國立嘉義大學九十六學年度

生物機電工程學系碩士班招生考試（乙組）試題

科目：自動控制　　（※禁止使用計算機）

1. Given the block diagram model as shown in the following Fig.1,
   (a) Sketch an equivalent signal-flow graph. (8%)
   (b) Find the transfer function using block diagram reduction rules. (8%)
   (c) Use Mason's gain formula to determine the transfer function. (9%)

2. Consider the system in Fig. 2(a), where the Nichols chart of G(s) is given in Fig.2(b)
   (a) What is the gain margin of the closed-loop system? (5%)
   (b) What is the phase margin of the closed-loop system? (5%)
   (c) What is the steady state error when $r(t)=3$ and disturbance $d(t)=6$ for all $t>0$? (5%)
   (d) Where does the resonant peak of the closed-loop transfer function $\frac{G}{1+G}$ occur (answer in terms of frequency rad/sec) ? (5%)
   (e) What are the maximum amplitude M_{pw} and the resonance frequency ω_r? (5%)

3. A cylinder of mass and polar moment of inertia J about its axis rolls without slip (Fig.3). A damping force is applied at a radius r from that axis, and a spring forces is applied at a radius 2r.
   (a) Calculate the differential equation that relates x (horizontal displacement) to F (a horizontal force on the axis). (15%)
   (b) Find the transfer function $G(s)=\frac{x(s)}{F(s)}$ (5%)
   (c) For a unit step input find $x|_{t=\infty}$ using the final value theorem. (5%)

4. Consider a feedback system with the characteristic equation

$$1+\frac{K}{s(s+1)(s+2)}=0; \qquad K\geq 0$$

   (a) Draw the root locus. (15%)
   (b) Determine a range of values for K, if a range exists, for which the system is stable. (5%)
   (c) Find the gain K that results in marginal stability. Determine the oscillation frequency. (5%)

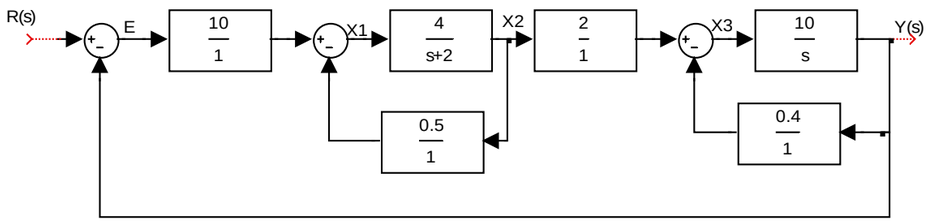

Fig. 1

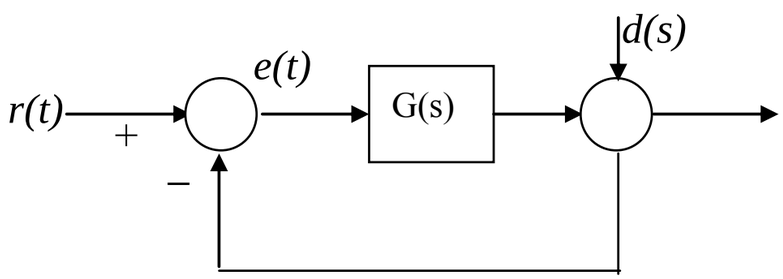

Fig.2(a)

