King Fahd University of Petroleum & Minerals
Electrical Engineering Department

EE 380 / 032	Control Engineering	Problem Session II

Q1. Using the Routh-Hurwitz criterion, determine the stability of the closed-loop system that has the following characteristic equation:

$$s^4 + 2s^3 + 10s^2 + 20s + 5 = 0$$

Q2. For the C.E. of the feedback control system given, determine the range of K so that the system is stable. Determine the value of K so that the system is marginally stable and the frequency of sustained oscillation:

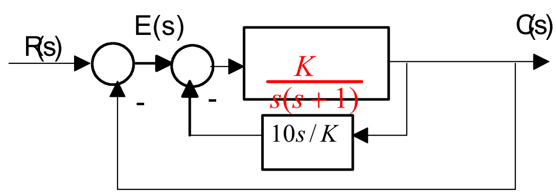
$$s^4 + 25s^3 + 15s^2 + 20s + K = 0$$

Q3. Given the forward-path transfer function of a unity-feedback control system,

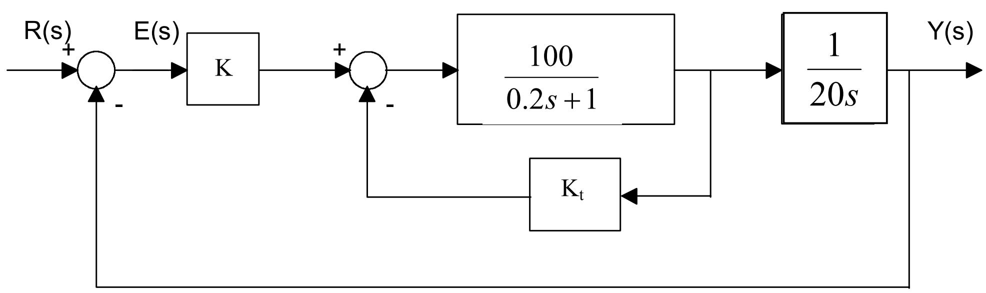
$$\frac{K(s+10)(s+20)}{s^2(s+2)}.$$

. Find K that will cause sustained constant amplitude oscillations.

Q4. Select K so that for an input of $100\, t\, u(t)$, the steady state error will be 0.01.



Q5. For the control system shown, find the values of K and K_t so that the maximum overshoot of the output is approximately 4.3% and the rise time t_r is approximately 0.2 sec. Simulate the system to check the accuracy of your solutions.



Q6. Find the step-, ramp-, and parabolic-error constants for the control system of Q5. The error signal is defined to be e(t). Assuming the system is stable, find the steady-state errors in terms of K and K_t when the following inputs are applied:

a) $r(t) = u_s(t)$ b) $r(t) = t\,u_s(t)$ c) $r(t) = \frac{t^2}{2} u_s(t)$

Q7. For the control system of Q5, find the values of K and K_t so that the damping ratio of the system is 0.6 and the 2% settling time of the unit-step response is 0.1 sec. simulate the system to check the accuracy of your results.

Q8. The forward-path transfer functions of unity-feedback control systems are given by:

a) $$G(s) = \frac{K(s+4)}{s(s^2+4s+4)(s+5)(s+6)}$$ b) $$G(s) = \frac{K(s^2+2s+10)}{s(s+5)(s+10)}$$

Construct the root-loci for $\infty > K > 0$