85 學年度 國立成功大學 碩士班招生考試 電機工程研究所 控制工程 試題 共 2 頁 第 1 頁

1. A DC motor speed control is shown in Figure 1, where $G(s)=\frac{K_0}{s+1}$, $D(t)=K[e+\frac{1}{K_I}\int_0^t e\,dt]$, $\tau=1/60$, and $K_0=10$.

(a) Please compute the transfer function from torque T_l to output Ω. (5%)

(b) Please compute the transfer function from reference input Ω_r to output Ω. (5%)

(c) Please determine K and K_I so that the characteristic equation of the closed-loop system will have roots at $-60\pm j60$.

(Hint: for parts (a) & (b), $\frac{v_a(s)}{e(s)}=D(s)$) (10%)

2. The Bode Plot shown in Figure 2 is before and after compensation of an open-loop feedback system. Determine the compensation network transfer function $G_c(s)$. (14%)

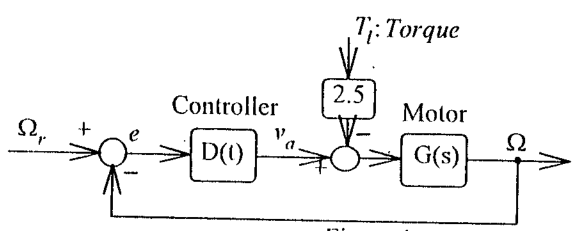

Figure 1

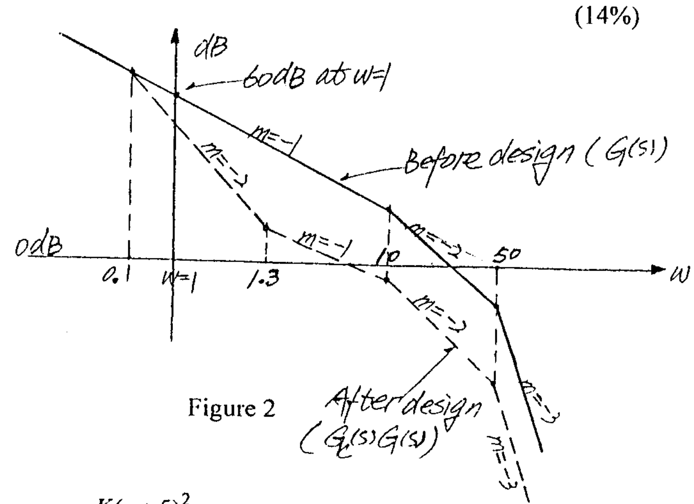

Figure 2

3. A unity feedback system has the open-loop transfer function $G(s)=\frac{K(s+5)^2}{s^2(s-10)}$. Please draw the Nyquist plot to determine the range of K for which the system is stable. (Note: Any other method is NOT accepted.) (13%)

4. (a) Please define the meanings of (OR explain the physical meanings of) "linearity", "relaxed at t_0", "causal", and "time invariant". (12%)

(b) If a linear system has p input terminals and q output terminals, and if the system is initially relaxed at $-\infty$, then the input-output description can be described as $y(t)=\int_{-\infty}^{\infty}G(t,\tau)\,u(\tau)\,d\tau$, where $y(t)\in R^q$ is the output vector, $u(t)\in R^p$ is the input vector, and $G(t,\tau)\in R^{q\times p}$ is the impulse response matrix. Please give new input-output descriptions for the following systems : (1) a linear relaxed at t_0 system, (2) a linear, causal, and relaxed at t_0 system, (3) a linear time invariant system, and (4) a linear time invariant, causal, and relaxed at $t_0=0$ system. (8%)

5. Consider the temperature control system of Figure 3. Suppose that the digital filter transfer function is given by $D(z)=1.2+\frac{0.1z}{z-1}$ which is a PI controller. Suppose that T=2 s and let $R_d(s)$=0.

(a) Using the closed-loop transfer function, derive a discrete state model for the system. (8%)

(b) Derive a discrete state model for the plant from the plant transfer function. Then derive the state model of the closed-loop system by adding the filter and the feedback path to the flow graph of the plant. (6%)

(c) Calculate the transfer function from the state model of (b), to verify these results. (6%)

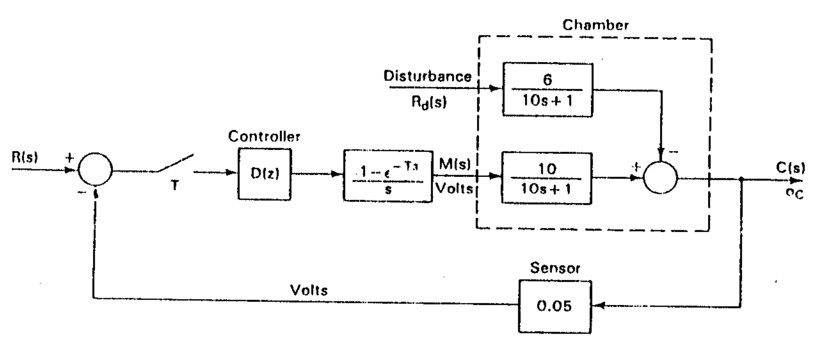

Figure 3

(背面仍有題目,請繼續作答)

6. Consider a unity feedback system with $G(s)=\dfrac{K(s+\alpha)}{s(s+3)(s+6)}$.

(a) Sketch the root locus for $\alpha=5$. (7%)

(b) Find the values of α and K that will yield a second-order closed-loop pair of poles at $-1\pm j100$. (6%)