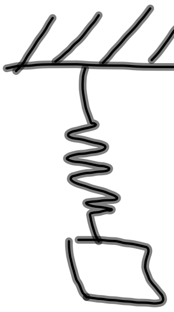
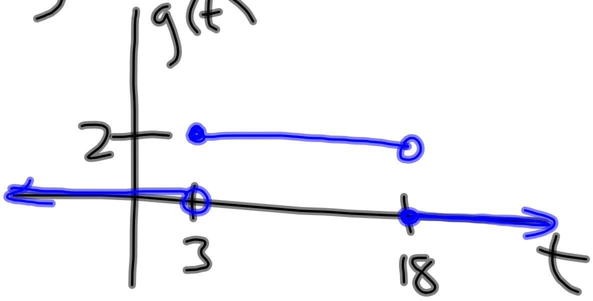
$$\underbrace{2y''+2y'+5y}_{y} = \cancel{g(t)}\ 2u(t-3)-2u(t-18)$$





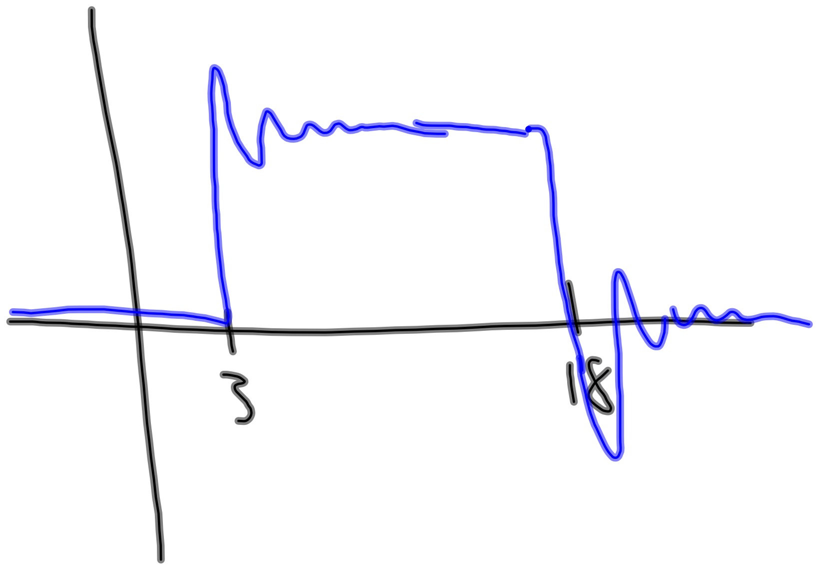
$$2y''+2y'+5y=0$$

$$2r^2+2r+5=0 \qquad r=\frac{-2\pm\sqrt{4-40}}{4}$$

$$r=-\frac{1}{2}\pm\frac{3}{2}i$$

$$y=c_1e^{\left(-\frac{1}{2}+\frac{3}{2}i\right)t}+c_2e^{\left(-\frac{1}{2}-\frac{3}{2}i\right)t}$$

