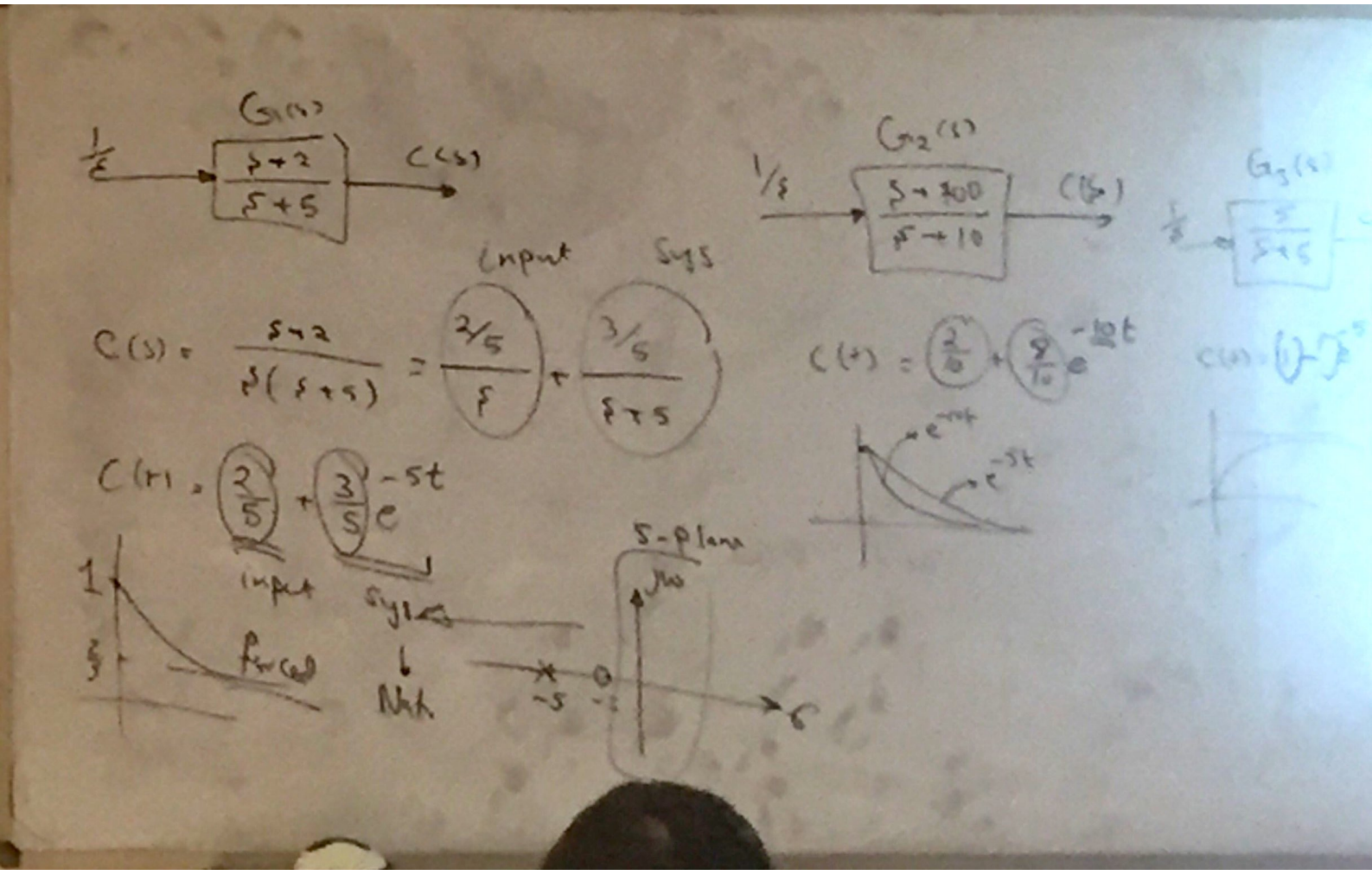
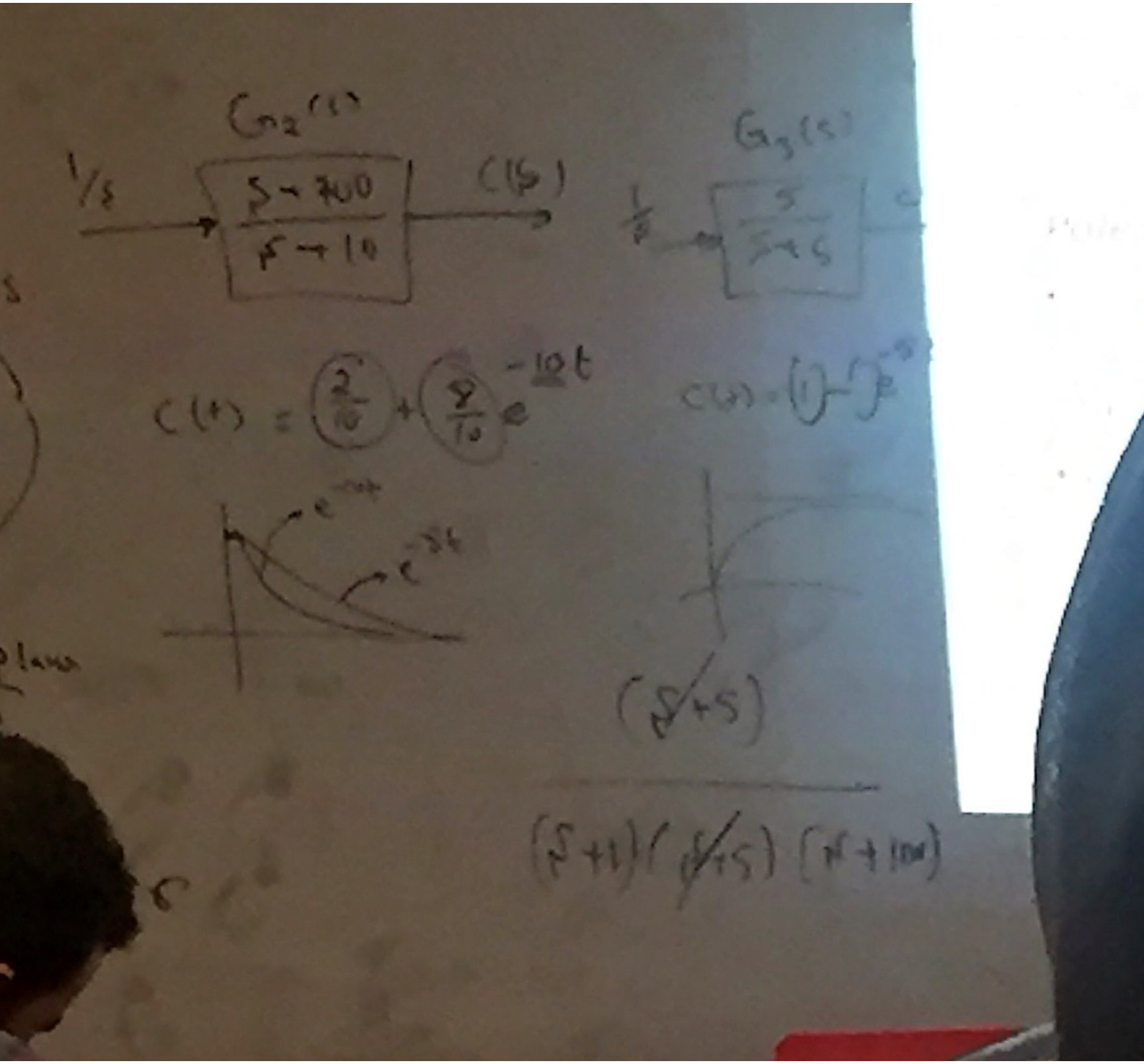
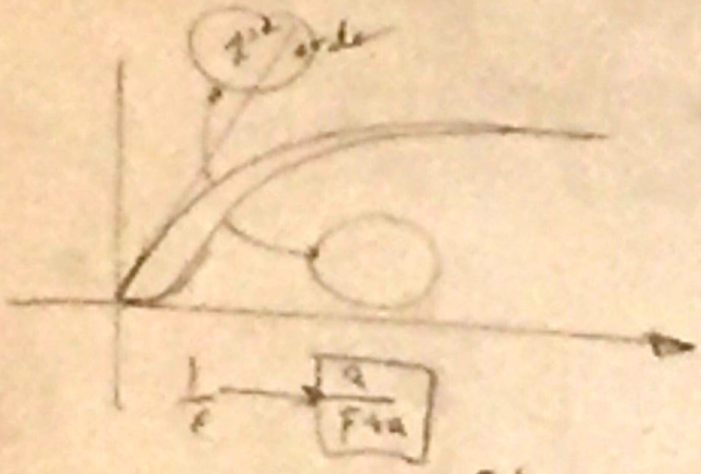


