

Math 464: Midterm Exam #1
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Solve all 4 problems.

1. **(25 points)** Find the Fourier transform of

(a) **(15 points)**

$$f(x) = \frac{1}{x+i}$$

(b) **(10 points)**

$$f(x) = \int_{-\infty}^{\infty} e^{2\pi i s x - s^4} ds$$

2. **(25 points)** Use Parseval's identity to compute

$$\int_{-\infty}^{\infty} \left(\frac{\sin(2x)}{x} \right)^3 dx.$$

3. **(25 points)** Show that the Fourier transform of the convolution of two functions is the product of the Fourier transforms of the functions. (Assume that the order of integration can be changed whenever needed).
4. **(25 points)** Use Poisson's relation to compute the Fourier coefficients and expand in Fourier series the following 1-periodic function

$$f(x) = \begin{cases} x, & 0 \leq x < 1/4, \\ 0, & 1/4 \leq x < 1. \end{cases}$$