國立臺灣科技大學
九十一學年度碩士班招生考試試題

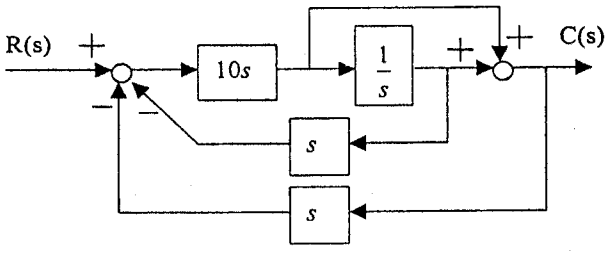
系所組別： 機械工程系丁組
科　目： 線性系統控制

注意：本科目總分 100 分。試題卷有 2 頁，共 5 題，每題 20 分。

1. (a) Write down the procedure to have Bode plot of a given DC motor experimentally without using instruments such as signal analyzers or spectrum analyzers. (10%)
   (b) Please use daily life example to explain the physical meaning of the bandwidth of a dynamic system without using any sense such as -3dB or Bode plot. (10%)

2. Describe the properties of the following systems in terms of their linearity and time dependence.
   (a) $\ddot{y}(t)+5\dot{y}(t)+6y(t)=0$ (4%)
   (b) $\ddot{y}(t)+5\dot{y}(t)+6y(t)+10=0$ (4%)
   (c) $\ddot{y}(t)+5\dot{y}(t)+6y(t)+\sin t=0$ (4%)
   (d) $\ddot{y}(t)+(5\sin t)\dot{y}(t)+6y(t)=0$ (4%)
   (e) $\ddot{y}(t)+5\dot{y}(t)+6\sin y(t)=0$ (4%)

3. Find the steady state error between reference input R(s) and actual output C(s) for standard step input. (20%)



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4. Consider a single-input system

$$\ddot{x} + 10\dot{x} + a(t)x = b(t)u + d(t)$$

where $a(t)$ and $b(t)$ are known system parameters and $b(t) \neq 0$ for all $t \geq 0$. Assume that disturbance $d(t)$ is measurable.

(a) Please design a controller so that the system state converges to zero asymptotically. (10%)

(b) Design a controller so that the system state $(x, \dot{x})$ converges to the desired trajectory $(x_d, \dot{x}_d)$ asymptotically. (10%)

5. Given a control system

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = u$$

where u is selected as a state feedback law as

$$u = -x_1 - x_2$$

You are asked to check system stability in the following steps:

(a) Find the equilibrium state of the system. (5%)

(b) Define a proper Lyapunov function candidate. (5%)

(c) Use the Lyapunov function candidate to prove that the equilibrium state is stable in the sense of Lyapunov. (5%)

(d) Further, please prove that the equilibrium state is actually asymptotic stable in the large. (5%)

Note: *In solving this problem, you may only apply the Lyapunov stability theory.*