國立成功大學

112學年度碩士班招生考試試題

編　號：134

系　所：航空太空工程學系

科　目：自動控制

日　期：0206

節　次：第 1 節

備　註：不可使用計算機

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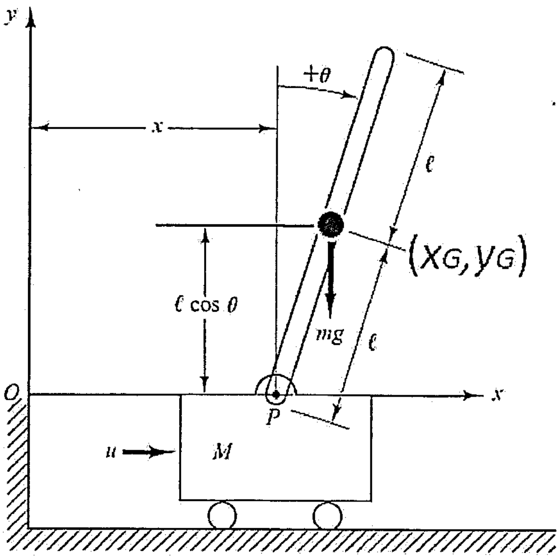
1. (25%) Consider an inverted pendulum system shown as below, where u is the applied force.

(a) Please derive the equations of motions. (10%)

(b) Apply the system linearization with respect to the small angle condition and find the corresponding transfer function from the applied input u to the system output x. (10%).

(c) Examine and explain the stability of the linearized system. (5%)

PS : Please follow the coordinate system defined in the figure.



2. (25%) Please derive the transfer function of $f(t)$ and find the step response of these functions.

(a) $f(t)=\delta(t)$, where $\delta(t)$ denotes an impulse function. (5%)

(b) $f(t)=t$. (5%)

(c) $f(t)=Ae^{-at}$, where A and a are constants. (5%)

(d) $f(t)=\sin(\omega t)$, where ω denotes a constant frequency. (5%)

(e) $f(t)=e^{-at}\sin(\omega t)$, where a and ω are constants. (5%)

PS : Detailed derivations must be given via using the definition of Laplace transform!

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3.

Consider the system shown in Figure 3 with

$$G(s)=\frac{0.1}{(s+5)(s+10)}$$

(a). Using root-locus approach, design $C_1(s)$ that will produce closed-loop complex poles at $s = -5 \pm 10j$ and zero steady state error to a step input reference, for $C_2(s) = 1$. (15%)

(b). With the controller $C_1(s)$ obtained in (a), design a cascade lag compensator $C_2(s)$ such that the steady state error to ramp reference is 0.05 without a significant influence on the performance achieved by $C_1(s)$. (10%)

Achieve the requirement with minimum order controller on both cases and sketch the corresponding root locus.

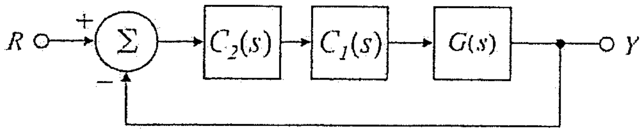

Figure 3 Block diagram of a closed loop system

4.

Consider the Bode plot of a system $G(j\omega)$ shown in Figure 4.

(a) Determine the corresponding transfer function of the system. (10%)

(b) Draw the corresponding Nyquist plot. (10%)

(c) Determine the stability of the unity negative feedback system by Nyquist stability criterion. (5%)

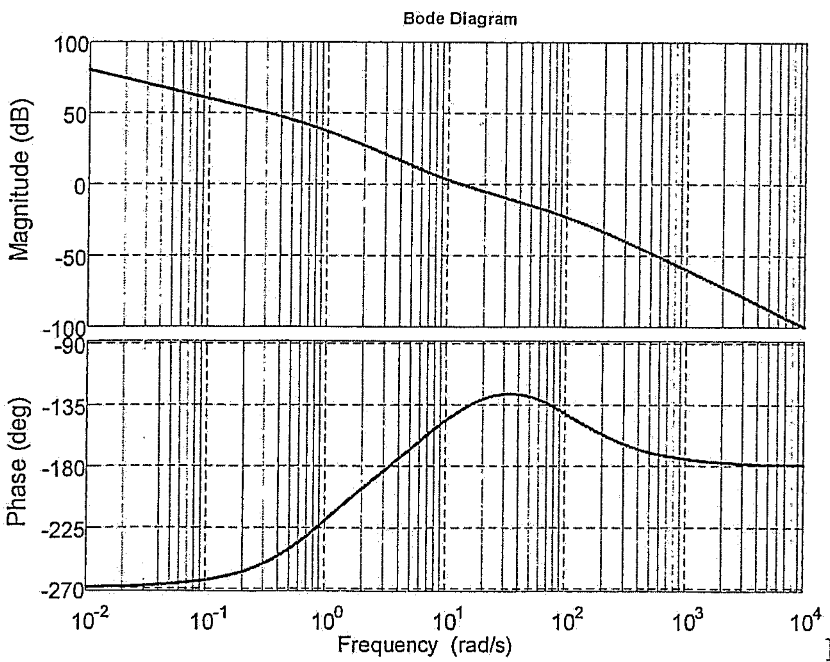

Figure 4