國立台灣科技大學九十九學年度碩士班招生試題

系所組別：材料科學與工程學系碩士班乙組

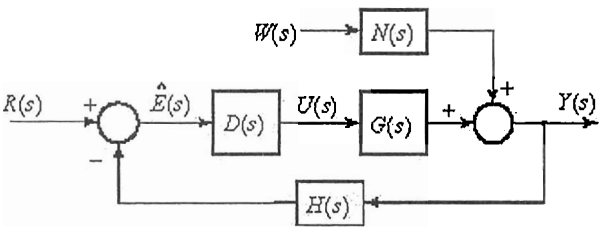
科　　目：控制系統

（總分為100分）

總分 100 分，共五大題。選擇題務必於答案卷內依序作答，在試題內作答者不予計分。

一、選擇題：共 5 小題，每題 8 分，總計 40 分。每小題皆為四選一之選擇題，空白者零分計算，選錯一小題則倒扣 2 分至本大題零分止。(40%)

1. Consider the block diagram shown in following Figure.



The transfer function between $Y(s)$ and $W(s)$ is

(A) $\dfrac{D(s)G(s)N(s)}{1+D(s)G(s)H(s)}$ (B) $\dfrac{N(s)}{1+D(s)G(s)H(s)}$ (C) $\dfrac{N(s)}{1-D(s)G(s)H(s)}$

(D) None of the answers in (A), (B), and (C) is correct

2. An inertial and frictional load are driven by a dc motor with torque T_M.

The dynamic model of the system is $T_M(t) = J\dfrac{d\omega(t)}{dt} + B\omega(t)$

The steady-state speed of the motor for step input will be doubled when

(A) inertia J is doubled (B) friction B is doubled

(C) both the inertia J and friction B re doubled

(D) None of the answers in (A), (B), and (C) is correct

3. The characteristic equation of a feedback control system is given by

$2s^4 + s^3 + 2s^2 + 5s + 10 = 0$, The number of roots in the right half of s-plane are

(A) zero (B) 1 (C) 2 (D) 3

4. A unity feedback system with open-loop transfer function $G(s) = K/[s^2(s+5)]$, where $K > 0$, is unstable for

(A) $K > 5$ (B) $K < 5$ (C) $K > 0$ (D) All the answers in (A), (B) and (C) are correct

5. A unity feedback system with open-loop transfer function $G(s) = 4/[s(s+p)]$ is critically damped.

The value of the parameter p is

(A) 4 (B) 3 (C) 2 (D) 1

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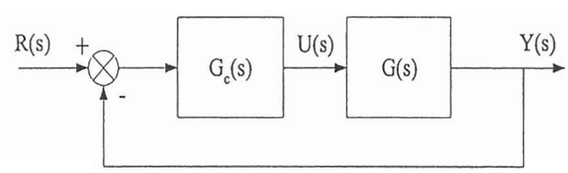
二、A single-input /single-output plant has the transfer function

$$G(s)=\frac{1}{s(s+1)(s+8)}$$

(a) For the control system as shown, design PD control $G_c(s)$ so that the dominant closed-loop poles have a damping ratio of 0.5 and an undamped natural frequency of 2 rad/sec. (8%)

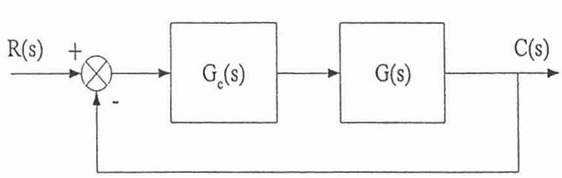


(b) Obtain a state-space model, $\dot{x}=Ax+Bu$ and $y=Cx$, and design a state-feedback control that will place the closed-loop poles at -1 and $-2\pm 4j$.(7%)

三、For the pitch control system of a missile with

$$G(s)=\frac{3}{s^2(s+10)}$$

1. Sketch the root locus to determine whether $G_c(s)$ can be chosen to be a simple gain. (6%)
2. Design a controller $G_c(s)$ which can stabilize the system and for which the system will have a settling time of 4 seconds at high gains (Use a 2% settling time). What is the steady-state error for a unit ramp input? (9%)



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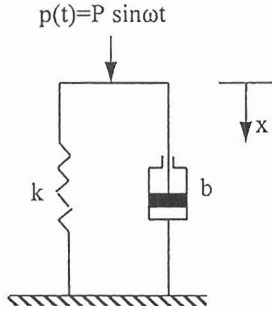
四、Consider the mechanical system as shown, where k is the spring constant, b is the viscous frictional coefficient. If excitation force $p(t) = P\sin\omega t$, where P=1 N and $\omega = 2$ rad/s, is applied, the steady-state amplitude of x(t) is found to be 0.05 m. If the forcing frequency is changed to $\omega = 10$ rad/s, the steady-state amplitude of x(t) is found to be 0.02 m.

Determine the values of b and k. (15%)



五、In the Figure shown below with $G = 1/[(s+1)(s+2)(s+3)]$:

1. Sketch the loci for $G_c = K$ and determine the limiting value of K for stability. (7%)
2. Repeat for the lag compensator $G_c = (K/5)(s+2.5)/(s+0.5)$ and compare the steady-state errors for step inputs with part (a). (8%)