國立臺灣科技大學
九十學年度碩士班招生考試試題

系所組別： 機械工程系丁組
科　　目： 線性系統控制

1. A type one system with an open loop transfer function of $G(s)=\dfrac{5}{s(s+4)}$. The design specifications are shown in following response curve, Fig. 1. The required velocity error constant is $\dfrac{27}{8}$. Please find a controller $\dfrac{K(s+b)}{(s+a)}$ for the dynamic system to satisfy the above requirements. Is it a phase-lead or phase-lag controller? (25%)

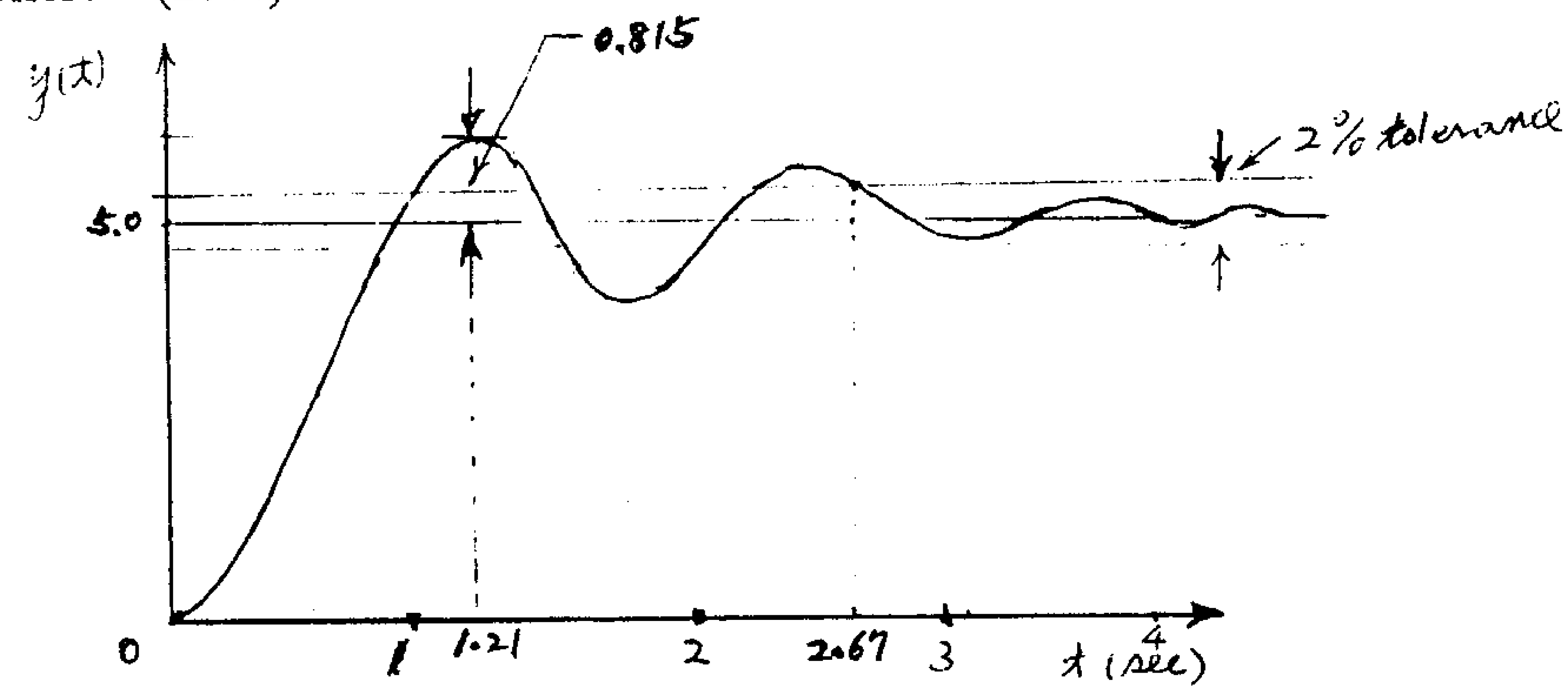

Fig. 1 Step response curve

2. (a) Please write the state equations of the system shown in following block diagram, Fig. 2, with x_1, x_2 and x_3 state variables. Determine the system's controllability and observability. (8%)

