國立臺灣大學 103 學年度碩士班招生考試試題

1. (a) What is linear time-variant (LTI) system? (5%)

   (b) Please provide an operational definition for LTI system such that a real system can be tested. (10%)

2. (a) Please draw the block-diagram of a general feedback control system. (Please mark all the functional blocks and variables clearly.) (15%)

   (b) With the block diagram, please explain why such a feedback configuration can achieve our control goal of regulation normally? (Hint: what isregulation? how can it be achieved with the feedback configuration?) (10%)

3. Suppose a dynamical system is modeled by a set of dynamical equations in the following:

$$\begin{cases}(\mathrm{M}+\mathrm{m})\ddot{x}+b\dot{x}-ml\ddot{\theta}\cos\theta+ml\dot{\theta}^2\sin\theta=F\\ (\mathrm{I}+\mathrm{m}l^2)\ddot{\theta}-mgl\sin\theta=ml\ddot{x}\cos\theta\end{cases}$$

   with M=0.8, m=0.2, l=1.0, b=2, I=0.8, g=10.0. Also assume the operating point of the system is at θ=0 and $\dot{\theta}^2 \sim 0$.

   (a) Please derive the transfer function model G(s) of the dynamical system. (10%)

   (b) Suppose that the dynamical system G(s) is put into a closed-loop system as in Figure 1, please determine the range of k_1 (C(s)=k_1)such that the closed-loop system to be stable. (10%)

   (c) Please draw the root locus of the closed-loop system in Figure 1. (10%)

4. Given a Bode Plot for a dynamic system G as in Figure 2, please answer the following questions:

   (a) Is the dynamic system G stable? (5%)

   (b) What is Phase Margin (PM)? How is it related to the stability of a system as in Figure 1?. (5%)

   (c) What properties of G can you read from the Bode Plot in Figure 2? (10%)

   (d) How should we design a compensator if PM is to be greater than 45 degrees and the steady-state error is to be smaller than 0.01? (10%)

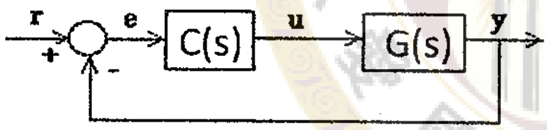

Figure 1 A feedback control system

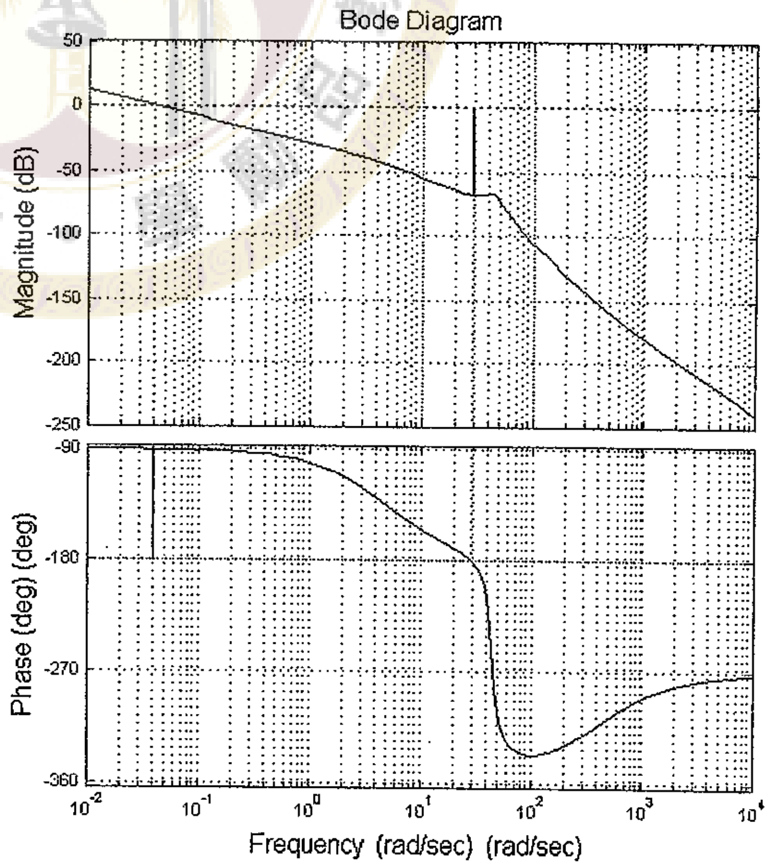

Figure 2 Bode plot on the right