

Dynamic Control Exam

Sam Woolner

Dynamic control exam

Q1) a)

$$v = 70 \text{ m/s}$$

$$a = 9.81 \text{ m/s}^2$$

u	$70 \sin(30)$	$70 \sin(60)$	$70 \cos(30)$

$$T = \frac{2 \times 70 \sin(30)}{9.81} = 1.455$$

$$T = \frac{2 \times 70 \sin(60)}{9.81} = 1.260 \text{ s}$$

$$R = \frac{70^2 \sin(60)^2}{9.81} = 38.187 \text{ meters}$$

Sam Woolner

Q2)

$$A: s = 3t^2 + 10t + 8$$

$$B: s = 5t^3 + 4t^2 + 4$$

$$C: s = 10t^3 - 30t + 2$$

$$A: s = 3t^2 + 10t + 8$$

$$\text{velocity } \dot{s} = 6t + 10$$

$$\text{Acceleration } \ddot{s} = 6$$

$$B: s = 5t^3 + 4t^2 + 4$$

$$\text{vel } \dot{s} = 15t^2 + 8t$$

$$\text{acc } \ddot{s} = 30t + 8$$

$$C: s = 10t^3 - 30t + 2$$

$$\text{vel } \dot{s} = 30t^2 - 30$$

$$\text{acc } \ddot{s} = 60t$$

a)

$$\text{vel } 6t + 10$$

$$15t^2 + 8t$$

B

$$15t^2 + 8t$$

A

$$6t + 10$$

$$15t^2$$



$$6t$$

$$t = 3.5 \text{ sec}$$

b)

B

C

$$\text{acc } 30t + 8$$

$$60t$$

$$30t$$

$$60t - 8$$

$$= 52t$$

c)

Q3) a)

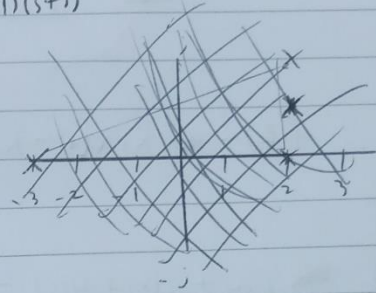
$$G(s) = \frac{(s+2)}{s(s+1)(s+1)}$$

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

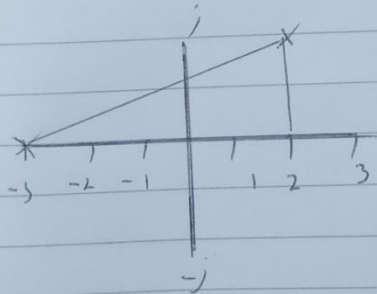
$$\frac{(-3+2j)+2}{-3+2j(-3+2j+1)(-3+2j+3)}$$

$$\frac{(-1+2j)}{-3+2j(-2+2j)(-2j)}$$

$$\frac{(-1+2j)}{6-6j+4j^2+4j^2(2j)}$$

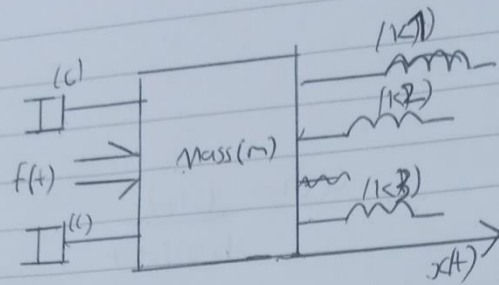


b)



Sam Woolner

Q4) a)



$$f(t) - k_1 x(t) - k_2 x(t) - k_3 x(t) - c_1 \frac{dx}{dt} - c_2 \frac{dx}{dt} = m \frac{d^2 x}{dt^2}$$

b) $6m + 6(k) + 4(c) = 16 \text{ Hz}$

$m = 6$

$c = 2$

$k = 2$

c)

d)

p5

as) a)

$$\text{unit step} = \frac{1}{s}$$

$$\frac{1}{s} \cdot \frac{4(s+1)}{(s+2)(s+3)}$$

$$e^{-at} = \frac{1}{(s+a)}$$

$$\frac{1+4(s+1)}{s(s+2)(s+3)}$$

$$G_s = \frac{4(s+1)}{(s+2)(s+3)}$$

$$= \frac{A}{s} + \frac{B}{(s+2)} + \frac{C}{(s+3)}$$

b)