(b) If $\dfrac{x_1(s)}{Y(s)}=\dfrac{1}{s+1}$, then find the overall transfer function $\dfrac{Y(s)}{U(s)}$, and use this transfer function to construct the "controllable phase variable form" state model. $\dot{X}=AX+BU$, $Y=CX+DU$ (8%)

(c) If the desired closed loop poles be $s=-1\pm j\sqrt{3}$, and s=-6, then use your phase variable form model $\dot{X}=AX+BU$ of (b) to calculate the feedback control gain K vector of U= -KX. (9%)

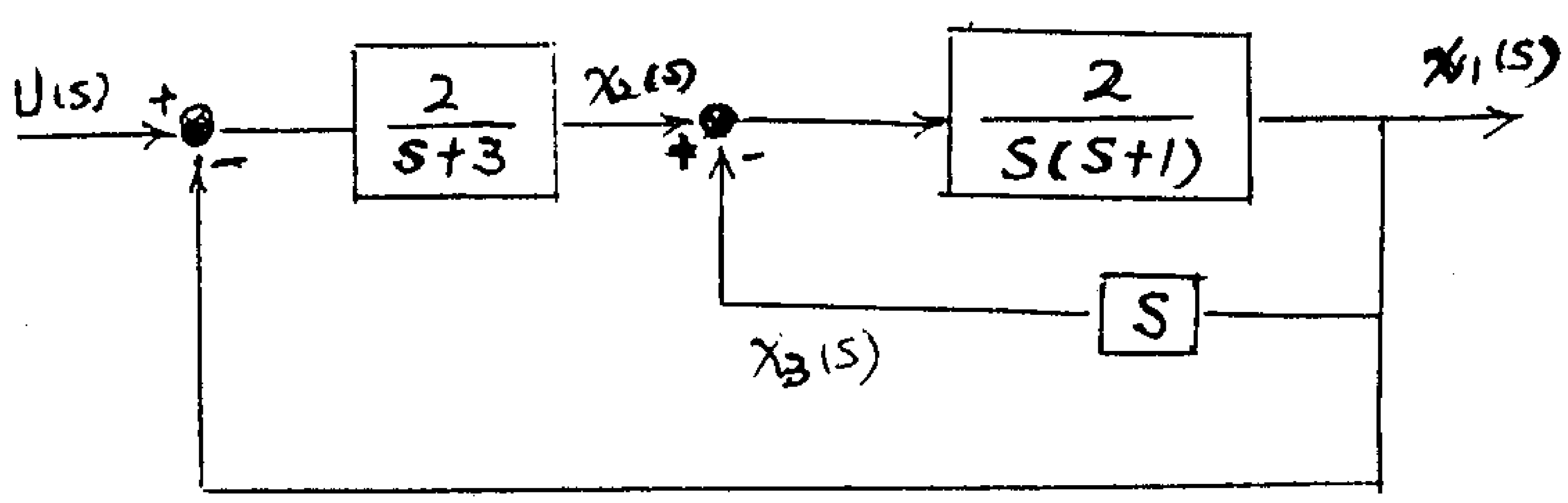

Fig. 2 System block diagram

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3. A unit feedback control system with open loop transfer function as follow

$$G(s)=\frac{K}{s(0.3s+1)(3s+1)(0.05s+1)}, K>0$$

Please employ Nyquist Criterion to determine the range of K value for the control system to be stable, and then use Routh Hurwitz method to verify it. (25%)

4. Based on the following asymptotic Bode diagram, Fig.3 , to solve the following problems.

(a) Find the open loop transfer function $G(s)=\frac{kB(S)}{A(s)}$ with each step explanation. (9%)

(b) If we want the system has 45° phase margin, how to adjust the gain value k? (8%)

(c) Then estimate the percentage overshoot, settling time and peak time based on the following equations. (8%)

$$\Phi M=\tan^{-1}(2\varsigma/\sqrt{-2\varsigma^{2}+\sqrt{1+4\varsigma^{4}}} \ , \ \omega_{BW}=\frac{4}{T_s\varsigma}\sqrt{(1-2\varsigma^{2})+\sqrt{4\varsigma^{4}-4\varsigma^{2}+2}}$$