$$=e^{-\frac{1}{2}t}\left(d_1\cos\tfrac{3}{2}t+d_2\sin\tfrac{3}{2}t\right)$$

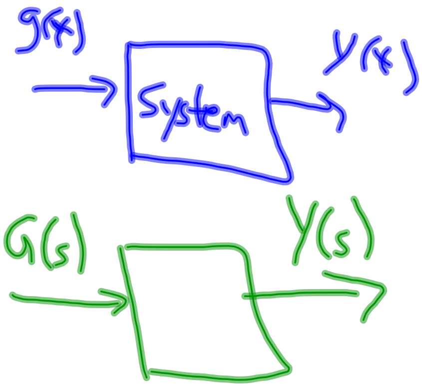


$$2y''+2y'+5y=g(t)\qquad \begin{aligned} y(0)&=0\\ y'(0)&=0\end{aligned}$$

$$2s^2Y(s)+2sY(s)+5Y(s)=G(s)$$

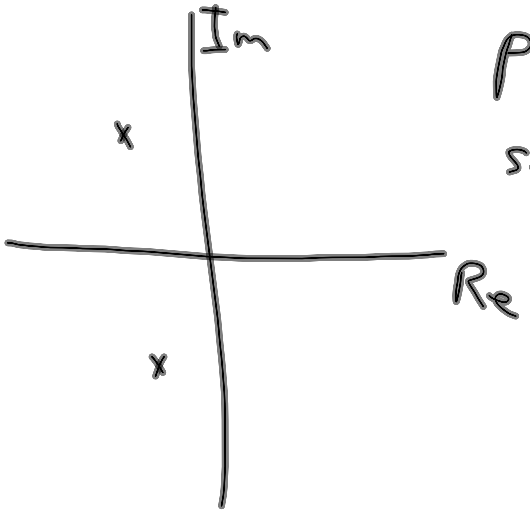
$$Y(s)(2s^2+2s+5)=G(s)$$

$$\boxed{Y(s)=\underbrace{\frac{1}{2s^2+2s+5}}_{H(s)}G(s)}$$



Transfer function

$$H(s)=\frac{1}{2s^2+2s+5}=\frac{1}{(s+\frac{1}{2}+\frac{3}{2}i)(s+\frac{1}{2}-\frac{3}{2}i)}$$



Poles

$$s=-\frac{1}{2}-\frac{3}{2}i,\ -\frac{1}{2}+\frac{3}{2}i$$

$$\vec{x}' = A\vec{x}$$

$$(\lambda-3)^2(\lambda+2)^4(\lambda-1) = 0$$

$$(\lambda-3)(2\lambda^2+2\lambda+5) = 0$$

$$\vec{x}' = \begin{bmatrix} a & b \\ c & d \end{bmatrix}\vec{x}$$

"normally"

1. $\lambda_1, \lambda_2, \vec{k}_1, \vec{k}_2$

$$\vec{x} = c_1\vec{k}_1 e^{\lambda_1 t} + c_2\vec{k}_2 e^{\lambda_2 t}$$

All holds if $\lambda_1, \lambda_2, \vec{k}_1, \vec{k}_2$ are complex.

2. $\vec{x}' = \begin{bmatrix} a & b \\ c & d \end{bmatrix}\vec{x}$ $\quad \lambda, \vec{k}_1, \vec{k}_2$

$$\vec{x} = c_1\left[\vec{k}_1\right]e^{\lambda t} + c_2\left[\vec{k}_2\right]e^{\lambda t}$$

3. $\vec{x}' = \begin{bmatrix} a & b \\ c & d \end{bmatrix}\vec{x}$ $\quad \lambda, \vec{k} \Longrightarrow$ Find $\vec{p}$

$$(A-\lambda I)\vec{p} = \vec{k}$$

$$\vec{x}' = c_1\vec{k}e^{\lambda t} + c_2\left[\vec{k}t + \vec{p}\right]e^{\lambda t}$$

Apr 24-9:19 AM

Exam $1\frac{1}{2}$ hr from 8:30 + 10:30

Series

- Find a series sol to an ODE
- Manipulate a series, including making it look recognizable.

$\frac{0}{0} x^5$

Way $\to$

5!

Laplace Transform

- Solving an IVP
- Find Laplace transforms using table, particularly step function
- Find $\mathcal{L}^{-1}$, including doing partial fraction, results w/ step function
- Find a Laplace transform from the definition.

Systems – solve $\vec{x}' = A\vec{x}$

- full eigenvectors
- less than full
- complex

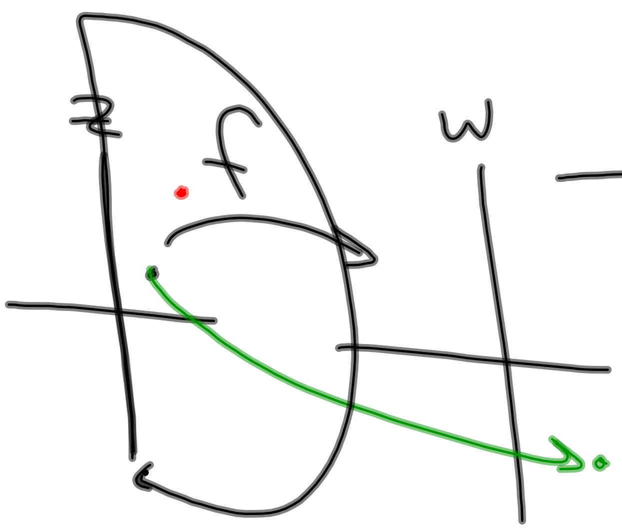
Assn 9 #2

$$\vec{X} = \begin{bmatrix} 3\cos 2t + \sin 2t \\ \cos 2t + 7\sin 2t \end{bmatrix} e^{5t}$$

$$x_1 = (3\cos 2t + \sin 2t)e^{5t}$$

$$x_2 = \cdots\cdot$$

$w = f(z)$



$y = f(x)$

$\frac{1}{x-2}$