90 學年度 國立成功大學碩士班招生考試 電機工程(乙組)系所 控制工程 試題 共 一 頁 第 一 頁

1. A dynamic vibration absorber is shown in Fig. 1.
   (a) Obtain the differential equations describing the system in which $F(t)$ is the input and $y_1(t)$ is the output. (8%)
   (b) Determine the values of M_2 and k_{12} such that the main mass M_1 does not vibrate when $F(t) = A\sin\omega_0 t$. (7%)

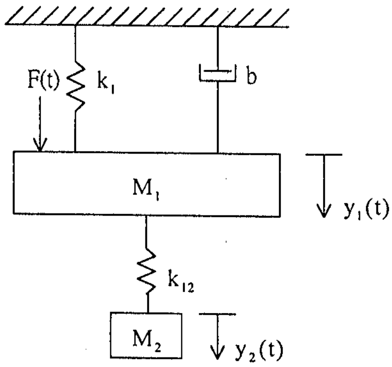

Fig. 1

2. Consider the feedback system in Fig. 2. Fig. 3 depicts the Bode diagram of $G(s)$. Determine an approximate second-order model of $G(s)$. (10%)

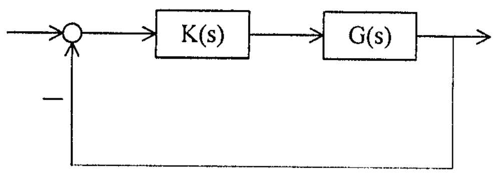

Fig. 2

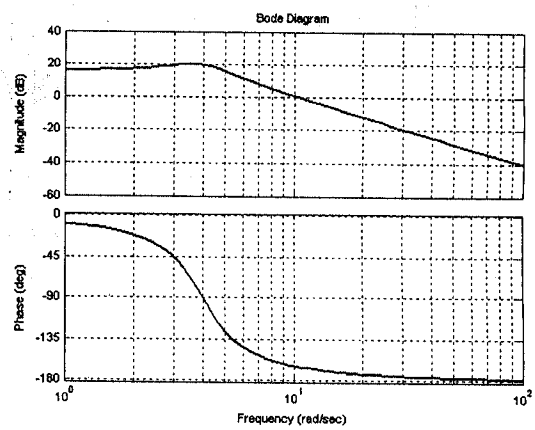

Fig. 3

3. With respect to Problem 2. Design a feedback controller $K(s)$ such that the closed-loop system is stable and has at least 40^0 phase margin and 10 dB gain margin. (10%)

4. Prove that if A is a stability matrix, then the Lyapunov equation $A^T P + PA + Q = 0$ has a unique solution for every Q. (Note: A^T is the transpose of A). (15%)

5. For a discrete-time system with $T = 0.01$ sec, the characteristic equation is given by $(z-0.99)(z^2-0.5z+1.0)=0$.
   (a) Show that this system is marginally stable. (8%)
   (b) Find the frequency at which the system will oscillate. (7%)

6. (a) Name five representations of systems in state space. (5%)
   (b) Why are marginally stable systems considered unstable under the BIBO definition of stability? (5%)
   (c) Define *system type*. (5%)
   (d) Describe the conditions that must exist for all closed-loop poles and zeros in order to make a 2nd-order approximation. (5%)
   (e) Why is there more improvement in steady-state error if a PI controller is used instead of a lag network? (5%)
   (f) Describe the change in the open-loop frequency response magnitude plot if time delay is added to the plant. (5%)
   (g) Briefly explain how a lag network allows the low-frequency gain to be increased to improve steady-state error without having the system become unstable. (5%)

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