STUDENT NUMBER : #

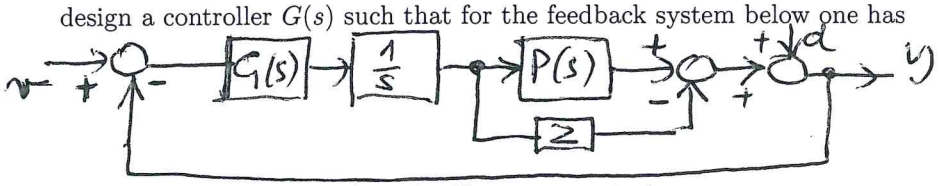
Exam of Control Systems (A) - 9/1/2018

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

1) With

$$P(s) = \frac{30}{s+10}$$

design a controller $G(s)$ such that for the feedback system below one has



(i) asymptotic stability (use the Nyquist criterion)

(ii) $|e_1| \leq 0.2$ (e_1 is the steady state error to inputs $v(t) = t$)

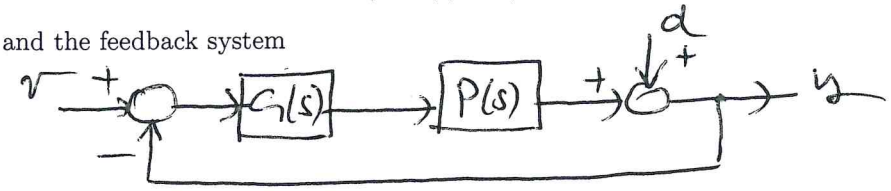
and for the open loop system one has

(iii) crossover frequency $\omega_t^* = 2$ rad/sec and phase margin $m_\phi^* \geq 50°$.

2) Given

$$P(s) = \frac{3}{(s-1)(s+2)}$$

and the feedback system



a) draw the root locus of $P(s)$ (with the help of the Routh criterion)
b) determine a controller $G(s)$ such that the feedback system has poles with real part ≤ -1 and damping ≥ 0.7
c) for the feedback system calculate the steady state response to $d(t) = t$.

3) Given

$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = u - a^2 x_1 - 2a x_2,\ y = x_1$$

(i) determine for $a \in \mathbb{R}$ the forced output response to $u(t) = \cos t$

(ii) determine, whenever possible, for $a \in \mathbb{R}$ the steady state output response to $u(t)$