背面尚有圖表

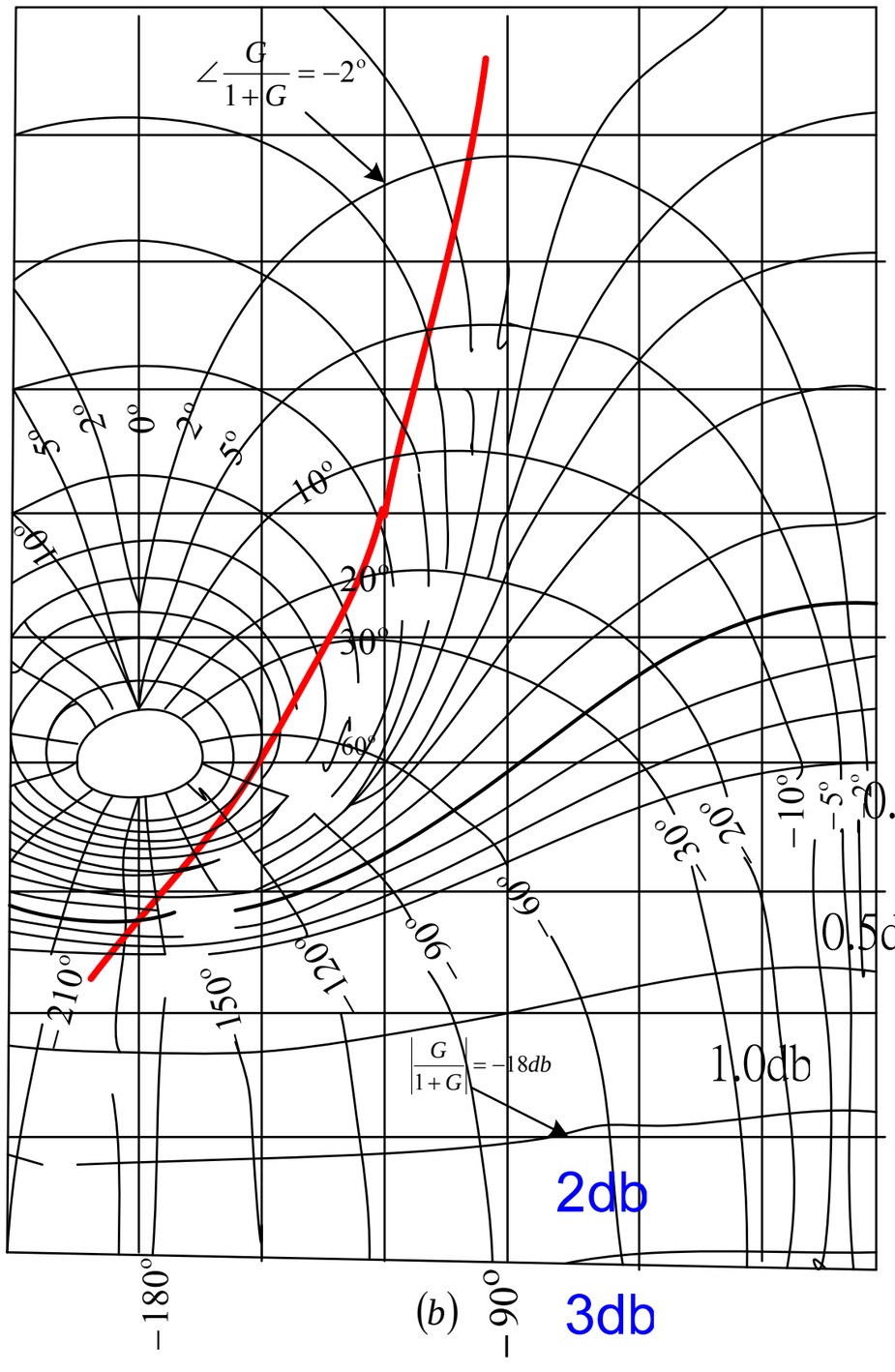

Fig. 2(b)

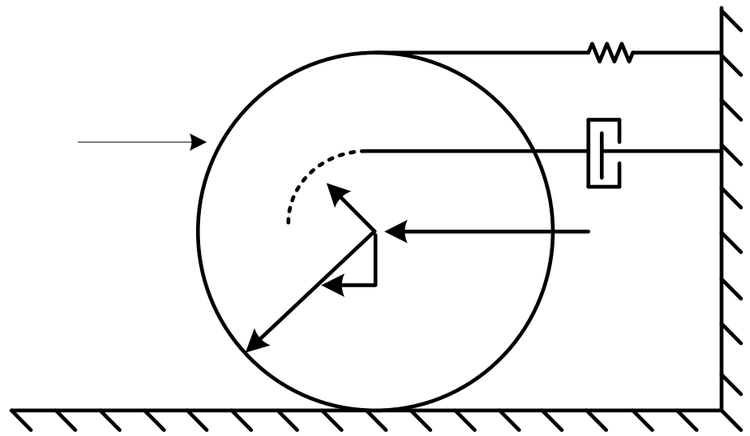

Fig.3

0db

0.10 -0.10db

0.23db

0.5db 0.2 -1db

1.0db

2db -2db

3db -3db

4db 0.6

5db -4db