

University of Massachusetts Lowell
Department of Electrical and Computer Engineering
EECE 5090 Linear Systems

Problem set 4

1. Evaluate using contour integration

a.

$$\int_{-\infty}^{\infty} \frac{\sin(t)}{t} dt = \text{Im} \left[\int_{-\infty}^{\infty} \frac{e^{jt}}{t} dt \right]$$

b.

$$\int_{-\infty}^{\infty} \frac{\sin(t)^3}{t^3} dt = \int_{-\infty}^{\infty} \frac{3\sin(t) - \sin(3t)}{4t^3} dt$$

2. Given $f(t) \leftrightarrow F(\omega)$ where $F = 0$ for $|\omega| > \Omega$ show

$$f(t) = f(t) * \frac{\sin(at)}{\pi t}$$

for $a > \Omega$.

3. Given

$$e^{i[at^2+bt+c]} \leftrightarrow \sqrt{\frac{\pi}{a}} e^{i\pi/4} e^{i \left[c - \frac{(b-\omega)^2}{4a} \right]}$$

find the FT of $x(t) = \cos(at^2 + bt + c)$

4. Given the differential equation

$$\frac{d^2 x}{dt^2} - t^2 x = \lambda x$$

find the differential equation in terms of $X(\omega)$

5. Given

$$f(t) = \sum_{k=0}^{N-1} \delta(t - kT)$$

- a. Find $F(\omega)$
- b. Plot $|F(\omega)|$

6. Given

$$f(t) = \sum_{n=-\infty}^{\infty} \frac{d\delta(t - nT)}{dt}$$

Find $F(\omega)$