KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
COLLEGE OF COMPUTER SCIENCES & ENGINEERING

COMPUTER ENGINEERING DEPARTMENT

COE-342 – Data and Computer Communication
March 6th, 2004 – Assignment
(Due Date: March 20th, 2004)

1) Textbook Problems: 2.7, 3.4, and 3.6
2) The Fourier series expansion for any periodic function $s(t)$ with period T, is given by

$$s(t) = \frac{A_0}{2} + \sum_{n=1,2}^{\infty} A_n \cos(2\pi nft) + B_n \sin(2\pi nft)$$

where the fundamental frequency $f = 1/T$. Using the following three trigonometric laws:

$$\frac{1}{T}\int_0^T \cos(2\pi nft)\cos(2\pi mft)dt = \begin{cases} 0 & n \neq m \\ 1/2 & n = m \end{cases}$$

$$\frac{1}{T}\int_0^T \sin(2\pi nft)\sin(2\pi mft)dt = \begin{cases} 0 & n \neq m \\ 1/2 & n = m \end{cases}$$

$$\frac{1}{T}\int_0^T \cos(2\pi nft)\sin(2\pi mft)dt = 0 \qquad \forall n, m$$

SHOW that the coefficients A_0, A_n, and B_n are given by the following expressions:

$$A_0 = \frac{2}{T}\int_{-T/2}^{T/2} s(t)dt$$

$$A_n = \frac{2}{T}\int_{-T/2}^{T/2} s(t)\cos(2\pi nft)dt \qquad n = 1,2,...$$

$$B_n = \frac{2}{T}\int_{-T/2}^{T/2} s(t)\sin(2\pi nft)dt \qquad n = 1,2,...$$

3) Consider the Sawtooth wave function listed in table B.1 of Appendix B (page 793) of the text book.
    a. Write a mathematical expression for s(t)
    b. Compute the Fourier series expansion for s(t)
    c. Write an expression for s_e(3)
    d. Plot the original s(t) and s_e(3) on the same graph. Is s_e(3) a good approximation for s(t)?
    e. Find the total power of s(t)
    f. Find n* such that s_e(n = n*) contains 95% of the total power in the original signal
    g. Write and expression for the power spectral density function for s(t)
    h. Plot the power spectral density function for s(t)