國立成功大學

110學年度碩士班招生考試試題

編　號：127

系　所：系統及船舶機電工程學系

科　目：自動控制

日　期：0202

節　次：第 2 節

備　註：可使用計算機

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※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider a linear system as follows:

$$\begin{cases} \dot{x} = \begin{bmatrix} 0 & 1 \\ -3 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \\ y = \begin{bmatrix} 1 & 0 \end{bmatrix} x \end{cases}$$

a. Design a controller $u = -Kx$ to yield a 10% overshoot and a settling time of 0.5 second, i.e., $s^2+16s+183.1=0$. (5%)

b. Evaluate the steady-state errors for a unit step input, a ramp input and a parabolic input. (10%)

c. Repeat the design of (a) by designing a proportional integral controller, and evaluate the steady-state errors for a unit step input, a ramp input and a parabolic input. (10%)

2. Consider the following linear time invariant system

$$\begin{cases} \dot{x} = Ax + Bu \\ y = Cx \end{cases}$$

a. Derive the steady-state error of this system for a unit step input u=1. (10%)

b. Prove the separation principle based on above linear time invariant system, and describe the physical meaning of this principle. (10%)

3. Consider the following HIV model

$$\begin{cases} \dfrac{dT}{dt} = s - \alpha T - (1-u_1)\beta T v \\ \dfrac{dT^*}{dt} = (1-u_1)\beta T v - \mu T^* \\ \dfrac{dv}{dt} = (1-u_2)kT^* - cv \end{cases}$$

where u_1 and u_2 are control inputs and s, α, β, μ, k and c are constant parameters.

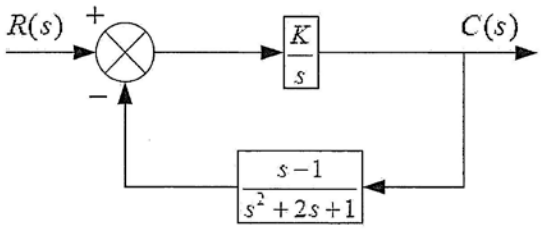
a. Linearize this HIV model with respect to an operation point: (T_o, T_o^*, v_o) and (u_{10}=u_{20}=0). (15%)

b. If s=10, α=0.02, β=2.4×10^{-5}, μ=0.24, k=100 and c=2.4, and define the system's output y=v, express the linearized HIV model as a standard state space form. (5%)

4. Please verify that how many roots of the following polynomial are in the right-half S plane, in the left-half S plane, and on the $j\omega$-axis: (10%)

$$p(s) = s^5 + 6s^3 + 5s^2 + 8s + 10$$

5. Find out the range of K which stabilizes the system as shown in Figure . (15%)



6. Describe the transfer function of the Bode plot shown as below (4%),and calculate Gain Margin (2%), Phase Margin (2%), and Bandwidth (2%)