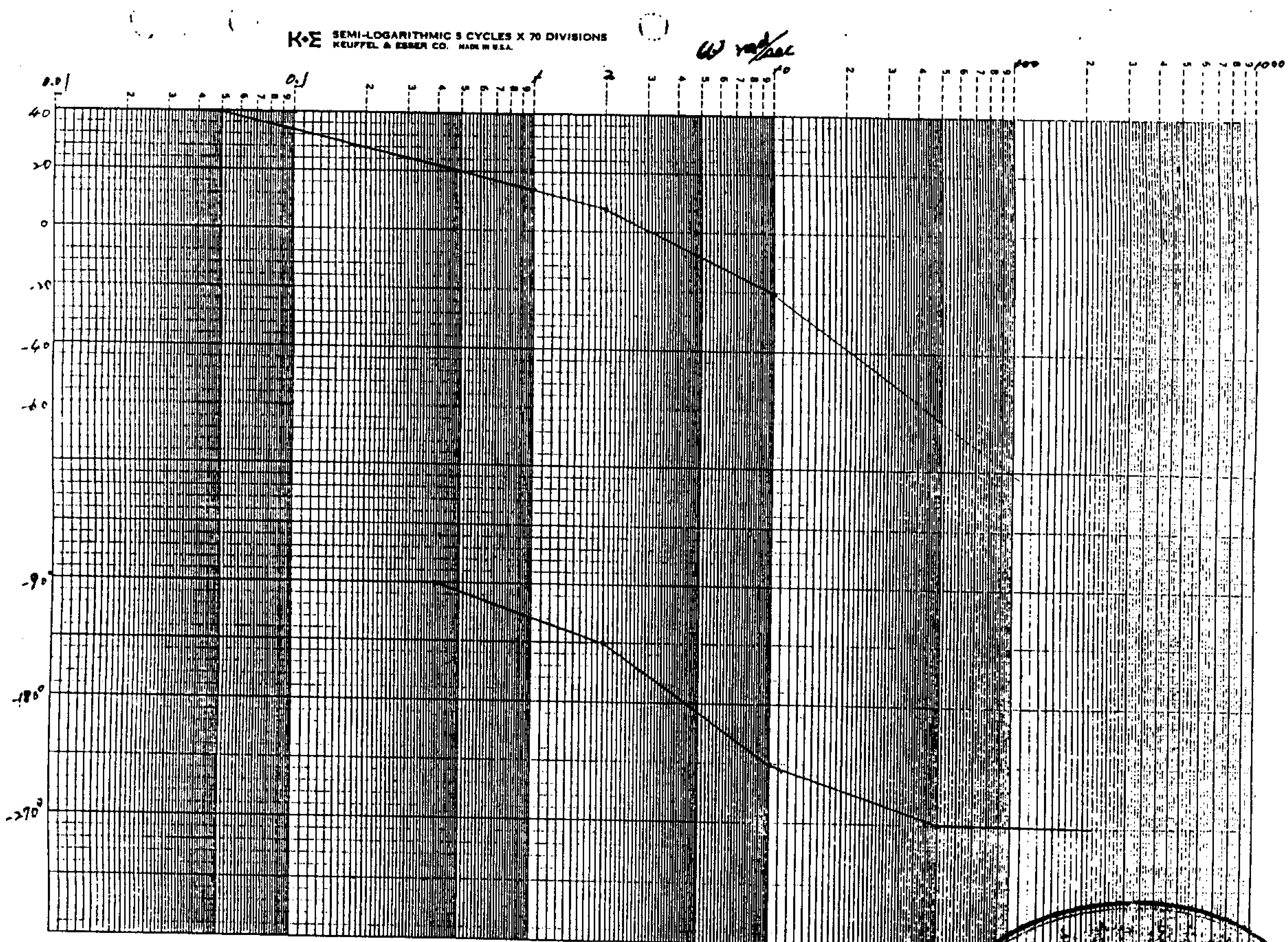

Fig. 3 Asymptotic Bode diagram

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