American University of Beirut

Faculty of Engineering and Architecture

Department of Electrical and Computer Engineering

EECE200 – Introduction to Engineering– Fall 2012-2013
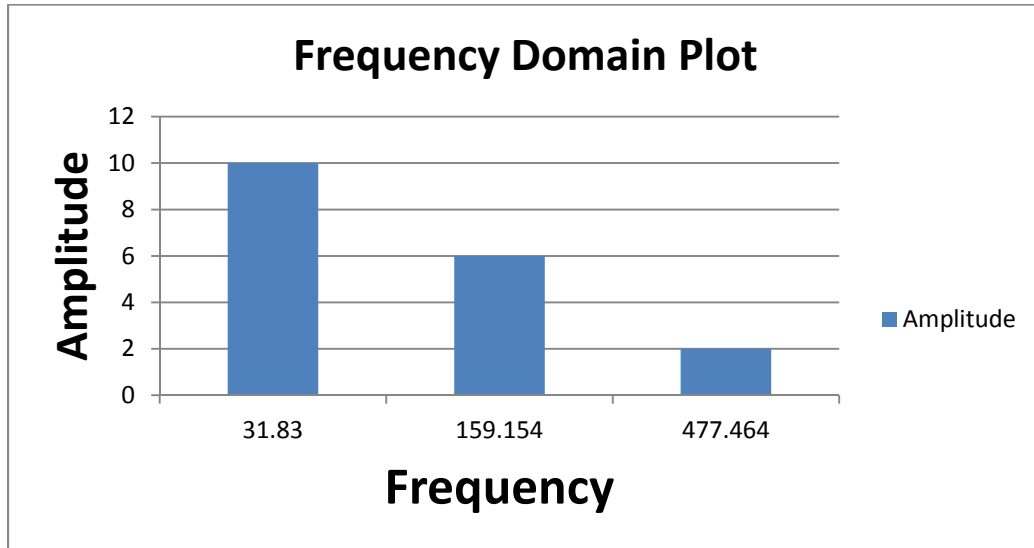
Homework 1 Solution

Problem 1 [30 points]

a. The amplitude of y1 is 10V   [1]
   The amplitude of y2 is 2V   [1]
   The amplitude of y3 is 6V   [1]

b. For y1
   T= 0.0314-0 = 0.0314 sec   [1]
   F= 1/T = 31.8309 Hz   [1]
   $\omega = 2\pi F = 200$ rad/sec   [1]

   For y2
   T= 0.002618-0.000524 = 0.002094 sec [1]
   F= 1/T = 477.464 Hz   [1]
   $\omega = 2\pi F = 3000$ rad/sec   [1]

   For Y3
   T= 0.00628-0 = 0.00628 sec   [1]
   F= 1/T = 159.1549 Hz   [1]
   $\omega = 2\pi F = 1000$ rad/sec   [1]

c. The third second signal has the highest frequency (477.464 Hz) [1]

d. For Y1
   At T = 0.00786 sec Y1 =10 ; 10=10sin(200t+φ1) ; sin(200t+φ1)=1 ; 200t+φ1=π/2 [1]
   φ1=0 rad/s [1]
   φ1=0 deg [1]
   On the graph at T=0 sec the signal has a zero amplitude. Substituting in the equation verifies the calculated results [1]
   For Y2
   At T = 0 sec Y2 =2 ; 2=2sin(3000t+φ2) ; sin(3000t+φ2)=1 ; 3000t+φ2=π/2 [1]
   φ1=π/2 rad/s [1]
   φ1=90 deg [1]
   On the graph at T=0.005 sec the signal has a 0.5 amplitude. Substituting in the equation verifies the calculated results [1]
   For Y3
   At T = 0.0015 sec Y3 =-6 ; -6=6sin(1000t+φ3) ; sin(1000t+φ3)=-1 ;
   1000t+φ3=-π/2 [1]
   φ3=π rad/s [1]

φ3=180 deg [1]
On the graph at T=0 sec the signal has a zero amplitude. Substituting in the equation verifies the calculated results [1]

e.   1 point for each correct column (total 3) and one point for labeling each axis (total 2) [5 points].

Frequency Domain Plot

Amplitude vs Frequency

Frequency	Amplitude
31.83	10
159.154	6
477.464	2

Legend: ■ Amplitude

Problem 2 [10 points]

   a.   108Mhz to 88Mhz [1]
   b.   200KHz [1] (108Mhz-88Mhz)/200KHz = 100 stations [1]
   c.   Radio Monte Carlo [1]. Frequency is 1233 KHz [1] No enough bandwidth [1]
   d.   A color TV has bigger bandwidth as it needs to transmit the different color [3]

Problem 3 [25 points]

   a.   4x4 = 16 pixels [2]
   b.   2 bits are needed to represent the pixel because we have 4 levels of gray which are represented with 2 bits ($2^2=4$ levels) [1] for the number of bits and [1] for verification
        Very Dark red: 00 [2]
        Dark red: 01 [2]
        Light red: 10 [2]
        White: 11 [2]

   c.   [0.5] for each correct element in the matrix

2	0	1	2
1	3	0	3
0	2	3	1
3	3	2	0

   d.   16 (elements)x2(bits for each element)x25 (frames per second)x60 (sec per minute)x5 (minutes)/8 (bits per byte)= 30000 bytes. 30000/1024= 29.2968 Kbytes. 29.2968/1024= 0.02861 Mbytes [4]

e.   No the size will not change [1]

Problem 4 [35 points]

a. $110111001.011010_2 = 1\text{x}2^{8} + 1\text{x}2^{7} + 0\text{x}2^{6} + 1\text{x}2^{5} + 1\text{x}2^{4} + 1\text{x}2^{3} + 0\text{x}2^{2} + 0\text{x}2^{1} + 1\text{x}2^{0} + 0\text{x}2^{-1} + 1\text{x}2^{-2} + 1\text{x}2^{-3} + 0\text{x}2^{-4} + 1\text{x}2^{-5} + 0\text{x}2^{-6} = 441.40625$ [9]

b. $548.23_{10} = 111001010.00111010111$ [4] on the answer and [5] on the steps

458/2	229	0
229/2	114	1
114/2	57	0
57/2	28	1
28/2	14	0
14/2	7	0
7/2	3	1
3/2	1	1
1/2	0	1

0.23x2=0.46; 0.46x2=0.92; 0.92x2=1.84; 0.84x2=1.68; 0.68x2=1.36; 0.36x2=0.72; 0.72x2=1.44; 0.44x2=0.88; 0.88x2=1.76…………………..

c. $4376_8 = 4\text{x}8^{3} + 3\text{x}8^{2} + 7\text{x}8^{1} + 6\text{x}8^{0} = 2302_{10} = 100011111110_2$ [2] for the answer and [2] for the steps

2302/2	1151	0
1151/2	575	1
575/2	287	1
287/2	143	1
143/2	71	1
71/2	35	1
35/2	17	1
17/2	8	1
8/2	4	0
4/2	2	0
2/2	1	0
1/2	0	1

d. $101011110_2 = 15E_{HEX}$ [4]
     $1110_2 = E_{HEX}$
     $0101_2 = 5_{HEX}$
     $0001_2 = 1_{HEX}$

e. $1A8B_{16} = 1\text{x}16^{3} + 10\text{x}16^{2} + 8\text{x}16^{1} + 11\text{x}16^{0} = 6795$ [9]