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

COE 540 – Computer Networks
Assignment 1 – Due Date March 2nd, 2015

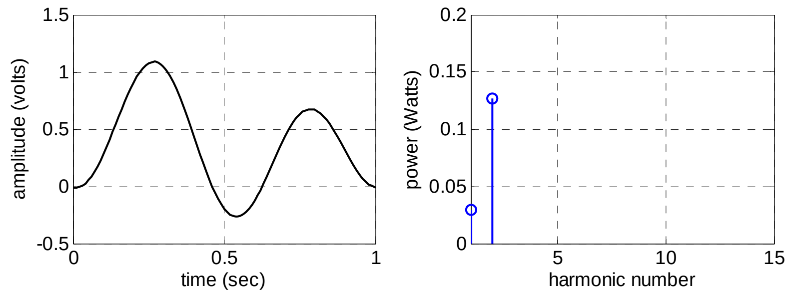
Problem #	Maximum Mark	Mark
1	40	
2	10	
3	10	
4	10	
5	10	
6	10	
Total	90	

Problem (1):

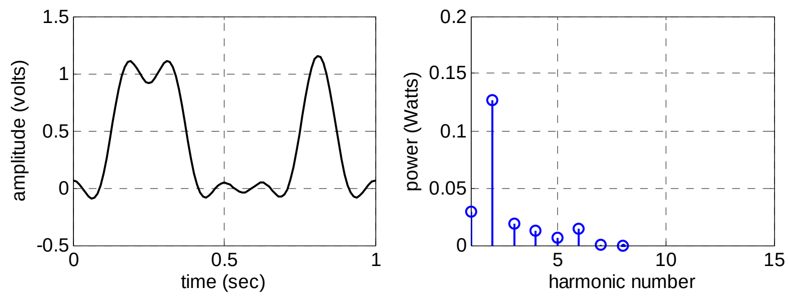
Solution

a) $g(t) = \begin{cases} 1 & \frac{T}{8} < t \leq \frac{3T}{8} \\ 1 & \frac{6T}{8} < t \leq \frac{7T}{8} \\ 0 & \text{otherwise} \end{cases}$ for $t \in (0, T]$.

b) Refer to the following table:



(c) 2 harmonics.



(e) 8 harmonics.

c) >> Assign_01_132_COE_540_Problem_2

For number of harmonics = 15 - Total power = 0.362 Watts

For number of harmonics = 1 - Total power = 0.170 Watts

For number of harmonics = 2 - Total power = 0.297 Watts

For number of harmonics = 4 - Total power = 0.329 Watts

For number of harmonics = 8 - Total power = 0.350 Watts

Note that the total power for the original *unfiltered* $g(t)$ is equal to

$$P_g = \frac{A^2 \times (2 \times T/8) + A^2 \times (1 \times T/8)}{T} = \frac{3}{8} A^2 \text{ Watts}$$

Or 0.375 Watts for A = 1 Volts.

This total power should be also the same as

$$P_g = \left(\frac{c}{2}\right)^2 + \frac{1}{2} \sum_{n=1}^{\infty} a_n^2 + b_n^2$$

d) When g(t) is passed through the ideal LPF, the output signal includes only frequencies less than 9 Hz. That is gL(t) is given by

$$g_L(t) = \frac{c}{2} + \sum_{n=1}^{8} a_n \sin\left(\frac{2\pi nt}{T}\right) + \sum_{n=1}^{8} b_n \cos\left(\frac{2\pi nt}{T}\right)$$

where the coefficients a_n, b_n and c are given in textbook. The period T is specified as 1 sec. Note the summation runs up to $n = 8$ only.

This is the same signal plotted in Figure 2-1 (e) on page 112 of textbook. The total power for this $g_L(t)$ is equal to 0.350 Watts (from part (c)).

e) When g(t) is passed through the ideal HPF, the output signal includes only frequencies equal or higher to 9 Hz. The output $g_H(t)$ is given by

$$g_H(t) = \sum_{n=9}^{\infty} a_n \sin\left(\frac{2\pi nt}{T}\right) + \sum_{n=9}^{\infty} b_n \cos\left(\frac{2\pi nt}{T}\right)$$

Note that the summations now run from $n = 9$ so that lower harmonics (plus DC) are suppressed.

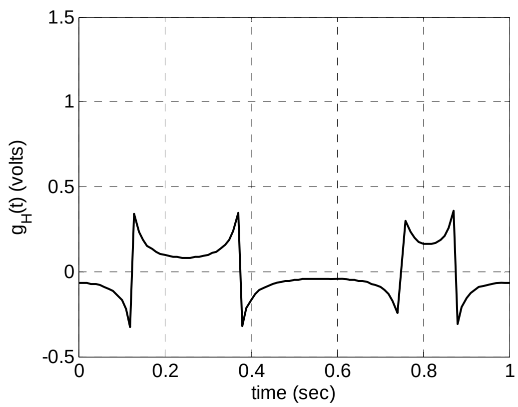
The total power for this signal is equal to

$$P_{g_H} = \frac{1}{2}\sum_{n=9}^{\infty} a_n^2 + b_n^2$$

Now, rather than evaluating the above expression directly, we can see that

$$P_{g_H} = P_g - \left(\left(\frac{c}{2}\right)^2 + \frac{1}{2}\sum_{n=1}^{8} a_n^2 + b_n^2\right)$$

which is equal to 0.0244 Watts.



The plot for $g_H(t)$ is as shown. Note that $g_H(t)$ has no resemblance to the original $g(t)$ **since the low frequency components are now removed**.

Problem (2):

Let d be equal to 40000 km. The request needs to traverse a distance equal to $2d$ to reach the server, and the response needs to traverse the same distance. Therefore, the minimum delay is equal to $\frac{4d}{v} = \frac{4\times40000\times1000}{3\times10^8} = 0.533$ seconds. Here $v = 3 \times 10^8$ m/sec is the speed of light. There are transmission and processing delays on top of this propagation delay.

Problem (3):

Refer to discussion in textbook pages 146 and 147.

Problem (4): {to be cancelled}

Problem (5):

Item	**Pros**	**Cons**
Fixed payload size	Easy of processing (parsing)	Waste of bandwidth for unfilled payloads
Small payload size	Appropriate for real-time traffic (or delay/jitter sensitive traffic)	Waste for bandwidth when overhead fields are used

Problem (6):

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>> Assign01_FHD_Problem
(a)
Size of frame =     49766400 bits     or       0.0058 Gbytes
     bit rate =   1492992000 bits/sec or       0.1738 Gbytes/sec
(b)
Size of single-layer blue ray disc is  25 Gbytes
Maximum movie length is  143.838 sec or    2.397 min
(c)
Size of 120 min video is 1251.411 Gbytes

1 byte  = 8 bits
1Kbytes = 1024
1Mbytes = 1024x1024 bytes
1Gbytes = 1024x1024x1024 bytes
Size of single-layer blue ray disc = 25 Gbytes
```