國立高雄第一科技大學 97 學年度 碩士班 招生考試 試題紙

系 所 別：系統資訊與控制研究所　　組　別：控制組

考科代碼：1422　　考　科：自動控制

注意事項：

1、本科目可使用本校提供之電子計算器。

2、請於答案卷上規定之範圍作答，違者該題不予計分。

1.(14分) 請分別就下列各種補償控制器(Compensator)說明其轉移函數、功用效果(Function)、及其特性(Characteristics)：(a)PI Compensator (b)Lag Compensator (c) PD Compensator (d)Lead Compensator (e)PID Compensator (f)Lead-Lag Compensator.

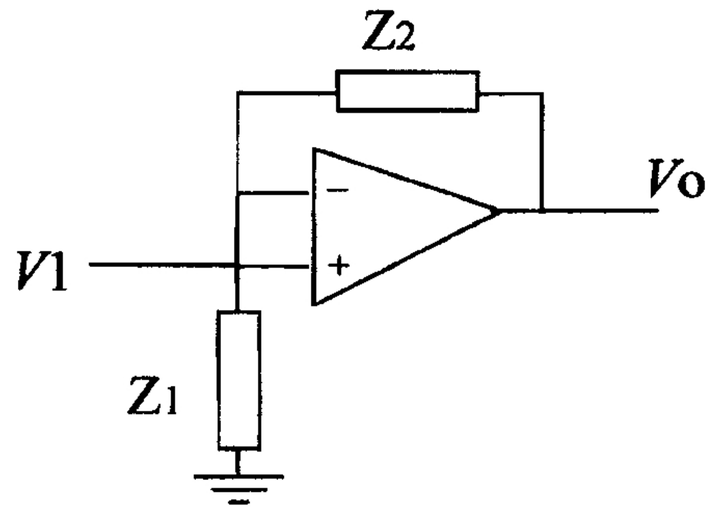
(各 2%, 2%, 2%, 2%, 3%, 3%)

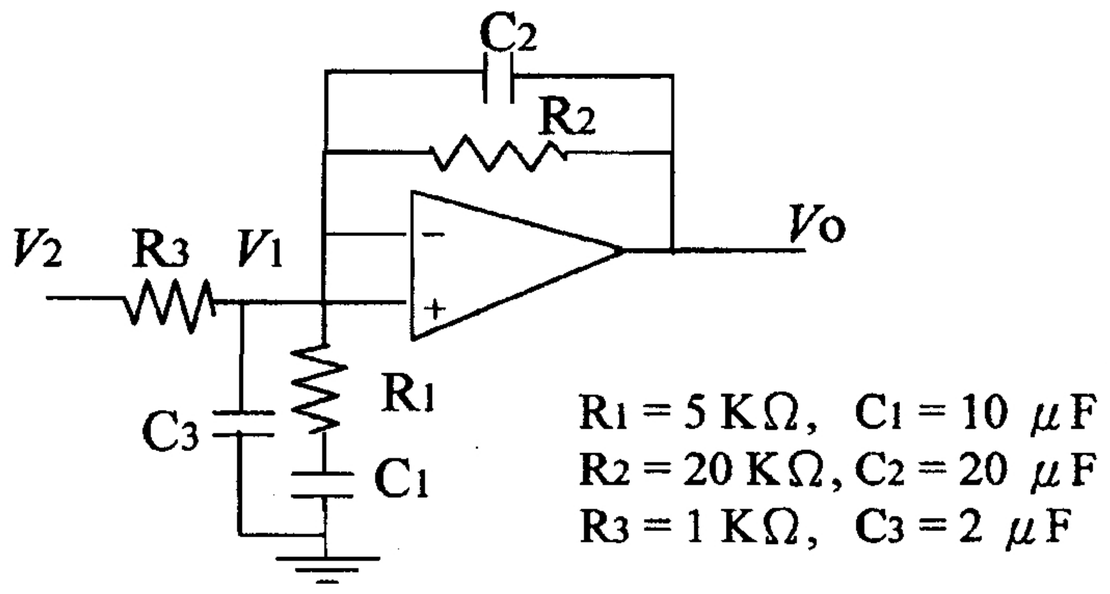
2 (14分)

(a) 請繪出一 OP-Amp 之等效電路圖, 並說明其理想特性爲何? (4%)

(b) Derive the transfer function, $G(s) = V_o(s) / V_1(s)$, in terms of Z_1 and Z_2, for the non-inverting amplification circuit shown in the left below. (5%)

(c) Find the transfer function, $G(s) = V_o(s) / V_2(s)$, for the non-inverting circuit shown in the right below. (5%)





$R_1 = 5\,K\Omega$, $C_1 = 10\ \mu F$
$R_2 = 20\,K\Omega$, $C_2 = 20\ \mu F$
$R_3 = 1\,K\Omega$, $C_3 = 2\ \mu F$

3. (12分)

(a) A system represented in state space as

$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

can be transformed to a similar system with $x = Pz$.

