國立臺灣科技大學
九十四學年度博士班招生考試試題
系所組別：高分子工程系丙組、高分子工程系在職教師丙組
科　　目：控制工程

共五大題，總分 100 分

一、**Explanation** （共 20%）
（a）**Controllability** （5%）　（b）**Observability** （5%）
（c）**Gain Margin**（5%）　（d）**Final-value theorem** （5%）

二、

A controlled plant described by

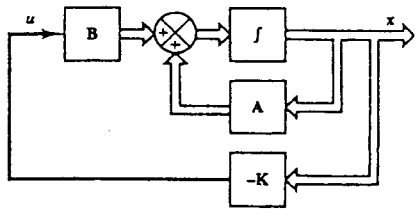
$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}u$$

where

$$\mathbf{A} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

By using state feedback control u= -**Kx**, the desired closed-loop poles are designed as $s = -2 \pm j4$ and $s = -10$.

Determine the state feedback gain matrix **K**. (20%)



三、

A unity negative feedback system with a forward transfer function,

$$G(s) = \frac{K}{s(s^2 + 6s + 10)} \quad , K \geq 0.$$

Sketch the root locus plot. (20%)

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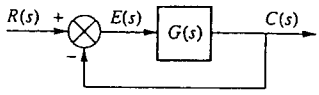
四、

For the unity feedback system with (20%)

$$G(s)=\frac{K(s-2)(s+4)(s+5)}{(s^2+3)}$$

find the range of K for stability.



五、

A force P acts tangent to the path of a particle of mass m, which is attached to a rigid bar of length ℓ (20%)

(1) Derive the equations of motion of the system. (10%)

(2) For small oscillations, and the input is P and the output is θ,

(a) Derive the system transfer function, and calculate the natural frequency of the swing of the mass. (5%)

(b) Is this open loop system stable or unstable? If it is not stable, for stability consideration, what kind of controller do you recommend? (5%)