大同大學 101 學年度研究所碩士班入學考試試題

考試科目：**自動控制**　　所別：機械工程研究所　　

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

(1) A unity feedback system has the loop transfer function

$$L(s) = G_C(s)G(s) = \frac{10K}{s(s+b)}$$

Determine the relationship between the steady-state error to a ramp input and the gain K and system parameter b. For what values of K and b can we guarantee that the magnitude of the steady-state error to a ramp input is less than 0.1? (15 points)

(2) The matrix differential equation for a magnetic bearing system is

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ -3 & -1 & 0 \\ -2 & -1 & -2 \end{bmatrix} \mathbf{x}$$

where $\mathbf{x}^T = [y,\ dy/dt,\ i]$, y = bearing gap, and i is the electromagnetic current. Determine whether the system is stable. (15 points)

(3) For a unity negative feedback system with the loop transfer function

$$G(s) = \frac{K}{s(1+0.2s)(1+0.05s)}$$

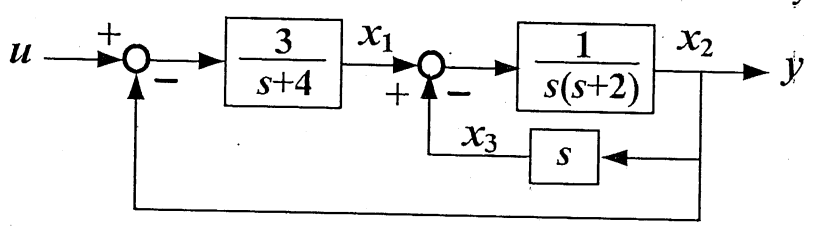
(i) Determine gain K so that the gain margin equals to 20dB.
(ii) Find gain K so that the phase margin equals to 40°. (15 points)

(4) The characteristic equation of a feedback control system is

$$s^3 + 3s^2 + (K-4)s + K = 0$$

Determine the range of K so that the system is stable using the ***Nyquist stability criterion***. (15 points)

(5) For the block diagram shown below, find the state-variable equations ($\dot{x} = Ax + Bu$ and $y = Cx$) using the defined state variables x_1, x_2, and x_3. Is this system controllable? Is this system observable? (20 points)



(6) A unity feedback system has the loop transfer function

$$L(s) = \frac{K}{s^4 + 12s^3 + 64s^2 + 128s}$$

Sketch its root locus for $0 \le K \le \infty$. Find all the necessary values such as asymptotes centered, asymptotes angle, breakaway point, the locus cross the imaginary axis, arrival angle and departure angle. (20 points)