

1. Let $f(x)$ be a 2π - periodic function such that $f(x) = x^2 - x$ for $x \in [-\pi, \pi]$. Find the Fourier series for $f(x)$.

2. Let $f(x)$ be a 2π - periodic function such that $f(x) = x^2$ for $x \in [-1, 1]$. Using the complex form, find the Fourier series of the function $f(x)$.

3. Let $g(x) = \begin{cases} \sin x & \text{if } -\pi \leq x \leq \pi \\ 0 & \text{if } |x| > \pi \end{cases}$
 - a. Verify that the function g satisfies the condition $\int_{-\infty}^{\infty} |g(x)|^2 dx < \infty$.
 - b. Compute the Fourier Integral of $g(x)$.
 - c. Determine what the Fourier Integral of $g(x)$ converges to at each real number.

4. Consider the Gaussian function $g(t) = e^{-at^2}$ for $a \in \mathfrak{R}$.
 - a. Sketch the graph in EXCEL of the Gaussian function when $a = -0.1$, $a = 1$, and $a = 10$ in the same frame.
 - b. Compute the Fourier Transform of the Gaussian function for $a = 1$.