國立中正大學
112學年度碩士班招生考試
試 題

[第2節]

科目名稱	自動控制
系所組別	機械工程學系-乙組

—作答注意事項—

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始40分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

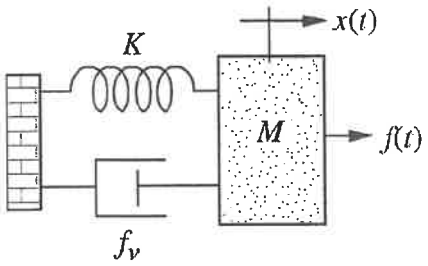
國立中正大學 112 學年度碩士班招生考試試題

科目名稱：自動控制　　本科目共 1 頁　第 1 頁

系所組別：機械工程學系-乙組

1. (20%) Given the pole location of the standard 2nd order system (-3 ± 6*j*), please find the natural frequency, damping ratio, peak time, percent overshoot, and approximate settling time.

2. (20%) Please find the dynamic equations and free body diagrams in time domain and Laplace domain for the following system. The transfer function of $X(s)/F(s)$ should be reported. If it is a second-order system, please also provide the damping ratio and natural frequency.



3. (10%) For the unity-feedback system, find the value of K to yield an acceleration error constant K_a of 50.

$$G(s) = \frac{K(s+4)(s+6)(s+12)}{s^2(s+1)(s+5)(s+7)(s+9)}$$

4. (25%) Consider the dynamics G with the transfer function being

$$G(s) \equiv \frac{s}{s^2+1}.$$

(a) (10%) Plot the root locus of $1+kG(s)=0$ along with positive k, i.e. $k \in [0,\infty)$.

(b) (10%) Plot the loot locus of $1+kG(s)=0$ along with negative k, i.e. $k \in (-\infty,0)$.

(c) (5%) Let the dynamics G be negatively feedback-connected by saturation with upper limit 0.5 and lower limit -0.5 to form a closed-loop dynamics M. It is found that the closed-loop dynamics M is bounded-input-bounded-output stable. Explain this fact by the root locus plotted in (a) and (b).

5. (25%) Consider the dynamics G with the transfer function being structured as

$$G(s) = G_0(s)(1+W(s)\Delta(s)),\ G_0(s) = \frac{1}{s+2};\ W(s) = \frac{s+2}{s+1}.$$

Therein $\Delta(s)$ is uncertain, but the peak value of its Bode magnitude plot has been identified with 1, i.e.

$$|\Delta(j\omega)| \le 1 \text{ for } \forall \omega \ge 0.$$

Let the dynamics G be negatively feedback-connected by a positive gain k, $k>0$, to form a closed-loop dynamics M. To guarantee the closed-loop dynamics M be (internal) stable, what values of k are candidate?