國立臺灣師範大學 103 學年度碩士班招生考試試題

科目：**自動控制**　　適用系所：**機電工程學系**

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. Please describe (1)Linear system, (2)Time-invariant system, (3)Causal system. (15 分)

2. In an armature-controlled dc motor which is shown in Fig. 1, a voltage e_a is applied to the armature through an amplifier of gain K_A. The torque T_M developed by motor drives the load with angular velocity ω.

K_T, K_b = motor torque and back emf constant

R_a = armature winding resistance

L_a = armature winding inductance

T_w = disturbance load torque

J = moment of inertia of the motor rotor with attached mechanical load

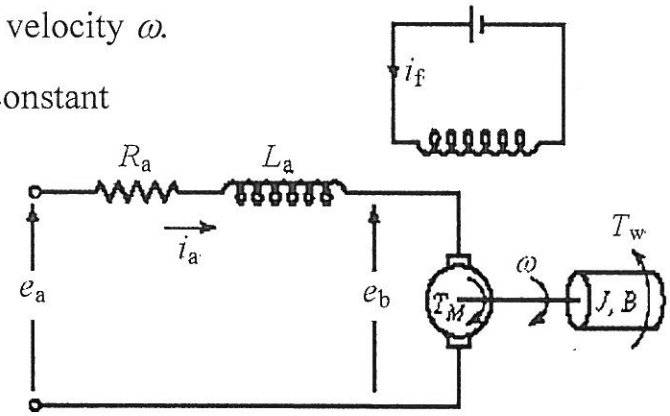

Fig. 1

B = viscous-friction coefficient of the motor rotor with attached mechanical load

ω, θ = angular velocity and displacement of the motor rotor

Assume the block diagram of the above dc motor drive system is shown in Fig. 2

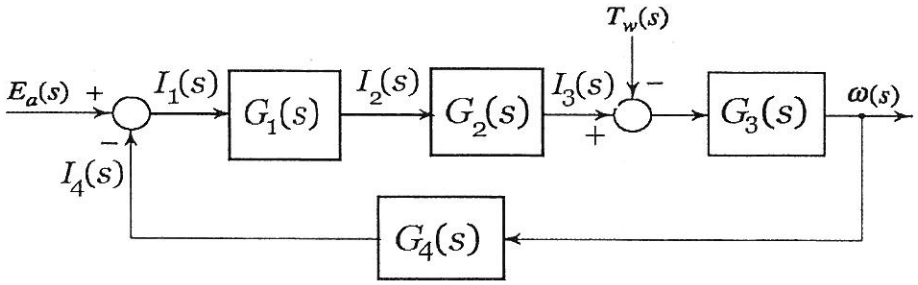

Fig. 2

(1) Find $I_1(s)$, $I_2(s)$, $I_3(s)$, $I_4(s)$, $G_1(s)$, $G_2(s)$, $G_3(s)$, and $G_4(s)$. (16 分)

(2) Describe the overall system transfer function. (4 分)

3. Given a unit feedback system block diagram as shown in Fig. 3.

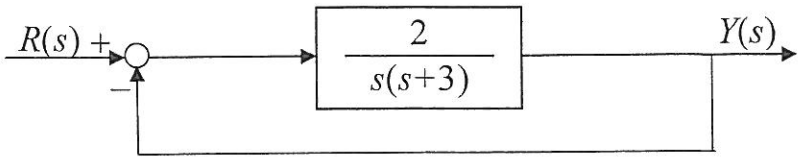

Fig. 3

(1) Describe the overall system transfer function. (5 分)

(2) Is the system stable or not? Please proof your answer. (5 分)

(3) Find the response $y(t)$ to the input ①step=$2.5r(t)$ ②ramp=$2.5\ t\,r(t)$ in time domain of this system. (10 分)

(4) Calculate the system steady state error of step and ramp response. (5 分)

4. The system $G(s)$ in Fig. 4 has three poles($+5j$, $-5j$, and -2) and no zeros. The controller $C(s)$ has four types (1)$C(s)=K_P$, (2)$C(s)=K_P+K_I/s$, (3)$C(s)=K_P+K_D\,s$, and (4)$C(s)=K_P+K_I/s+K_D\,s$ (where K_P, K_I, and K_D are all positive numbers). Which type of controller can move all the closed-loop poles to the left half plane? Please proof your answer. (20 分)

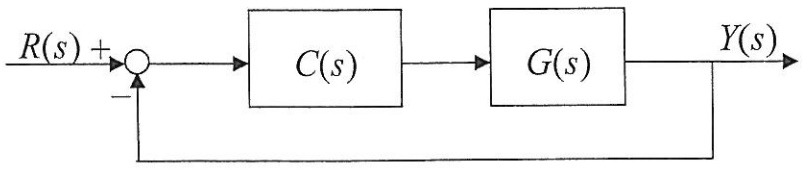

Fig. 4

5. How to determine the bandwidth of the closed-loop control system? Please explain the reasons why the bandwidth is a good measure of the speed of the system response. (20 分)