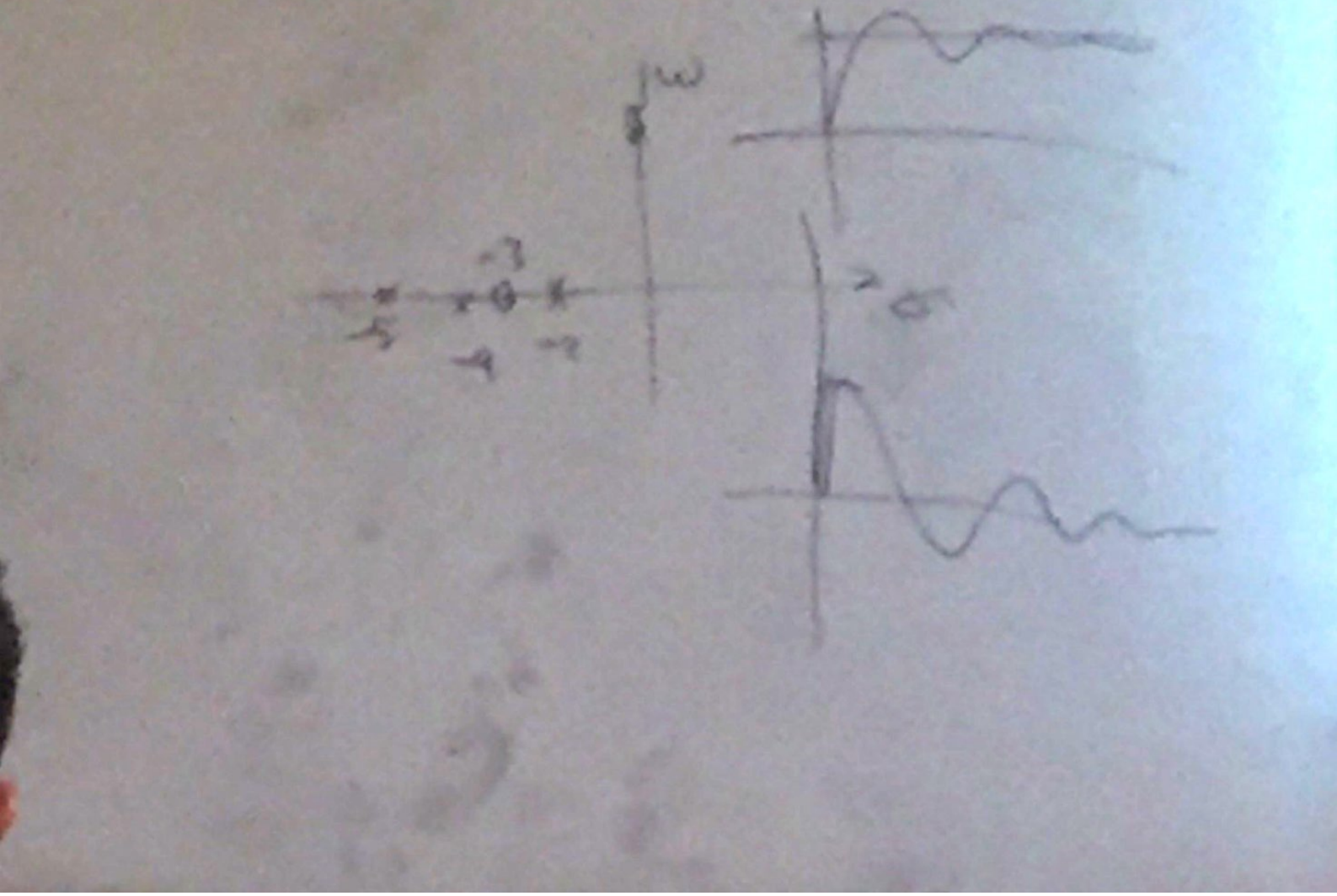


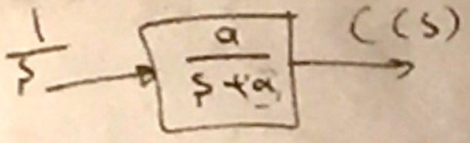


$$C(t) = 1 - e^{-at}$$

$$\frac{d}{dt} C(t) \Big|_{t=0} = a e^{-at} \Big|_{t=0} = a$$

$$i(t) = k_1 + k_2 e^{-2t} + k_3 e^{-4t} + k_4 e^{-5t}$$





$$T_r = t\Big|_{C(t)=0.9} - t\Big|_{C(t)=0.1} = \frac{2.3}{a} - \frac{0.11}{a} \simeq \frac{2.2}{a}$$

