NAME, SURNAME AND STUDENT NUMBER (* mandatory fields):

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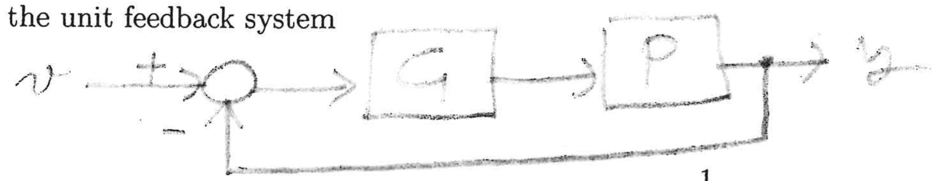
# CONTROL SYSTEMS - 4/2/2020 (A)

**[time 3 hours; no textbooks; no programmable calculators]**

1) Consider the unit feedback system



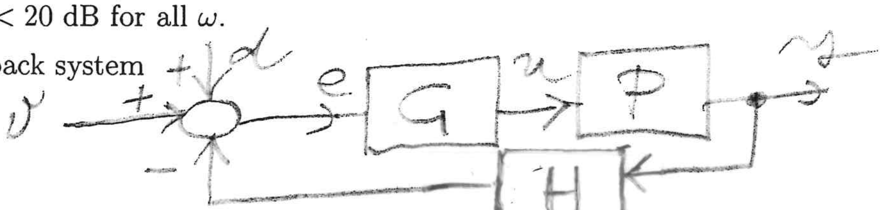

with input $v$, error $e$, output $y$ and $P(s) = \dfrac{1}{s(s-1)}$. Design a controller $G(s)$ such that

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

(ii) the open loop system $PG(s)$ has largest as possible crossover frequency $\omega_t^*$ rad/sec and phase margin $m_\phi^* \geq 25°$.

(iii) $|G(j\omega)|_{dB} < 20$ dB for all $\omega$.

2) Consider the feedback system




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

(i) the closed-loop system is asymptotically stable

(ii) its steady state error $e_{ss}(t)$ to ramp inputs $v(t) = t$ is 0,

(iii) its steady state output $y_{ss}(t)$ to cosinusoidal disturbances $d(t) = \cos t$ is 0,

(iv) $G(s)$ has minimal dimension.

Finally, draw as precisely as possible the root locus of $PG(s)$.

3) Given


with $F(s) = \dfrac{s+2}{s+1}$ and $G(s) = \dfrac{1}{s+1}$ find the transfer functions from $d$ to $y$ and from $v$ to $y$. Finally, calculate the output response $y(t)$ to $d(t) = (3 - \sin(2t))\delta_{-1}(t)$.