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： 機械工程系碩士班丁組

科　　目： 系統控制

（總分為100分）

題目共五大題 ，總分 100 分 每小題有標示所占分數

1. (a) Please reduce the block diagram shown in Figure 1 to obtain the system closed loop transfer function. (10%)

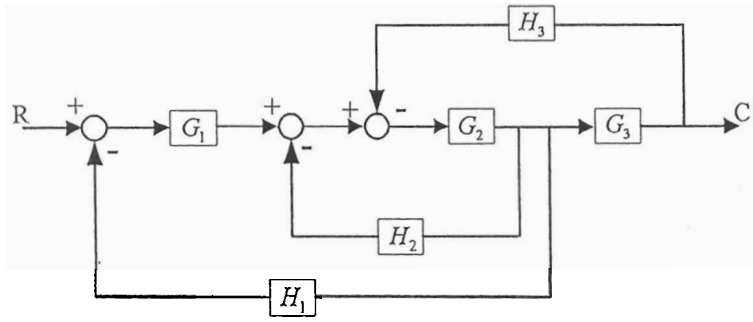

Figure 1

(b) Calculate the time domain output response c(t) of a control system with transfer function $T(s)=\frac{4}{s+3}$ and input $r(t)=3u_s(t)\cos 2t$, where $u_s(t)$ is a unit- step function. (10%)

2. The system shown in Figure. 2 is a unity feedback control system with an output derivative feedback loop.

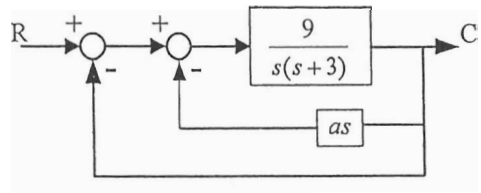

Figure. 2

(a) In the absence of derivative feedback loop ($a = 0$), please determine the closed loop system **damping factor and natural frequency.** Calculate the steady-state error resulting from a unit-ramp input (15%)

(b) Determine the derivative feedback constant a, which will increase the damping factor of this closed loop system to 0.7. What is the steady-state error corresponding to a unit-ramp input with this specified derivative feedback constant? **(15%)**

3. Please answer following questions shortly

(a) What kind of plots can be used to show system frequency response? And please write down their main indices related to the system stability. (5%)

(b) What are the system time domain response and frequency domain response? Please explain what can we observe from these response plots? (5%)

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4. A unit feedback control system has an open loop transfer function as following equation. Please sketch this system root locus plot by determining the following values.

$$G(s)=\frac{k}{(s+2)(s+3)(s^2+2s+5)}$$

(a) centroid, asymptotic angles (5%)

(b) angle of departure of root loci from the poles (5%)

(c) estimate real axis breakaway point (5%)

(d) the value of k which causes sustained oscillations and the frequency of oscillation. (5%)

5. From the following asymptotic Bode diagram, Figure 3,

(a) Find the open loop transfer function $G(s)=\frac{kB(S)}{A(s)}$ with simple explanation. (5%)

(b) Please write down this system gain margin and bandwidth (rad/sec). (5%)

(c) If we want the system has 45° phase margin, how to adjust the gain value k? (5%)

(d) Please simply sketch this system Nyquist plot with system type and pole-zero number only. You do not need to calculate any crossover point. (5%)

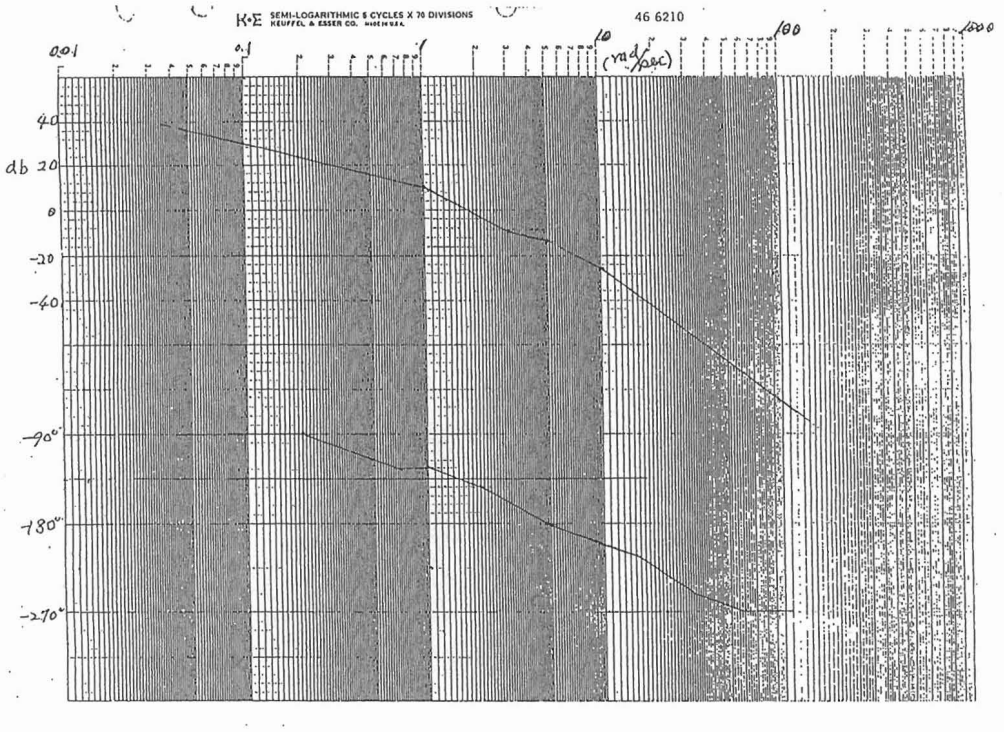

Figure 3