

# Midterm 2

$$1. \frac{5s^3 + 6s + 7}{s(0.01s+1)} = P$$

free int type 1

$$LT(3t) = \frac{3}{s^2}$$

$$2. e_{ss} = \frac{1}{M}$$

$$= \frac{1}{sPC}$$

$$= \lim_{s \rightarrow 0} \frac{(5s^3 + 6s + 7)(4)}{s(0.01s+1)(s^2 + 2s - 3)}$$

$$= \lim_{s \rightarrow 0} \frac{1}{\cancel{s} \left( \frac{5s^2 + 6s + 7}{0.01s+1} \right)}$$

$$= \frac{1}{0.01 + 7} = 1/7$$

$$\lim_{s \rightarrow 0} \frac{12s(5s^3 + 6s + 7)}{s^3(0.01s+1)(s^2 + 2s - 3)}$$

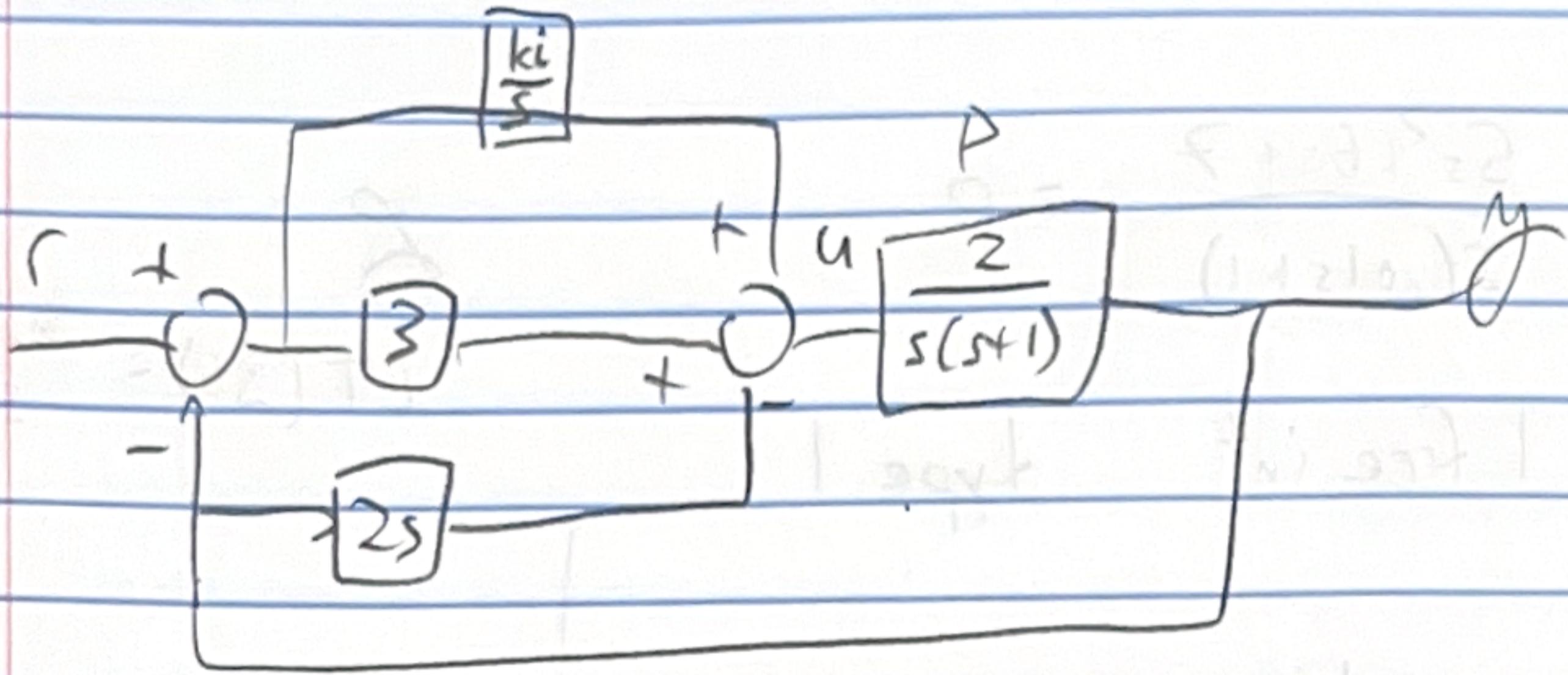
$$4. \lim_{s \rightarrow 0} \frac{(8s^3 + 6s + 7)(4)}{s(0.01s+1)(s+3)(s-1)}$$

