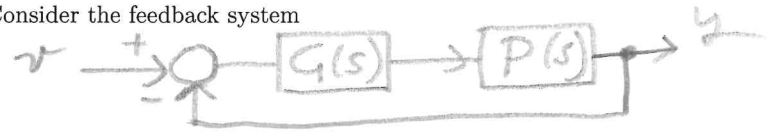
CONTROL SYSTEMS - 30/10/2020

[time 2 hours and 30 minutes; no textbooks; no programmable calculators]

Ex. # 1) Consider the feedback system

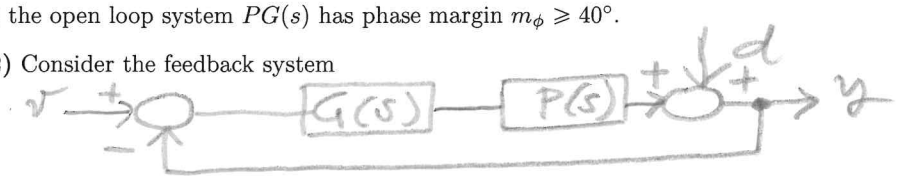


with $P(s) = \frac{1}{s^2(s-1)}$. Design a controller $G(s)$ such that

(i) the closed-loop system is asymptotically stable (use Nyquist criterion with approximate Bode plots)

(ii) the open loop system $PG(s)$ has phase margin $m_\phi \geqslant 40°$.

Ex. # 2) Consider the feedback system



with $P(s) = \frac{s+2}{s-1}$. Design a controller $G(s)$ such that

(i) the poles of $W(s) = \frac{GP(s)}{GP(s)+1}$ have real part $\leqslant -4$,

(ii) the steady state output response $y_{ss}(t)$ to disturbances $d(t) = t$ is zero.

Draw as precisely as possible the root locus of $PG(s)$.

Ex. # 3) For the system

$$\begin{aligned} \dot{x}_1 &= -x_1 + x_2 + u \\ \dot{x}_2 &= -x_2 \\ y &= x_1 \end{aligned} \tag{1}$$

calculate the forced output response $y(t)$ with input $u(t) = \sin t$ and, if it exists, the steady-state output response $y_{ss}(t)$.