國立臺灣科技大學

114學年度碩士班招生

試題

系所組別：0742電機工程系碩士班丁二組

科　　目：信號與系統

<<507421>>

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(總分為 100 分；所有試題務必於答案卷內頁依序作答)

1. (15%) Let $x(t)$ in Fig. 1.

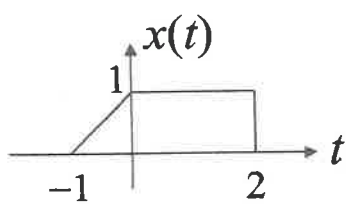

Fig. 1. A wave-form.

Please make a sketch of (a). $x(t-3)$. (b) $x(3-t)$. (c) $x(2(t+1))$.

2. (20%) Calculate the Fourier series coefficients of the following continuous-time periodic signal in Fig. 2.

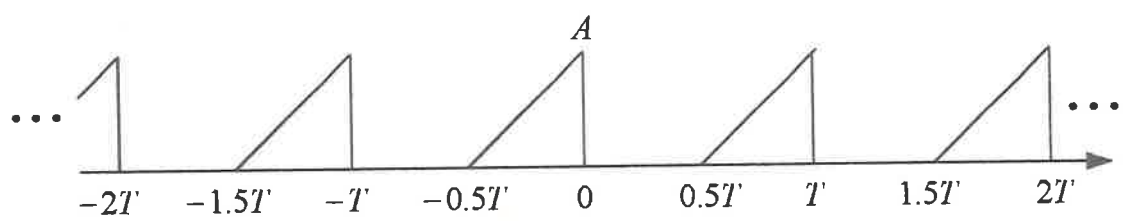

Fig. 2. A continuous-time periodic signal.

3. (15%) Let $x(n)$ be a discrete-time signal. Its z-transform is

$$X(z) = \frac{1}{(1+0.5z^{-1})(1-0.5z^{-1})^2}, \text{ Region of convergence is } |z| > 0.5.$$

Please find the expression of $x(n)$.

4. (21%) Find (a) $C(s)/R(s)$, (b) the value of K in the system of Fig. 3(a) that will place the closed-loop poles as shown in Fig. 3(b), (c) the poles in part (b).

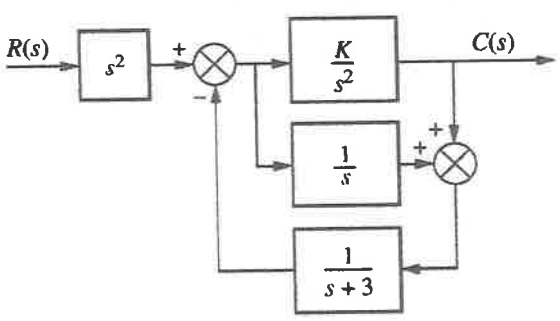

Fig. 3(a). Feedback system.

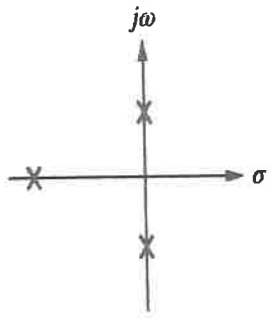

Fig. 3(b). Closed-loop pole

5. (10%) Consider the feedback in Fig. 4 with $G(s) = K/(s+1)$, $H(s) = 1/(s+2)$, and K is any real number. Find the range of K such that the closed-loop system is stable.

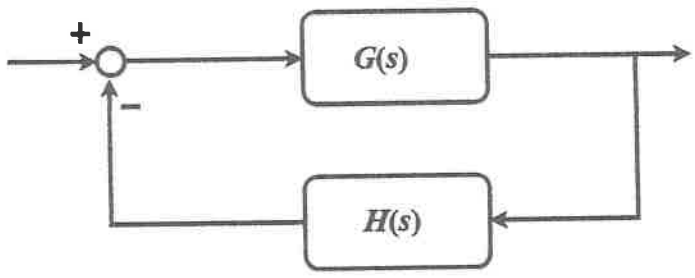

Fig. 4. A feedback system.

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(總分為 100 分；所有試題務必於答案卷內頁依序作答)

6. (19%) (a) Plot the Bode plot of open-loop transfer function $G(s) = (s+3)/[(s+2)(s^2+2s+25)]$. The plot is depicted by the frequency log (w), amplitude (dB), and phase (degree). (b) Find its gain margin (GM) and phase margin (PM) for a unit negative feedback (see Fig. 5).
(Hint: (i) phase =-(pole number - zero number)*90 (degree) as frequency approaches infinite, (ii) a 2nd order $G(s) = \omega_n^2/[s^2 + 2\zeta\omega_n s + \omega_n^2]$, its amplitude peak $M_p = 1/\left[2\zeta\sqrt{1-\zeta^2}\right]$, at $\omega_p = \omega_n\sqrt{1-2\zeta^2}$, $as\ \zeta \le 0.707$; its phase= -90 degrees at $\omega = \omega_n$, (iii) a 1st order $G(s) = 1/[1+\tau\ s]$, its phase=-45 degrees at $\omega = 1/\tau$, (iv) a amplitude $20\log_{10}(k)\,dB$ as $\omega \to 0$, (v) $\log_{10}(2) = 0.301, \log_{10}(3) = 0.4771, \log_{10}(5) = 0.6990, \log_{10}(7) = 0.8451$.

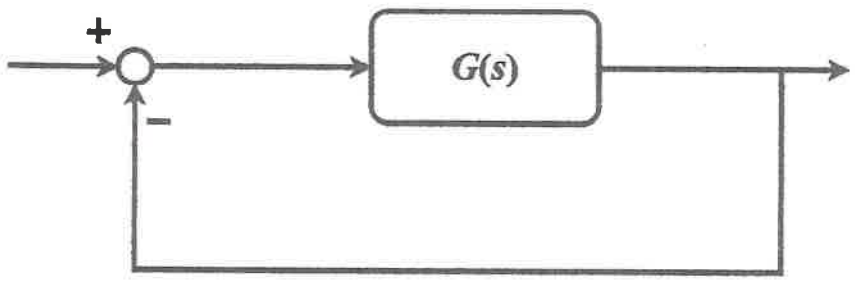

Fig. 5. A negative feedback system.