所別：機械工程學系碩士班 丁組(系統)(一般生)　　科目：自動控制　共 2 頁 第 1 頁
機械工程學系光機電工程碩士班 甲組(機電系統控制)(一般生)
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本科考試可使用計算器，廠牌、功能不拘　　＊請在試卷答案卷（卡）內作答

1. 考慮 *Figure 1* 中之系統，其中 $G(s) = \frac{3\sqrt{6}}{(s+1)(s+4)}$，請回答下列問題：：

(a) 請畫出 *G(s)*的極圖(polar plot) (3%)，找出 *G(s)*極圖與實數軸交點(3%)及其所對應的頻率(3%)， 同時請找出 *G(s)*極圖與單位圓的交點(3%)及其所對應的頻率(3%)。

(b) 請由 *G(s)*的極圖找出其所對應的 Gain Margin (GM) 為何(3%)? 與 Phase Margin (PM)為何?(3%)

(c) 請問在圖一系統中，若要選一個大於零的 *K* 使得閉迴路系統(closed loop system)穩定，則 *K* 的範圍應該為何(4%)?

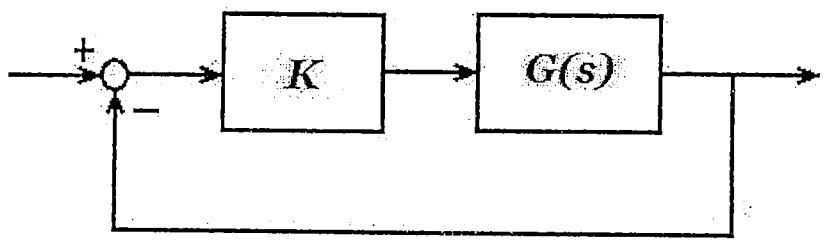

Figure 1. Block diagram for Problem 1.

2. A feedback control system is shown in the *Figure 2*. The specification for the closed-loop system requires that the overshoot to a step input be less than 10%.

(a) Determine the corresponding specification M_{pw} in the frequency domain for the closed-loop transfer function, where M_{pw} is defined as the resonant peak magnitude. (10%)

(b) Determine the resonant frequency ω_r. (8%)

(c) Determine the bandwidth of the closed-loop system. (7%)

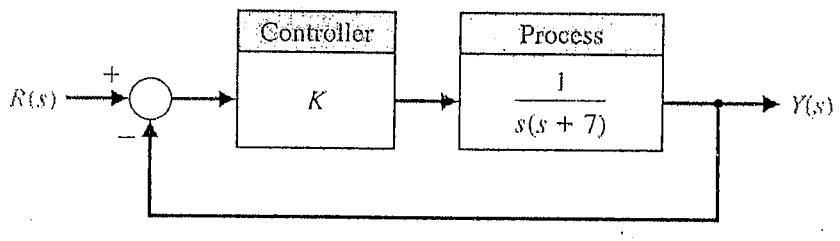

Figure 2. Block diagram for Problem 2.

注意:背面有試題

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參考用

3. Consider the stable feedback system shown in *Figure 3*, where an integral (I) controller of integral gain K_I is used.

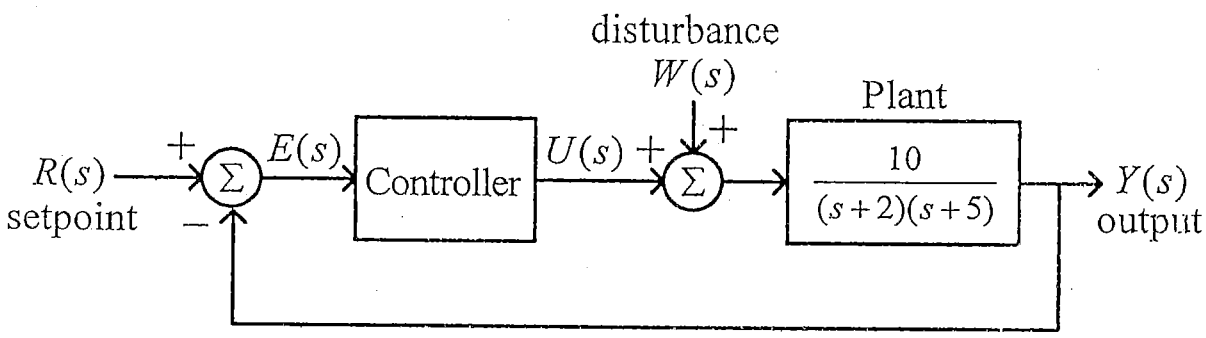


Figure 3. Block diagram for problem 3.

(a) Find the transfer function from R to Y. (4%)

(b) Let setpoint be a unit step, that is, $r(t) = 1$ for all $t \geq 0$. Show that the output can asymptotically track the input. (8%)

(c) Find the transfer function from W to Y. (4%)

(d) Let disturbance be a unit ramp, that is, $w(t) = t$ for all $t \geq 0$. Choose the particular value for the integral gain K_I that will result in the system with a steady-state error of less than 0.2. (9%)

4. Given a unit feedback system with $G(s) = \frac{10}{s(s+1)}$ and $G_c = \frac{s+z}{s+8}$,

(a) (5 points) Sketch the root locus of the closed-loop system when $K(= 10z)$ varies. (i.e, Root locus with respect to K. no detail computations are needed)

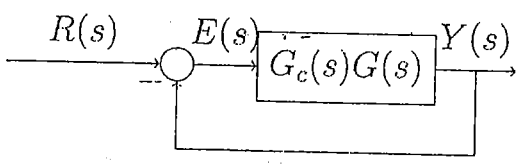
(b) (5 points) Suppose the ONLY real root $s = -7$ is known, find the dominant complex poles that have a damping ratio $\zeta = 0.5$.

(c) (5 points) Determine the value of z that achieves the design specifications stated in (b).

(d) (5 points) With z obtainded from (c), sketch the root locus of $K_1GH = \frac{K_1(s+z)}{s(s+1)(s+8)}$.

(e) (5 points) Given the totally different root loci obtained in (a) and (d), how do you know the plots are telling the same story?

When plot the root loci, no need for details, just a sketch to illustrate the idea.



Block diagram for Problem 4.

注意：背面有試題