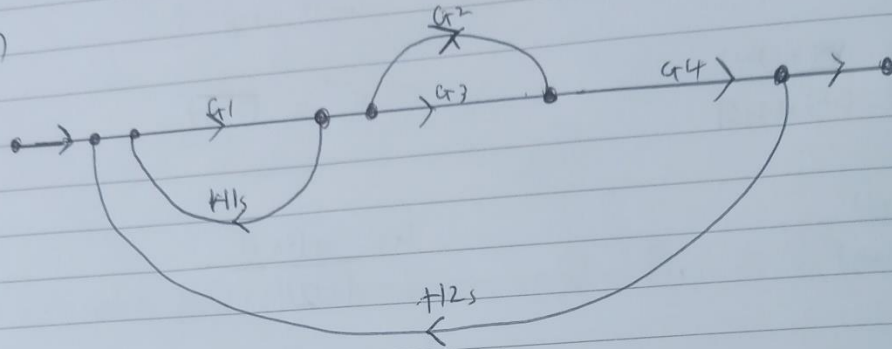
$$\frac{4(0.8+1)}{(0.8+2)(0.8+3)}$$

$$\frac{3.2+4}{0.64+2.4+1.6+6}$$

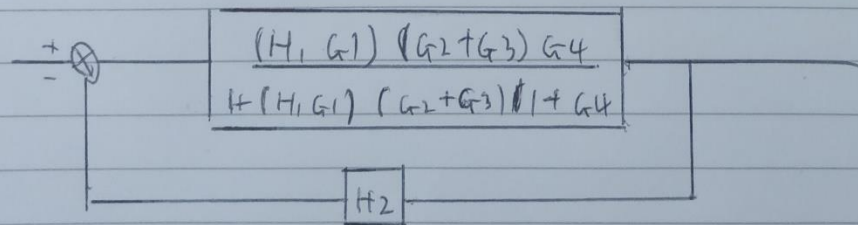
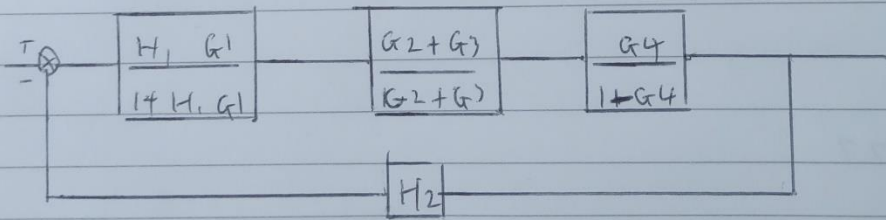
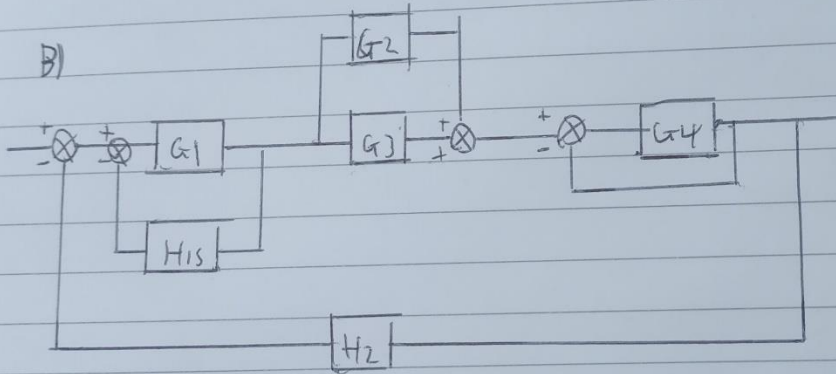
$$\frac{7.2}{10.64} = 0.677$$

Sam Woolner

Q6) a)



B)



Sam Woolner

$$\Rightarrow \frac{(H_1 G_1)(G_2 + G_3) G_4}{1 + (H_1 G_1)(G_2 + G_3) G_4} \\ 1 + H_2 \left(\frac{(H_1 G_1)(G_2 + G_3) G_4}{1 + (H_1 G_1)(G_2 + G_3) G_4} \right)$$

$$\Rightarrow \frac{G_1 (G_2 + G_3) G_4}{1 + G_1 (G_2 + G_3) + H_2 G_1 \cancel{(G_2 + G_3)} G_4}$$

$$\Rightarrow \frac{G_1 (G_2 + G_3) G_4}{1 + (G_2 + G_3) (G_1 + H_2 + G_2 + G_3 + G_4)}$$

END