國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別： 工程技術研究所自動化及控制學程丙組

科　目： 控制系統

總分 100分

1. Consider an antenna position control system shown in Figure 1. A controller with analog voltage output is used. A DC motor is used to drive the antenna. A potential meter is used as feedback of the antenna position. (20%)

(1) Describe the implementing procedures (including the designed diagrams or equations) of this control system. (15%)

(2) State how a computer can be applied in designing or analysing this system? (5%)

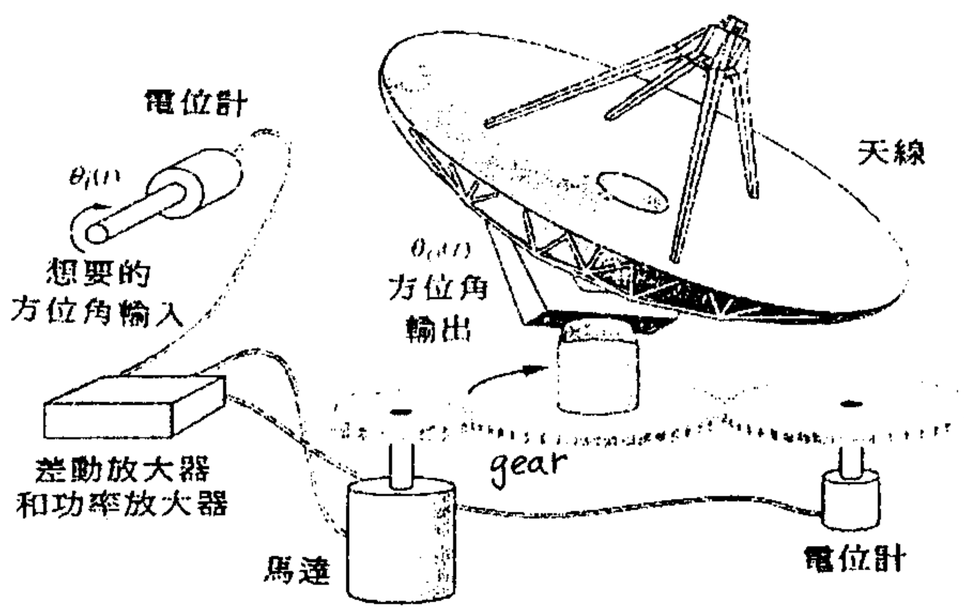

Figure 1 An antenna position control system

2. Consider a steady-state output system with unit step input. (10%)

(1) Explain the rise time and the steady-state error (6%)

(2) State how to improve a system if an overshoot occurs. (4%)

3.For each of the following Laplace-transformed signals, find the initial value y(0) and the final value $y(\infty)$ if it exists. (10%)

(1) $Y(s)=\frac{2s^2+9}{s^3+2s^2+9s}$

(2) $Y(s)=\frac{20}{s^3+2s^2+12s+3}$

4.Use the Routh-Hurwitz criterion to investigate the stability of the following characteristic equations.(10%)

(1) $s^4+2s^3+2s^2+5s+2=0$ (5%)

(2) $s^3+3s^2+s+3=0$ (5%)

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5. Consider that an open-loop transfer function of a control system with unity feedback is given by

$$G(s)=\frac{k}{s(1+s)(9+s)}$$ (30%) Note: log2=0.301 log3=0.477

(1) For k = 9, find phase-crossover frequency w_c in rad/s and the magnitude of $G(jw_c)$ (6%)
(2) For k = 9, find the gain margin and. expalain its meaning (6%)
(3) Find the range of k for system stability from the gain margin obtained in (2). (4%)
(4) Assume the phase of G(jw) at gain-crossover frequency 0.784 rad/s is −133.32 degrees, find the phase margin.(6%)
(5) For k = 18, plot the bode diagram of G(s) for w = 0.1, 0.2, 0.5, 1,2,5, 10. and find new gain margin (8%)

Table 1 |G| in DB for k=9

w	0.1	0.2	0.5	1	2	5	10	20
|G| (DB)	19.96	13.81	5.04	-3.06	-13.22	-29.3	-43.54	-59.79

6. The signal flow graph of a control s system is shown in figure 2. Input is u(t) and output is y(t). (20%)
(1) Find the state equation and matrix. (5%)
(2) Find the controllability matrix and investigate the controllability. (5%)
(3) Find transfer function G(s)=y(s)/u(s). (5%)
(4) Find output y(t) with unit impulse input δ (t). (5%)

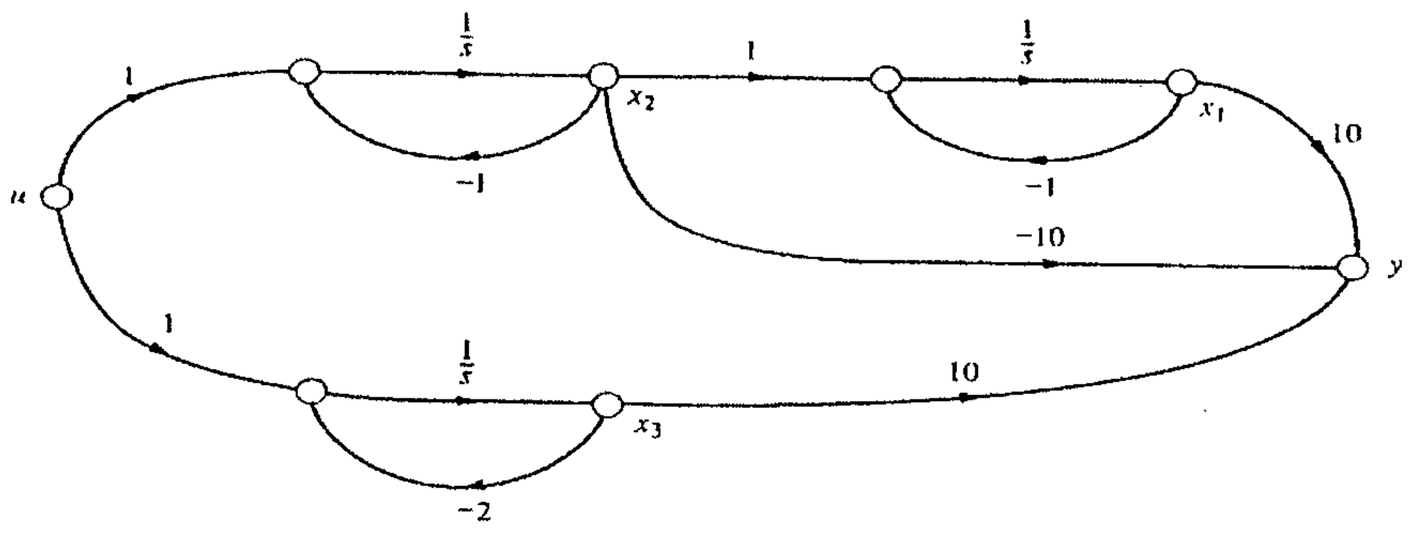

Figure 2 The signal flow graph of a control system