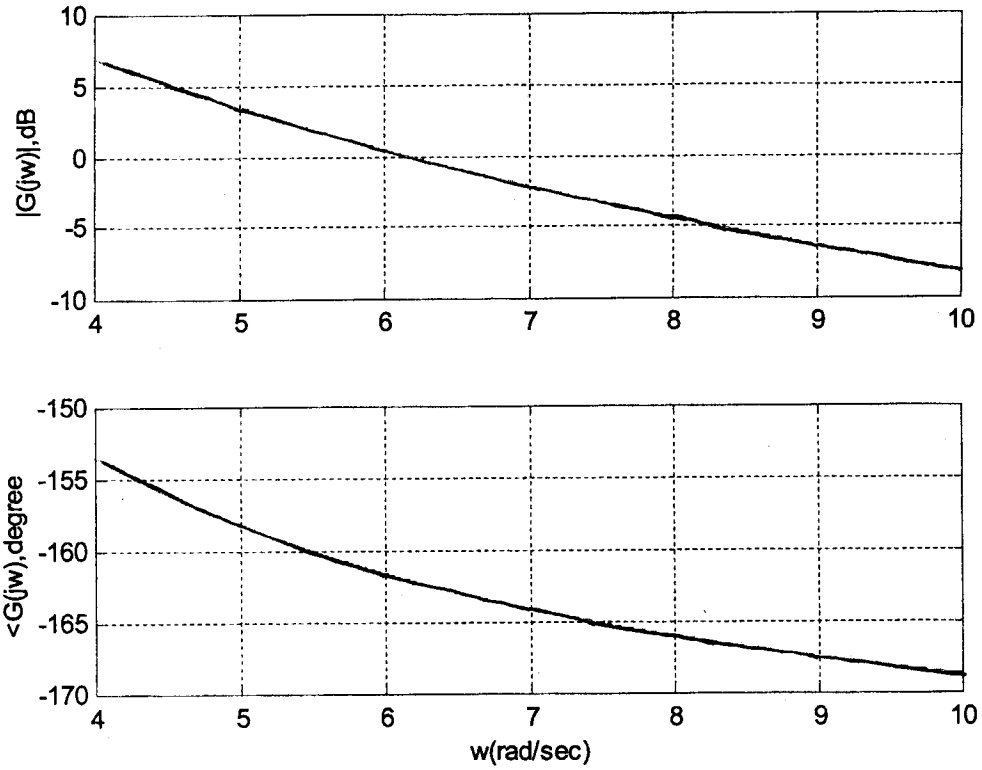
4. 20% A unity feedback control system with loop transfer function $G(s) = \frac{K}{s(s+2)}$

(a) To have a steady-state error for a ramp input equal to 5% of the magnitude of the ramp, find the value of K?

(b) With the K obtained in part (a), bode diagram of the transfer function $G(j\omega)$ is shown below. Estimate the phase margin pm.

(c) For series compensation, design a phase-lead compensator $G_c(s) = \frac{1+\alpha\tau s}{1+\tau s}$ so that the phase margin is raised to 45°.

注意：背面尚有試題



5. 15% For a linear time-invariant system, explain what are the unit-step response and impulse response. Let $y_{step}(t)$ be the unit-step response, show that the impulse response of the system equals $\frac{dy_{step}(t)}{dt}$.