八十五學年度核子工程學系工程物理系（所）＿＿＿＿組碩士班研究生入學考試

科目 控制系統 I 科號 3807 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

一、是非題 40%（每一小題2%，共20小題）

下列各小題之敘述若為正確答(T)，若不正確答(F)，將答案寫在答案卷內，答錯每題倒扣一分。

1. If a unity-feedback control system type is 2, it is certain that the steady-state error of the system to a step input or a ramp input will be zero. (T) (F)
2. For the second-order prototype system, when the undamped natural frequency ω_n increases, the maximum overshoot of the output stays the same. (T) (F)
3. The maximum overshoot of the following system will never exceed 100 percent when ζ, ω_n, and T are all positive.

$$\frac{Y(s)}{R(s)} = \frac{\omega_n^2(1 + Ts)}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$ (T) (F)

4. Increasing the undamped natural frequency will generally reduce the settling time of the step response. (T) (F)
5. Adding a zero to the forward-path transfer function will generally improve the system damping, and thus will always reduce the maximum overshoot of the system. (T) (F)
6. The location of the roots of the characteristic equation in the s-plane will give a definite indication on the maximum overshoot of the transient response of the system. (T) (F)
7. The following transfer function $G(s)$ can be approximated by $G_L(s)$ since the pole at -20 is much larger than the dominant pole at $s = -1$.

$$G(s) = \frac{10}{s(s + 1)(s + 20)} \qquad G_L(s) = \frac{10}{s(s + 1)}$$ (T) (F)

8. The asymptotes of the root loci refer to the angles of the root loci when $K = \pm\infty$. (T) (F)
9. Given the equation $1 + KG_1(s)H_1(s) = 0$, where $G_1(s)H_1(s)$ is a rational function of s and does not contain K, the roots of $dG_1(s)H_1(s)/ds$ are all breakaway points on the root loci $(-\infty < K < \infty)$. (T) (F)
10. Adding a zero to the loop transfer function will always increase the bandwidth of the closed-loop system. (T) (F)
11. Phase-crossover frequency is the frequency at which the phase of $L(j\omega)$ is 0°. (T) (F)
12. Gain margin is measured at the phase-crossover frequency. (T) (F)
13. A Bode plot can be used for stability analysis for minimum- as well as nonminimum-phase transfer functions. (T) (F)

14. Once the value of K_D of a PD controller is fixed, increasing the value of K_P will increase the phase margin monotonically. (T) (F)

15. If a PD controller is so designed that the characteristic-equation roots have better damping than the original system, the maximum overshoot of the system is always reduced. (T) (F)

16. A system compensated with a PD controller is usually more robust than a system compensated with a PI controller. (T) (F)

17. The phase-lead controller is generally less effective if the uncompensated system is very unstable to begin with. (T) (F)

18. The design objective of the phase-lead controller is to place the maximum phase lead at the frequency where the magnitude of the uncompensated $G_p(j\omega)$ is $-10\log_{10} a$, where a is the gain of the phase-lead controller. (T) (F)

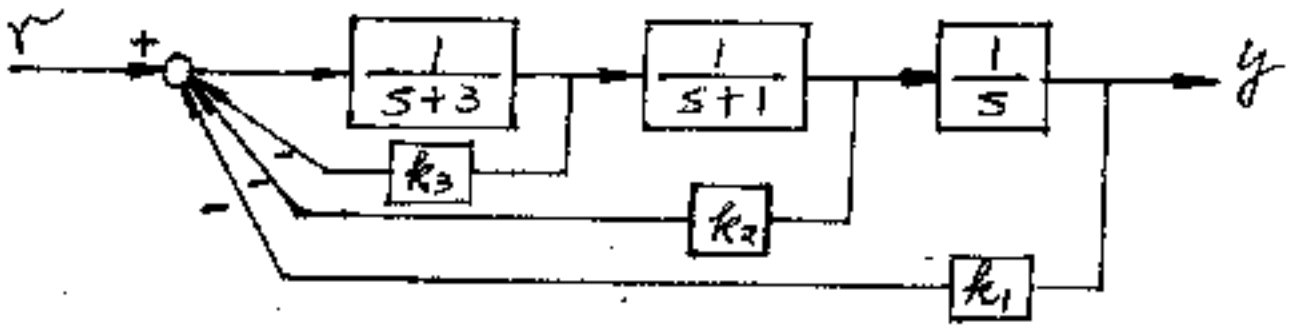
19. The phase-lead controller may not be effective if the negative slope of the uncompensated process transfer function is too steep near the gain-crossover frequency. (T) (F)

20. The principle of design of the phase-lag controller is to utilize the zero-frequency attenuation property of the controller. (T) (F)

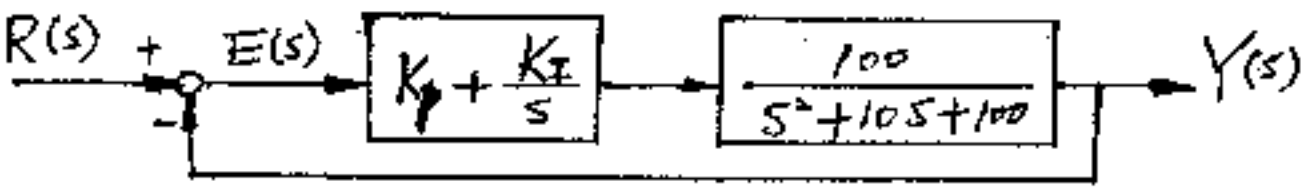
二、試求下列系統中之 k_1, k_2, k_3, 使符合 (20%)

i) 對 step input 之 steady-state error $e_{ss}=0$.

ii) 複數根位於 -1±j，



三、試依下圖



a) 求 K_I 使得 ramp-error constant $K_v=10$.

b) 利用求得之 K_I 值作 $0 \leq K_p < \infty$ 之系統根軌跡圖 (root contours) (20%)

四、試根據下列之圖解答 (a) 至 (j) 各小題所求之系統單迴授特性 (unity-feedback control) (20%)

(a) Gain-crossover frequency (rad/sec) when $K = 1$.

(b) Phase-crossover frequency (rad/sec) when $K = 1$.

(c) Gain margin (dB) when $K = 1$.

(d) Phase margin (deg) when $K = 1$.

(e) Resonance peak M_r when $K = 1$.

(f) Resonant frequency ω_r (rad/sec) when $K = 1$.

(g) BW of the closed-loop system when $K = 1$.

(h) The value of K so that the gain margin is 20 dB.

(i) The value of K so that the system is marginally stable. Find the frequency of sustained oscillation in rad/sec.

(j) Steady-state error when the reference input is a unit-step function.