1. Find the transfer function, $\Theta_2(s)/T_1(s)$, for the system of Fig.1. (20 %)

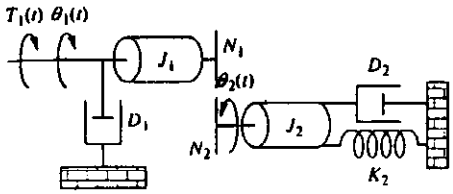

Fig.1

2. Design the values of K_1 and K_2 in the system of Fig.2 to meet the following specifications: steady-state error component due to a unit step disturbance is -0.00012; steady-state error component due to a unit ramp input is 0.003. (20 %)

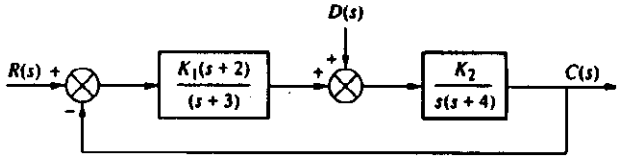

Fig.2

3. A position control system for a robot is shown in Fig. 3. Use a PID controller to design a system whose characteristic equation has a real root at -10, a damping ratio $\zeta = 0.8$, and a natural frequency $\omega_n = 2$. (20 %)

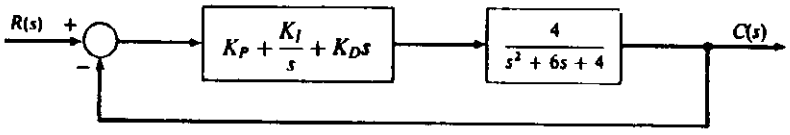

Fig. 3

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4. For the system shown in Fig. 4, the frequency-response curves for $G_1(j\omega)$and $G_2(j\omega)$ were determined experimentally. Construct the log-magnitude plot for $G(j\omega) = G_1(j\omega)G_2(j\omega)$. Determine the equation for $G(j\omega)$, and evaluate the gain K. （20%）

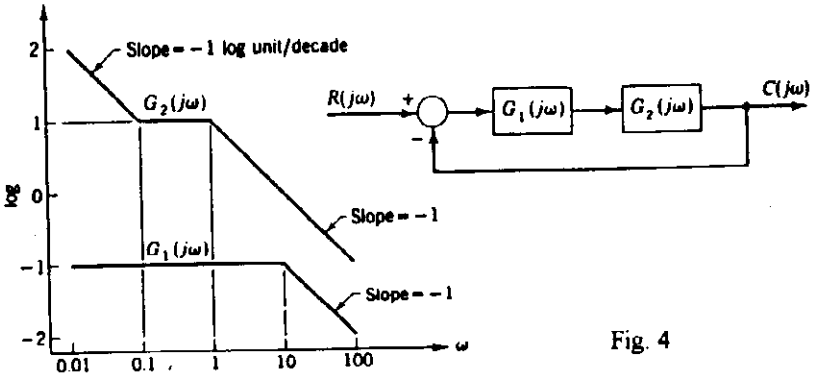

Fig. 4

5. Draw the Nyquist diagram for the system with $G(s)=K/[(s^2+2s+2)(s+2)]$. Calculate the gain margin in dB and indicate the phase margin for K= 6. （20 %）