國立高雄第一科技大學 100 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：2144　　考　科：自動控制

注意事項：

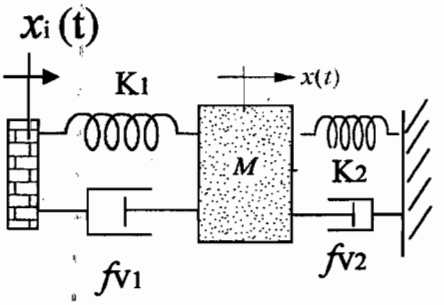
1、本科目得使用本校提供之電子計算器。

2、請於答案卷上規定之範圍作答，違者該題不予計分。

1. (12分)

(a) Find the transfer function, $G(s) = X(s) / X_i(s)$, for the translational mechanical system as shown.

(b) Find the state-space representation from the transfer function obtained.

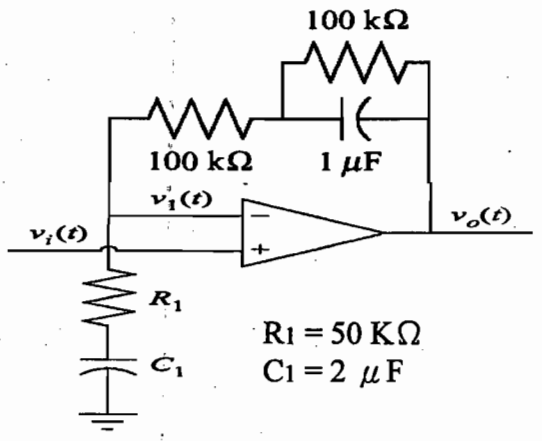


K_1= 24 N/m, K_2= 12 N/m, M = 4Kg, f_{v1} = 8 N-sec/m, f_{v2} = 4 N-sec/m

2. (12分)

(a)請繪出運算放大器(OP-Amp)之等效電路並述說其理想特性，

(b) Find the transfer function, $G(s) = V_o(s) / V_i(s)$, for the op-amp circuit as shown.



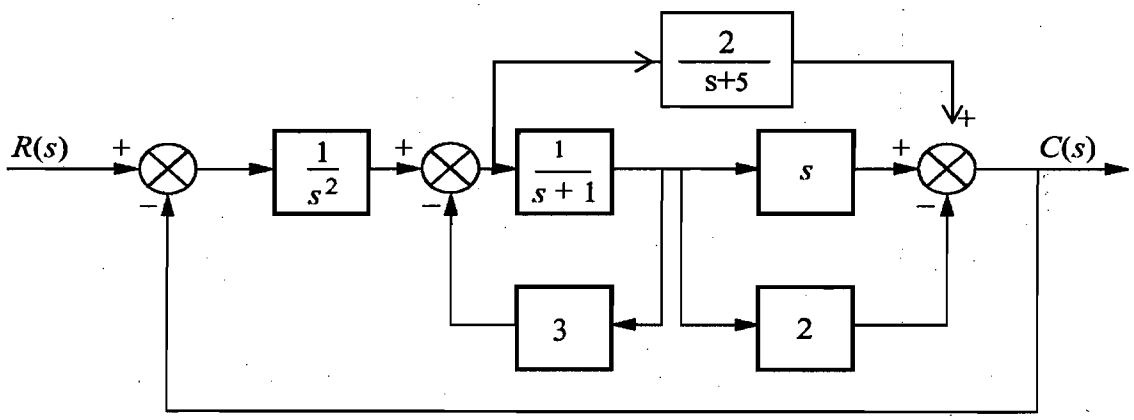
R_1 = 50 KΩ

C_1 = 2 μF

3. (12分)

(a)Find the closed-loop transfer function, T(s)=C(s)/R(s) for the system shown below, using block diagram reduction method

(b) Whether is this system stable, unstable, or marginally stable? Why?



