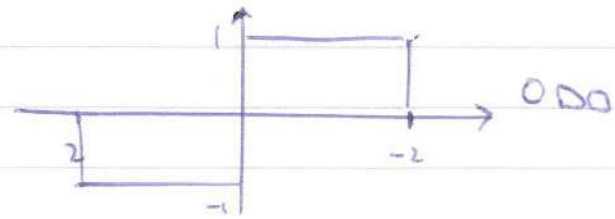


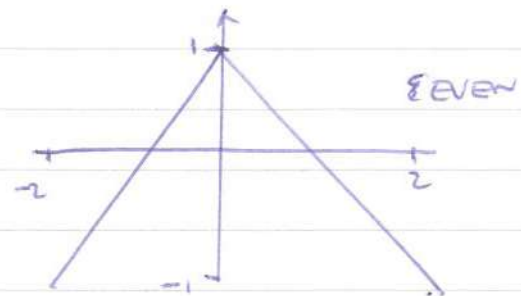
Tutorial 1

1. a) $f(t) = \begin{cases} -1 & -2 \leq t \leq 0 \\ 1 & 0 \leq t \leq 2 \end{cases}$



$$\begin{aligned} F(\omega) &= -2i \int_0^{\infty} f(t) \sin(\omega t) dt \\ &= -2i \int_0^2 1 \cdot \sin(\omega t) dt \\ &= -2i \left[-\frac{\cos(\omega t)}{\omega} \right]_0^2 \\ &= -\frac{2i}{\omega} (1 - \cos(2\omega)) \\ &\approx -\frac{4i}{\omega} \sin^2 \omega. \end{aligned}$$

b) $f(t) = \begin{cases} 1+t & -2 \leq t \leq 0 \\ 1-t & 0 \leq t \leq 2 \\ 0 & \text{otherwise} \end{cases}$



$$\begin{aligned} F(\omega) &= 2 \int_0^{\infty} f(t) \cos(\omega t) dt \\ &= 2 \int_0^2 (1-t) \cos(\omega t) dt \\ &= 2 \left\{ \left[(1-t) \frac{\sin(\omega t)}{\omega} \right]_0^2 - \int_0^2 (-1) \frac{\sin(\omega t)}{\omega} dt \right\} \\ &= 2 \left\{ -\frac{\sin(2\omega)}{\omega} + \frac{1}{\omega} \int_0^2 \sin(\omega t) dt \right\} \\ &= 2 \left\{ -\frac{\sin(2\omega)}{\omega} + \frac{1}{\omega} \left[-\frac{\cos(\omega t)}{\omega} \right]_0^2 \right\} \end{aligned}$$

$$= 2 \left\{ -\frac{\sin(2\omega)}{\omega} + \frac{1}{\omega^2} (1 - \cos(2\omega)) \right\}$$

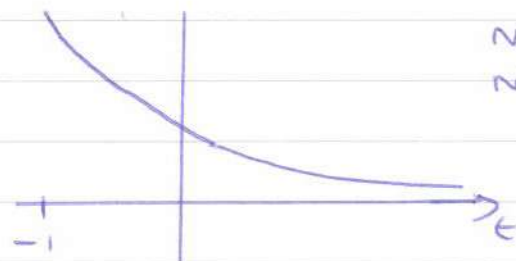
$$\text{OR} = 2 \left\{ -\frac{\sin(2\omega)}{\omega} + 2 \frac{\sin^2 \omega}{\omega^2} \right\}$$

$$\text{OR} = 2 \left\{ -2 \frac{\sin(\omega) \cos(\omega)}{\omega} + 2 \frac{\sin^2(\omega)}{\omega^2} \right\}$$

$$= \frac{4 \sin(\omega)}{\omega^2} \left\{ -\omega \cos(\omega) + \sin(\omega) \right\}$$

$$\underline{\text{OR}} = 4 \left\{ \sin^2(\omega) - \sin(\omega) \cos(\omega) \right\}$$

$$(c) \quad f(t) = e^{-2t} u(t+1)$$



NOT ODD
NOT EVEN

$$F(\omega) = \int_{-\infty}^{\infty} e^{-2t} u(t+1) e^{-i\omega t} dt$$

$$= \int_{-1}^{\infty} e^{-2t} \cdot e^{-i\omega t} dt$$

$$= \int_{-1}^{\infty} e^{-(2+i\omega)t} dt$$

$$= \left[\frac{e^{-(2+i\omega)t}}{-(2+i\omega)} \right]_{-1}^{\infty}$$

$$= 0 - \frac{e^{-(2+i\omega)(-1)}}{-(2+i\omega)}$$

$$= \frac{e^{2+i\omega}}{2+i\omega}$$

Q2.

Formula Book:

$$2(a) \quad \frac{1}{2+iu} \rightarrow e^{-2t} u(t)$$

Page 7 No 1
a=2

$$(b) \quad \frac{1}{i\omega-3} \rightarrow -e^{3t} u(-t)$$

Page 7 No 2
a=3

$$(c) \quad 12 \operatorname{sinc}(6\omega) = 12 \operatorname{sinc}\left(\frac{12\omega}{2}\right)$$

Page 7 No 4
T=12

$$\rightarrow g_{12}(t)$$

$$= \begin{cases} 1 & |t| < 6 \\ 0 & \text{otherwise} \end{cases} = u(t+6) - u(t-6)$$

$$(d) \quad \frac{\sin(3\omega)}{\omega} = 3 \frac{\sin(3\omega)}{3\omega}$$

$$= 3 \operatorname{sinc}(3\omega) = \frac{1}{2} 6 \operatorname{sinc}\left(\frac{6\omega}{2}\right)$$

No 4

T=6

$$= \frac{1}{2} g_6(t)$$

$$= \frac{1}{2} [u(t+3) - u(t-3)]$$

$$(e) \quad \frac{5}{(i\omega+3)^3} \rightarrow 5 \frac{t^2}{2!} e^{-3t} u(t)$$

No 10
a=3, n=3

$$(f) \quad \operatorname{sinc}^2(4\omega) = \operatorname{sinc}^2\left(\frac{8\omega}{2}\right) = \frac{1}{8} \cdot 8 \operatorname{sinc}^2\left(\frac{\omega}{2}\right)$$

No 5
A=1, T=8

$$= \begin{cases} \frac{1}{8} \left(1 - \frac{|t|}{8}\right) & |t| < 8 \\ 0 & \text{otherwise} \end{cases}$$

$$(g) \quad \frac{2}{9+\omega^2} = \frac{2}{3} \cdot \frac{3}{9+\omega^2} \rightarrow \frac{1}{3} e^{-3|t|}$$

No 6 a=3

$$(h) \quad e^{-\omega^2/2} \rightarrow \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}t^2}$$

No 9 a=1/2