4321

1. Find the five most important nonzero terms in a complex Fourier expansion of the function $f(x) = \frac{x}{\pi}$ on the interval $0 \le x \le 2\pi$, not just the coefficients c_n but also the terms with x dependence. You might want to make a plot to see if your expansion looks like the function.

2. Consider the quantum mechanical wave function $\psi(x) = A \exp\left(-\frac{x^2}{8}\right)$.
   (a) Find A by normalizing $< \psi|\psi >= \int |\psi|^2 dx = 1$. (All integrals are over the entire domain of the variable, $-\infty < x < \infty$ in this case.)
   (b) Graph the normalized function $\psi(x)$.
   (c) Find the Fourier transform $c(k)$ of $\psi(x)$.
   (d) Graph $c(k)$ vs. k.
   (e) What is Parseval's theorem?
   (f) Is $c(k)$ automatically normalized?
   (g) Find $< x >=< \psi|x|\psi >= \int x|\psi|^2 dx$, $< x^2 >$, and the standard deviation or uncertainty $\sigma_x = \Delta x = \sqrt{< x^2 > - < x >^2}$.
   (h) Find $< k >=< c|k|c >$, $< k^2 >$, and σ_k.
   (i) Is the Uncertainty Principle $\sigma_x \sigma_k \ge \frac{1}{2}$ satisfied?

7305

1. Find the five most important nonzero terms in a complex Fourier expansion of the function
$$f(x) = \begin{cases} x, & 0 \le x \le \pi \\ 0, & \pi < x \le 2\pi \end{cases}$$
on the interval $0 \le x \le 2\pi$, not just the coefficients c_n but also the terms with x dependence. You might want to make a plot to see if your expansion looks like the function.

2. Consider the quantum mechanical wave function $\psi(x) = \begin{cases} Ax, & 0 \le x \le \pi \\ 0, & \text{elsewhere} \end{cases}$.

   (a) Find A by normalizing $< \psi|\psi >= \int |\psi|^2 dx = 1$.

   (b) Graph the function $\psi(x)$.

   (c) Find the Fourier transform $c(k)$ of $\psi(x)$.

   (d) Graph the real part of $c(k)$ vs. k.

   (e) What is Parseval's theorem?

   (f) Is $c(k)$ automatically normalized?

   (g) Find $< x >=< \psi|x|\psi >= \int x|\psi|^2 dx$, $< x^2 >$, and the standard deviation or uncertainty $\sigma_x = \Delta x = \sqrt{< x^2 > - < x >^2}$.

   (h) Find $< k >=< c|k|c >$, $< k^2 >$, and σ_k.

   (i) Is the Uncertainty Principle $\sigma_x \sigma_k \ge \frac{1}{2}$ satisfied?

Bonus: Solve as much of the other class' assignment as you can.