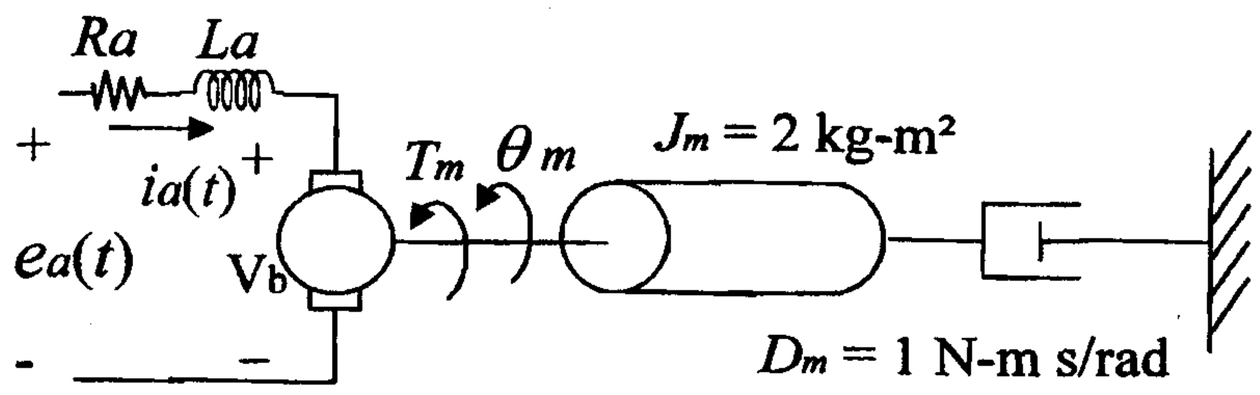
Derive the transformed system.

$$\dot{z} = A'z + B'u$$
$$y = C'z + D'u$$

(b)Given the system as follows,find the diagonal system that is similar

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$$
$$y = \begin{bmatrix} 1 & -1 \end{bmatrix} x + 5u(t)$$

4.(12分) Given the dc-motor driven system as shown below with fixed field,
(a) derive and draw the system block diagram with input $Ea(s)$, output $\theta m\ (s)$, armature current Ia(s), motor torque Tm(s), and speed ωm(s)
(b) find the transfer function, θm (s) / Ea(s).



Ra = 5 Ω
La = 0.1 H
Kt = 1 N-m/A
Kb = 0.5 V-s/rad

5.(12分) Given the dc-motor driven system as shown below with the same motor as in problem 4,
(a) derive the total inertia Jm and total damping Dm, both refer to the motor axis
(b) draw the system block diagram with input $Ea(s)$, armature current Ia(s), motor torque Tm(s), motor speed ωm(s), velocity V(s) of mass M and displacement $X(s)$ of mass M.
(c) find the transfer functions, X(s) / Ea(s).

