

***KFUPM - COMPUTER ENGINEERING DEPARTMENT*****COE-241 – Data and Computer Communication****Quiz 02    Model A****Student Name:****Student Number:**

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**Problem 1 (30 points):**

Given the following periodic signal:

$$s(t) = \frac{A}{2} + \frac{2A}{\pi} \cos\left(\frac{2\pi}{T}t\right) - \frac{2A}{3\pi} \cos\left(\frac{6\pi}{T}t\right)$$

where the amplitude  $A = 2$  volts, and the parameter  $T = 0.01$  seconds.

- (5 points) Specify the period and frequency of  $s(t)$ .
- (10 points) Compute the total power for  $s(t)$ .
- (5 points) Compute the bandwidth for  $s(t)$ .
- (10 points) Sketch the power spectral density function for  $s(t)$ .

**Problem 2 (30 points):**

Consider the two periodic signal  $s(t)$  and  $g(t)$  shown in Figure. Both signals have amplitude of  $A$  volts and period  $T$  seconds.

From class notes we know that the Fourier Series Expansion (FSE) for  $s(t)$  is given by

$$s(t) = \frac{A}{2} + \frac{2A}{\pi} \sum_{n=1,3,5}^{\infty} \frac{(-1)^{(n-1)/2}}{n} \cos\left(\frac{2\pi}{T} \times n \times t\right)$$

- (5 points) Does the signal  $g(t)$  contain a DC component? Why or why not?
- (5 points) Do you expect the  $A_n$  coefficients for FSE of  $g(t)$  to be nonzero? Why or why not?
- (5 points) Do you expect the  $B_n$  coefficients for FSE of  $g(t)$  to be nonzero? Why or why not?
- (15 points) Sketch/outline a derivation for the FSE for signal  $g(t)$  WITHOUT using the FSE definition.

Hint: write  $g(t)$  as a shifted and/or scaled version of  $s(t)$  and substitute in the given FSE for  $s(t)$ . You may need the trigonometric identity  $\cos(a \pm b) = \cos(a)\cos(b) \mp \sin(a)\sin(b)$

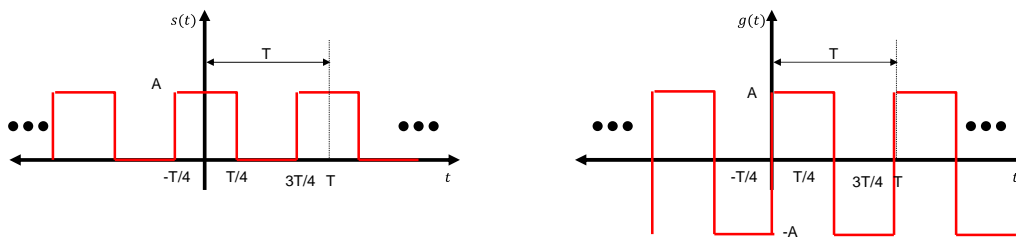


Figure: Signals  $s(t)$  and  $g(t)$  for problem 2.