$$\frac{1}{P} \underset{s \rightarrow 0}{\underset{\sim}{\rightarrow}} \frac{A}{s^2}$$

$$\frac{1}{\frac{s(0.01s+1)(s^2 + 2s - 3)}{(5s^3 + 6s + 7)(4)}} \underset{s \rightarrow 0}{\underset{\sim}{\rightarrow}} \frac{2}{5}$$

$$\frac{8(5s^3 + 6s + 7)}{s^2(0.01s+1)(s^2 + 2s - 3)}$$

S.



$$y = P_u$$

$$\dot{y} = P \left( \frac{k_i}{s} \right) (3)(2s) r$$

$$= P \left( \frac{k_i}{s} r + 3r - 2sy \right)$$

$$\ddot{y} = P \left( \frac{k_i}{s} (r - y) \right) + 3(r - y) - 2sy$$

$$(r - y) = \frac{P k_i}{s} r - \frac{P k_i}{s} y + 3r - 3sy - 2sy$$

$$y = r \left( \frac{P k_i}{s} + 3 \right) + y \left( -\frac{P k_i}{s} - 3 - 2s \right)$$

$$\frac{y}{r} = \frac{\frac{P k_i}{s} + 3}{1 + \frac{P k_i}{s} + 3 + 2s}$$

$$\frac{2}{s(s+1)}$$

$$= \frac{\frac{2k_i}{s^2(s+1)} + \frac{6}{s(s+1)}}{1 + \frac{2k_i}{s^2(s+1)} + \frac{6}{s(s+1)} + \frac{4}{(s+1)}}$$

$$\frac{2k_i + 6s}{s^3 + 5s^2 + 6s + 2k_i}$$

$$= \frac{\frac{2k_i}{s^2(s+1)} + \frac{6}{s(s+1)}}{1 + \frac{2k_i}{s^2(s+1)} + \frac{6}{s(s+1)} + \frac{4}{(s+1)}}$$

$$= \frac{\frac{2k_i}{s^2} + \frac{6}{s}}{\frac{1}{(s+1)} (s+1) + \frac{2k_i}{s^2} + \frac{6}{s} + 4} \rightarrow \frac{2k_i + 6s}{s^3 + s^2 + 2k_i + 6s + 4s^2}$$

6.

$$A(s) = s^3 + 3s^2 - 2s - 1$$

7.

$$H = \frac{s^3 - 1}{s^3 + 3s^2 - 6}$$

control canon form?

$$A = \begin{pmatrix} -3 & 0 & 6 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & 1 & 1 \\ 10 & -1 \end{pmatrix}$$

8

$$C = \begin{pmatrix} 1 & 2 & -1 \\ 1 & 2 & -1 \\ -1 & -2 & 1 \end{pmatrix}$$

$$\det(C) = 0 \quad X$$

not controllable

9.

$$\dot{x} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}x - \begin{pmatrix} 1 \\ -1 \end{pmatrix}u$$

$$\dot{y} = (0 \ 3)x$$

10.  $\alpha = -2 + 3j$

$$(s - (-2 + 3j))(s - (-2 - 3j))$$

$$= s^2 - 4s + 13$$

$$\alpha = (1 - 4 \ 13)$$

any  
not on answer

11.

$$q_A = (2 \ -1)$$

$$A_A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$$

13

A

B

$$x = \begin{pmatrix} -1 & 4 \\ 1 & 0 \end{pmatrix}^{-1} \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

$$y = \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

what is  $k$  for  $-1 \pm 2j$ 

$$\alpha = (1 - 4)$$

$$q_A =$$

14.

$$K = \begin{pmatrix} 2 & 5 \end{pmatrix}$$

$$u = -Kx + k_r r \quad k_r = (C_r(A \cdot BK)^{-1} B)^{-1}$$

$$C_r = \begin{pmatrix} -1 & 1 \end{pmatrix}$$

$$(-2 - 5) \cdot x + k_r r$$