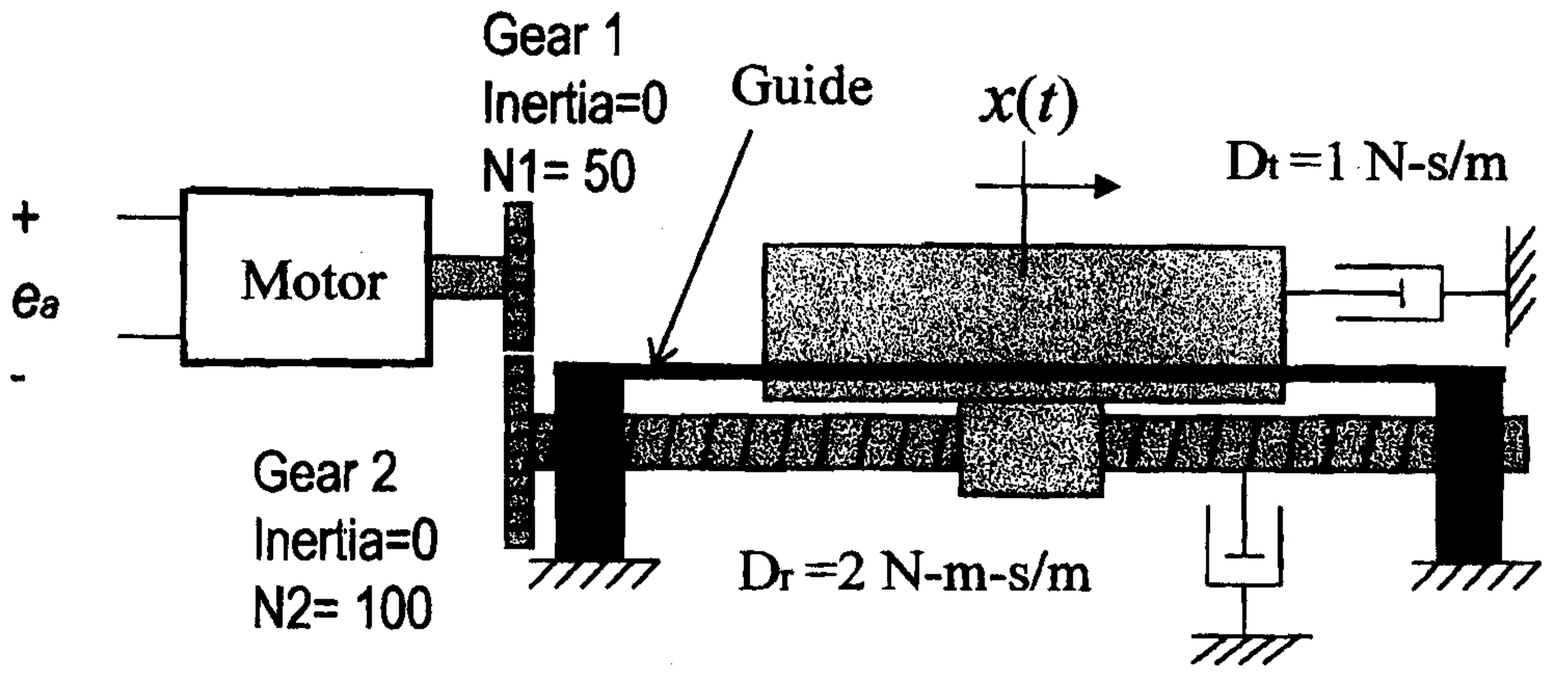


Table Mass, M = 100Kg
Ball Screw Pitch = 5mm

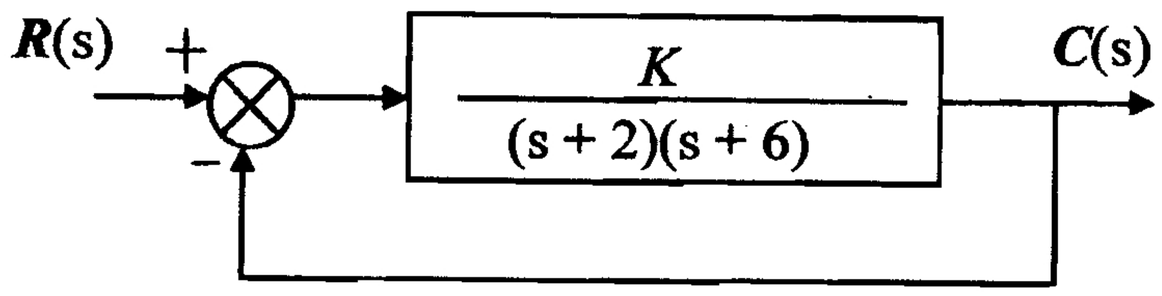
6.(18分) Given an uncompensated feedback system as shown below, do the following (approximate solution is enough)

(a) Sketch the root locus, including the asymptotes with real-axis intercept, σa, and angle, θa for the uncompensated system. (4%)

(b) Find the value of K for the uncompensated system to have < 5% overshot. (4%) (for %OS < 5%, you can approximate $\zeta = \cos\theta = 0.707$, or $\theta = 45^\circ$)

(c) Design a PD controller so that the system can operate with a settling time that is half that of the uncompensated system with the same overshot. (5%)

(d) Sketch the root locus of the PD compensated system (5%)



7.(18分) Given a unity feedback system as shown below,

(a) Plot the Bode diagram with Gc(s) = K = 1000. (3%)

(b) Find the phase margins and bandwidth of the uncompensated system in (a). (3%)

(c) Find the steady-state error for a ramp input,r(t) = 10tu(t). (4%)

(d) Design a lag compensator Gc(s) for the system to have phase margin of 60° with the same steady-state error. (4%)

(e) Find the bandwidth of the compensated system. (4%)