CHEM 290

K. Lindenberg and K. Baldridge Spring 2001

TAKE-HOME PORTION OF FINAL, WORTH 200 POINTS

INSTRUCTIONS: YOU MAY USE ANY MATERIAL YOU WISH (BOOKS, WEB SITES, ANYTHING ELECTRONIC OR MECHANICAL, BUT NOT (NOTE!!!) THE INPUT OF ANOTHER PERSON. YOU MAY NOT CONSULT WITH YOUR CLASSMATES OR WITH ANYONE ELSE. YOU MUST ALSO MAKE SURE THAT WE FULLY UNDERSTAND HOW YOU ARRIVED AT YOUR ANSWERS.

1. **Textbook Chapter 3 No. 24**

2. **Textbook Chapter 3 No. 25**

3. **Textbook Chapter 3 No. 26**

4. Find the Fourier series expansion for the following function $f(x)$. Plot the function and also the sum of 4, 6, and 10 terms of the series

$$f(x) = \delta(x), \quad -\pi < x < \pi.$$

5. Find the Fourier series expansion of the function

$$f(x) = \left(\frac{\pi}{2} - |x|\right)\cos x + (1+x^2)|\sin x| - \pi x \sin x, \qquad -\pi < x < \pi.$$

Use this result to evaluate

$$A \equiv \sum_{n=1}^{\infty} \frac{n^2}{(n^2 - \frac{1}{4})^3}.$$

6. The function

$$f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$$

is a symmetrical finite step function.

(a) Find $g_c(\omega)$, the Fourier cosine transform of $f(x)$.

(b) Taking the inverse cosine transform, show that

$$f(x) = \frac{2}{\pi}\int_0^{\infty} \frac{\sin\omega \cos\omega x}{\omega} d\omega.$$

(c) The inverse transform result in (b) provides an integral representation of the step function in part (a), and actually associates a value with $f(x)$ at $x = \pm 1$, points at which the original step function is not defined. Evaluate $f(1)$ and $f(-1)$ as defined by the result in (b).

7. Find the Fourier transform of the triangular pulse

$$f(x) = \begin{cases} h(1 - a|x|), & |x| < 1/a \\ 0, & |x| > 1/a. \end{cases}$$