4. (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

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -4 & -5 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \end{bmatrix} u(t)$$
$$y = \begin{bmatrix} 1 & 2 \end{bmatrix} x + 2u(t)$$

5.(20分) Given the dc-motor driven system as shown below with fixed field,

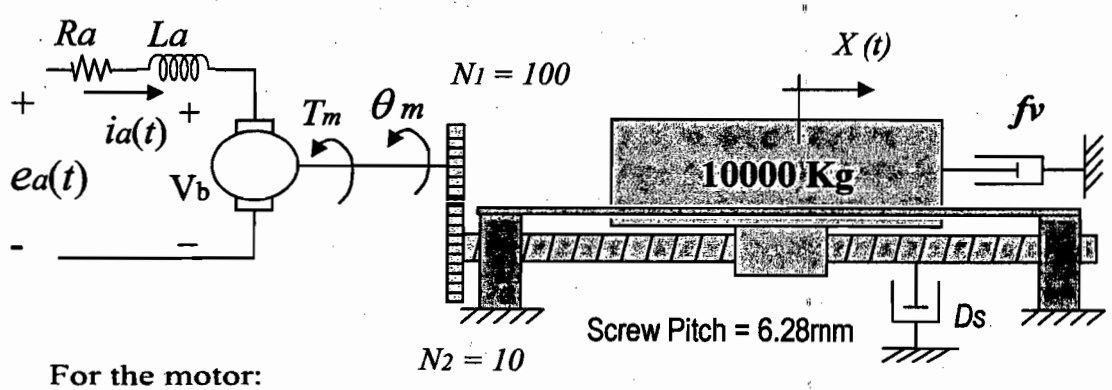
(a) if the gear pair, N1 and N2, is uncoupled, i.e., the motor is under free run without loading, derive and draw the system block diagram with input voltage $E_a(s)$, armature current $I_a(s)$, motor torque $T_m(s)$, motor speed $\omega_m(s)$, and motor angular displacement $\theta_m(s)$.

(b) in the case (a), find the transfer function, $\theta_m(s) / E_a(s)$

(c) under gear coupled, derive the total inertia J_m and total damping D_m, both refer to the motor axis

(d) under gear coupled, redraw the system block diagram with input voltage $E_a(s)$, armature current $I_a(s)$, motor torque $T_m(s)$, motor speed $\omega_m(s)$, velocity V(s) of mass M and displacement $X(s)$ of mass M.

(e) in the case (d), find the transfer functions, $X(s) / E_a(s)$.



For the motor:

$J_a = 1$ kg-m^2

$D_a = 1$ N-m-s/rad

$R_a = 1\ \Omega$ $\quad La = 20$ mH

$K_b = 1$ V-s/rad

$K_t = 1$ N-m/A

Ds = 0.01N-m-s/rad

$fv = 10000$N-s/m

6. (16分) Given a unity feedback system as shown below,

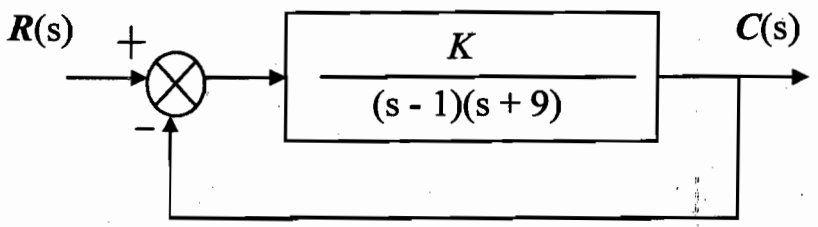
(a) Sketch the root locus with the asymptotes real-axis intercept, σ_a, θ_a, and the break-away point.

(b) Find the value of K for the uncompensated system to operate at 5% overshot, and find the settling time *Ts* and steady-state error for step input.

(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 one-third of the uncompensated system at 5% overshot.

(d) Sketch the root locus for the PD compensated system.



7.(16分) Given a unity feedback system as shown below,

(a) Plot the Bode diagram with Gc(s) = K = 200

(b) Find the phase margins and bandwidth of the uncompensated system (a) from the Bode plot.

(c) Design a lag compensator Gc(s) for the system to have phase margin of 60° with the same steady-state error specification as (a)

(d) Estimate the bandwidth of the compensated system (c).