Tutorial Sheet 6, EE302, Control Systems S2, 28th March 2024.

Q-1 For $G(s) = \frac{1}{(s+1)(s+2)}$, design a k that (in the std. negative unity feedback configuration) fetches 2%OS for closed loop step response. Find 2% settling time for this k.

- Use Graph paper to get value of k.
- For 2% settling time = 2.5 seconds (& 2%OS), use graph paper to design a PD controller.
- Use graph paper (scale to measure distances) to get new k (& the PD controller).
- Design a lead compensator.

Q-2: - Draw Bode plot (asymptotic) for $\frac{1}{(s+2)(s+20)(s+200)}$ & use graph paper to estimate k s.t. closed loop is unstable.
- Use Routh Hurwitz table to get k s.t. —11—.
- Plot Nyquist plot $G(j\omega)$ & get value of $\text{Re}\, G(j\omega)$ s.t. $\text{Im}\, G(j\omega) = 0$ to get k such that closed loop is unstable.

Q-3 Use Nyquist plot & Nyquist criteria for finding value of k that causes closed loop instability for $G(s) = \frac{s-3}{s+20}$. Use Routh table to verify.

Q-4: Plot Bode plot for getting gain margin for $\frac{1}{(s+1)(s+2)}$ & $\frac{1}{(s+1)(s+2)(s+3)}$.

Q-5: For Q-1 above: Design a lag compensator that makes the steady state error to one-tenth of the value with lead compensator.
- Simulate & check on a laptop.