①

$C(t) = 1 - e^{-at} = 0.9$

$e^{-at} = 0.1$

$-at = \ln 0.1$

$t = \frac{\ln 0.1}{-a}$

$= \frac{2.3}{a}$

$0.1 = 1 - e^{-at}$

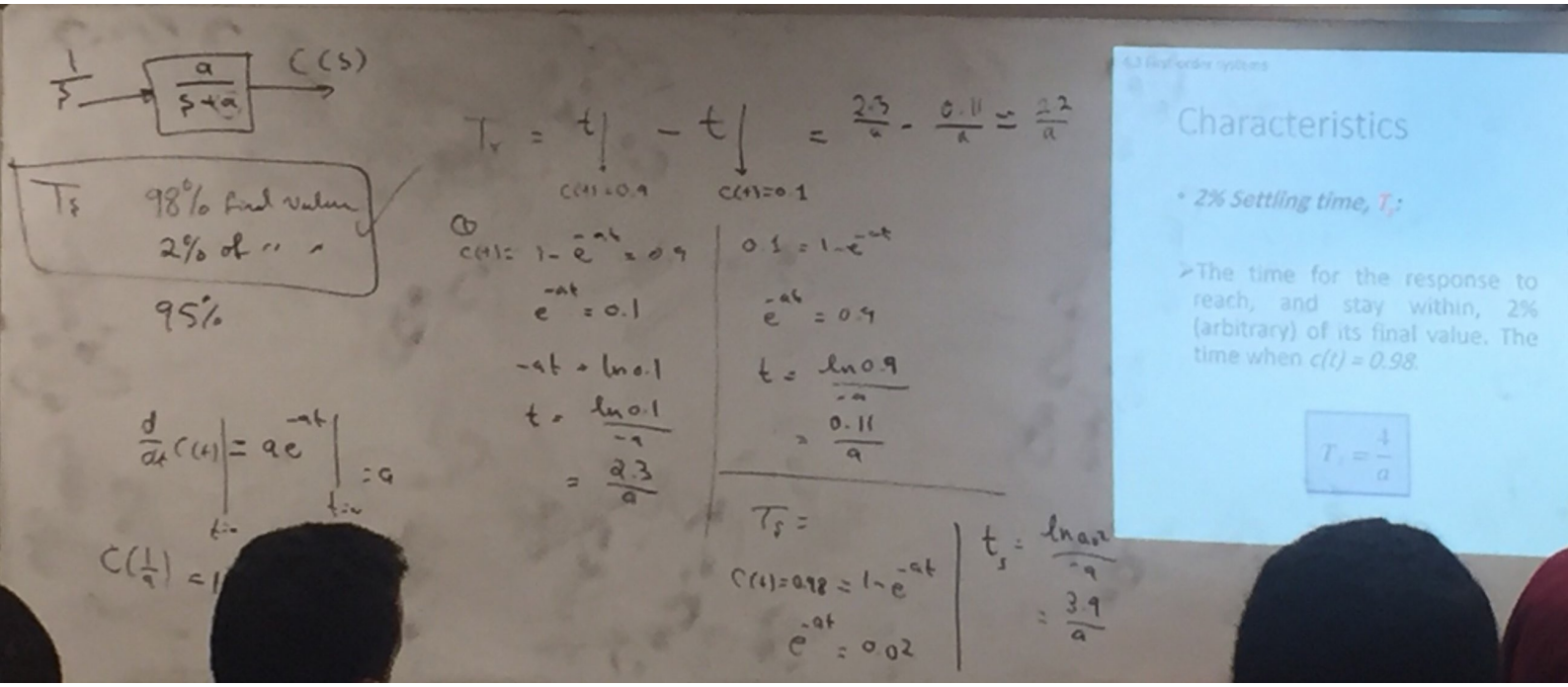
$e^{-at} = 0.9$

$t = \frac{\ln 0.9}{-a}$

$= \frac{0.11}{a}$

$\frac{d}{dt} C(t)\Big|_{t=0} = ae^{-at}\Big|_{t=0} = a$

$C(\frac{1}{a}) = 1 - 0.37 = 0.63$



First-Order Transfer Functions via Testing

- We determine that it has the first-order characteristics we have seen thus far, such as:
  - no overshoot
  - nonzero initial slope
- The transfer function for the system is

$$G(s) = 5.54/(s+7.7)$$

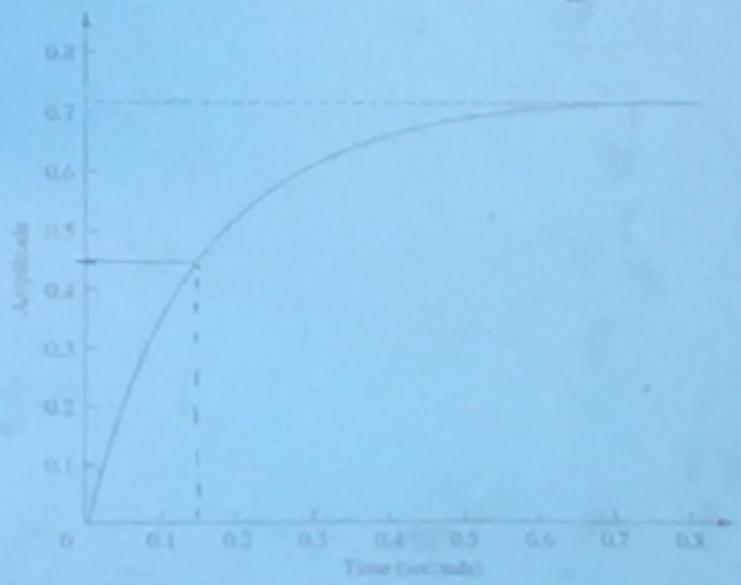


FIGURE Laboratory results of a system step response test

$$G(s) = \frac{K}{s+a}$$

$$R(s) = \frac{1}{s}$$

$$C(s) = \frac{K}{s(s+a)}$$

$$C(t) = \frac{K}{a} - \frac{K}{a} e^{-at}$$

$$t = \frac{1}{a} \Rightarrow a = \frac{1}{T_{rise\ Cmd}}$$

$$a = \frac{1}{0.13} = 7.7$$

$$\frac{K}{a} = 0.72 \qquad K = 5.54$$

$$T_r = t\Big|_{C(t)=0.9} - t\Big|_{C(t)=0.1} = \frac{2.3}{a} -$$

$$C(t) = 1 - e^{-at} = 0.9$$

$$e^{-at} = 0.1$$

$$-at = \ln 0.1$$

$$t = \frac{\ln 0.1}{-a}$$

$$= \frac{2.3}{a}$$

$$0.1 = 1 - e^{-at}$$

$$e^{-at} = 0.9$$

$$t = \frac{\ln 0.9}{-a}$$

$$= \frac{0.11}{a}$$

$T_s =$

$C(t) = 0.98 = 1 - e$

$e^{-at} = 0.0$