編號： 138 國立成功大學 107 學年度碩士班招生考試試題

系　　所：航空太空工程學系

考試科目：自動控制　　考試日期：0205，節次：1

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider the feedback control system shown in Fig.1, where $G(s)=\dfrac{5}{s^2+6s+8}$

   (a). (10%) Design a controller $kC(s)$ to achieve the following requirements

   (1). Zero steady state error to a step reference R(s)

   (2). Settling time (2% error) = 2 s.

   (3). damping ratio=0.5.

   (b). (5%) Determine poles and zeros of the closed-loop system obtained in part (a).

   (c). (10%) Plot root locus of the system with $C(s)$ obtained in part (a) with $k>0$.

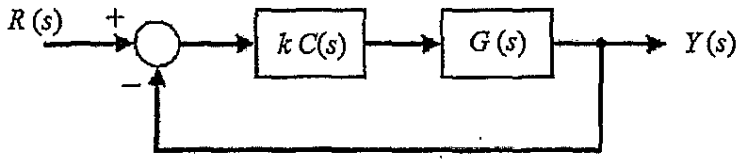

Fig.1　Block diagram of a closed-loop control system.

2. Consider a unity feedback system shown in Fig.2, where $KG(s)=\dfrac{K}{s(s^2+52s+100)}$,

   (a). (10%) For K = 1000, plot the Bode plot of G(s) and determine phase margin, gain margin, phase crossover frequency, gain crossover frequency.

   (b). (7%) For K = 1000, plot the Nyquist plot of G(s) and determine the upper bound of K for system stability.

   (c). (8%) Determine K such that the system has a phase margin of 45 degree.

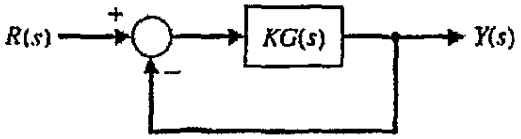

Fig2. A unity feedback system.

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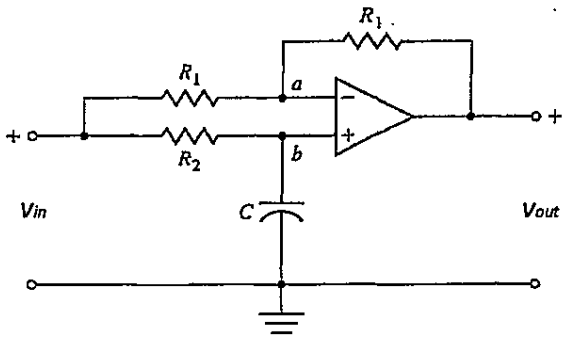
3. An operational amplifier circuit that can serve as a filter circuit is shown as follows.

(a). Determine the transfer function of the circuit $V_{out}(s)/V_{in}(s)$, assuming an ideal op-amp (10%).

(b). Find $v_{out}(t)$ when the input is $v_{in}(t)=At$, where $t\geq 0$ (10%).

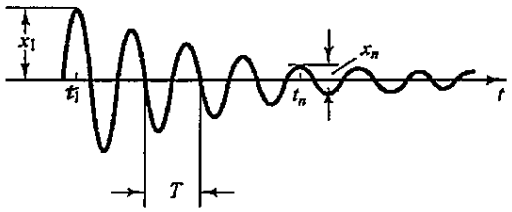
(c). Can we use the filter to attenuate the noise that appears in the input $v_{in}(t)$ (5%)? Please explain the reason (5%).



4. An oscillator is designed as a standard 2nd order system

$$G(s)=\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$$

where the response is shown as follows. Please calculate the damping ratio, which is represented in terms of x_1, x_n and n. (10%)



5. Consider the satellite attitude control system shown in Figure 5(a).

(a). Please find the steady state error when $R(s)$ is a step input. (5%)

(b). Consider Figure 5(b), can we design a proper K_h to achieve a desired nature frequency? Please explain why and how? (5%)

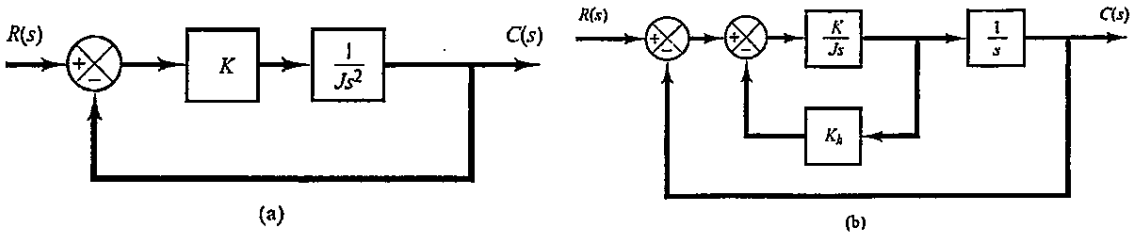


Figure. 5