Department of Electrical and Electronic Engineering

Assignment #2 EEE 363 Control System Marks: 10

Batch 17, Date of Submission: 15 July, 2021, 11:59 PM

Q1. A unit feedback system has the transfer function of 05

$$G(s) = \frac{40K}{s(s+4)(s+10)}$$

a. Construct Bode diagrams for K=1.
b. Determine the phase and gain margins of the system.
c. Determine the value for the static gain K such that the system has a gain margin of 10dB. Find the corresponding steady state errors.
d. From Bode diagrams determine the value for the static gain K such that the phase margin is 45^0. Determine the damping ratio and the natural frequency for the obtained value of K.
e. Draw the Nyquest diagram and determine the value of K for the system stability.

Q2. A unit feedback system with transport delay has the transfer function 05

$$G(s) = \frac{10Ke^{-0.5s}}{(s+4)(s+10)}$$ Approximate time delay as $e^{-Ts} \approx 1/(1+Ts)$

a. Plot on the same figure the Bode diagrams for the system with and without transport delay for K=1. Comment on system stability.
b. Plot the unit step response of the system for both cases and compare the results (steady state errors, transient response parameters).
c. Determine the value of the static gain K that gives a steady state unit step error of 0.02 for both the approximated system and the original system without time delay.
d. Design phase-lag, phase-lead, and phase-lag-lead controllers to achieve a steady state error of $e_{ss} \le 0.05$ and a phase margin $P_m \ge 50^0$ for the approximated system.
e. Draw the exact phase Bode diagrams of the compensated systems, including the time delay, and check the values obtained for the phase margins (Use MATLB).