KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-341 – Data and Computer Communication

Quiz 02 - Feb 11th, 2012 Due Mon Feb 20th, 2012

Student Name:
Student Number:

(25 points + 5 bonus) Consider the square wave function $s(t)$ shown in textbook Figure 3.7 (part c). Let the amplitude A be equal to 2 volts, while the period T be equal to 2 second. The textbook states that the Fourier Series Expansion (F.S.E.) for $s(t)$ is given by $s(t) = A \times \frac{4}{\pi} \times \sum_{n=1,3,5,\cdots}^{\infty} \frac{\sin(2\pi n f_0 t)}{k}$ as shown on page 74.

a) (2 points) write an expression for $s(t)$ for $t \in (0, T)$?

b) (2 points) Compute the total power of $s(t)$?

c) (8 points) Compute the F.S.E. of $s(t)$.

d) (6 points) Specify the power spectral density (PSD) function for $s(t)$?

e) (7 points) Find n^* such that power of $s\_e(n = n^*)$ at least 95% of the power contained in $s(t)$?

f) **(5 points - bonus)** If the signal is passed through a high pass filter which suppresses all frequencies in $[0,4f_0]$, but passes all frequencies in the interval $(4f_0, \infty)$ – Write an expression for the outputs signal $s_O(t)$., and find its total power?

Student must provide the answers first in terms of the amplitude A and the period T, and then substitute to obtain the numerical value.

Appendix: Relations you MIGHT need

$$\cos(a) = \cos(-a) \qquad \sin(a) = -\sin(a)$$

$$\cos(a +/- b) = \cos(a)\cos(b) -/+ \sin(a)\sin(b)$$

$$\sin(a +/- b) = \sin(a)\cos(b) +/- \cos(a)\sin(b)$$

$$\sin(2a) = 2\sin(a)\cos(b)$$

$$\cos(2a) = \cos^2(a) - \sin^2(b) = 2\cos^2(a) - 1 = 1 - 2\sin^2(a)$$

$$\cos(ax)^2 = \frac{1}{2} + \frac{1}{2}\cos(2ax)$$

$$\sin(ax)^2 = \frac{1}{2} - \frac{1}{2}\cos(2ax)$$

$$\int \cos(ax)dx = \frac{1}{a}\sin(ax) + C$$

$$\int \sin(ax)dx = \frac{-1}{a}\cos(ax) + C$$

$$\int \cos(ax)^2 dx = \frac{x}{2} + \frac{1}{4a}\sin(2ax) + C$$

$$\int \sin(ax)^2 dx = \frac{x}{2} - \frac{1}{4a}\sin(2ax) + C$$

$$\int x\cos(ax)dx = \frac{\cos(ax)}{a^2} + \frac{x\sin(ax)}{a}C$$

$$\int x\sin(ax)dx = \frac{\sin(ax)}{a^2} - \frac{x\cos(ax)}{a}C$$