STUDENT NUMBER.....

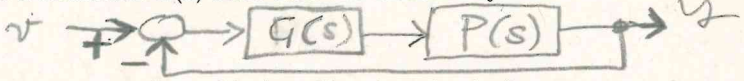
CONTROL SYSTEMS - 14/9/2018

[time 2 hours; no textbooks; no programmable pocket calculator]

1) Given the process

$$P(s) = \frac{5}{s(s+1)}$$

design a controller $G(s)$ such that the feedback system



(i) is asymptotically stable (use Nyquist criterion),

(ii) the absolute value of the steady state error to inputs $v(t) = t$ is less or equal to 0.02,

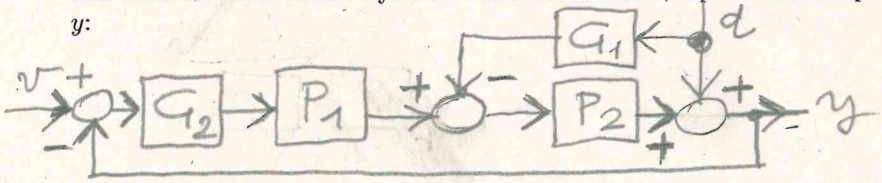
(iii) the open loop system PG has phase margin $\geq 50°$ and crossover frequency in the interval $[8, 14]$ rad/sec,

(iv) $20log_{10}|G(j\omega)| < 36dB$ for all ω.

2) Given the processes

$$P_1(s) = \frac{1}{s-1},\ P_2(s) = \frac{s+4}{s-2},$$

and consider the feedback system with disturbance d, input v and output y:

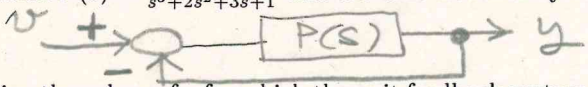


(i) Design G_1 in such a way that the forced response y to any disturbance d is 0,

(ii) design G_2 in such a way that the feedback system is asymptotically stable and the absolute value of the steady state error to inputs $v(t) = t$ is ≤ 1.

Draw the root locus of $PG_1G_2(s)$.

3) Given the process $P(s) = \frac{s^2+zs-z}{s^3+2s^2+3s+1}$ and the unit feedback system:



(i) Determine the values of z for which the unit feedback system has poles with real part ≤ -0.5.

(ii) Determine the values of z for which the unit feedback system has all real poles.