

# American University of Beirut

## Faculty of Engineering and Architecture

### Department of Electrical and Computer Engineering

#### EECE200 – Introduction to Engineering– Fall 2011-2012

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#### Homework 1 Solution

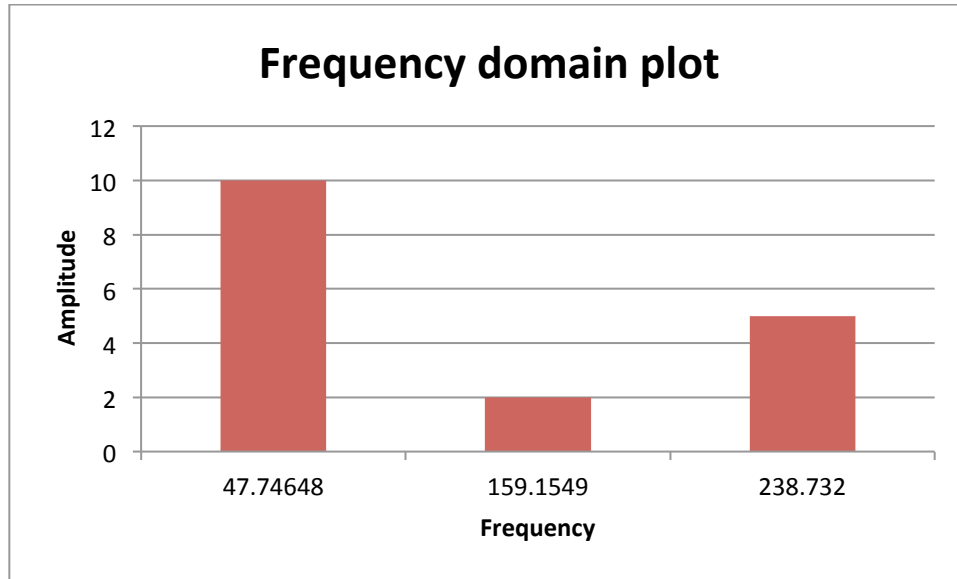
##### Problem 1 [30 points]

- a. The amplitude of  $y_1$  is 10V [1]  
The amplitude of  $y_2$  is 5V [1]  
The amplitude of  $y_3$  is 2V [1]
- b. For  $y_1$   
 $T = 0.0209 - 0 = 0.0209 \text{ sec}$  [1]  
 $F = 1/T = 47.74648 \text{ Hz}$  [1]  
 $\omega = 2\pi F = 300 \text{ rad/sec}$  [1]
- For  $y_2$   
 $T = 0.00733 - 0.00315 = 0.004188 \text{ sec}$  [1]  
 $F = 1/T = 238.732 \text{ Hz}$  [1]  
 $\omega = 2\pi F = 1500 \text{ rad/sec}$  [1]
- For  $Y_3$   
 $T = 0.00628 - 0 = 0.00628 \text{ sec}$  [1]  
 $F = 1/T = 159.1549 \text{ Hz}$  [1]  
 $\omega = 2\pi F = 1000 \text{ rad/sec}$  [1]
- c. The second signal has the highest frequency (1500 Hz) [1]
- d. For  $Y_1$   
At  $T = 0.00522 \text{ sec}$   $Y_1 = 10$  ;  $10 = 10 \sin(300t + \phi_1)$  ;  $\sin(300t + \phi_1) = 1$  ;  $300t + \phi_1 = \pi/2$  [1]  
 $\phi_1 = 0 \text{ rad/s}$  [1]  
 $\phi_1 = 0 \text{ deg}$  [1]  
On the graph at  $T = 0 \text{ sec}$  the signal has a zero amplitude. Substituting in the equation verifies the calculated results [1]
- For  $Y_2$   
At  $T = 0 \text{ sec}$   $Y_2 = 5$  ;  $5 = 5 \sin(1500t + \phi_2)$  ;  $\sin(1500t + \phi_2) = 1$  ;  $1500t + \phi_2 = \pi/2$  [1]  
 $\phi_1 = \pi/2 \text{ rad/s}$  [1]  
 $\phi_1 = 90 \text{ deg}$  [1]  
On the graph at  $T = 0.001 \text{ sec}$  the signal has a 0 amplitude. Substituting in the equation verifies the calculated results [1]
- For  $Y_3$   
At  $T = 0.00157 \text{ sec}$   $Y_3 = -2$  ;  $-2 = 2 \sin(1000t + \phi_3)$  ;  $\sin(1000t + \phi_3) = -1$  ;  
 $1000t + \phi_3 = -\pi/2$  [1]  
 $\phi_3 = \pi \text{ rad/s}$  [1]

$\phi_3=180$  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].



### Problem 2 [10 points]

- Radio one [1]. Frequency is 105.5 MHz [1]. Range of FM station is 88 MHz to 108MHz [1]
- Total bandwidth of AM radio is  $1700-530=1170$  KHz. Since each station is assigned a 10KHz bandwidth, total number of stations that the AM bandwidth can afford =  $1170/10=117$  stations.[3]
- Yes the TV station bandwidth is bigger than the FM stations because they are transmitting audio as well as video which requires more data or bandwidth [2]
- No the bandwidth needed for a black and white TV is smaller since we are sending data for one color only. [2]

### Problem 3 [25 points]

- $5 \times 5 = 25$  pixels [2]
- 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  
Black: 00 [2]  
Dark grey: 01 [2]  
Light Grey: 10 [2]  
White: 11 [2]

c.

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

3 3 3 1 3  
2 0 1 3 0

[0.32] for each correct element in the matrix

- d.  $25 \text{ (elements)} \times 2 \text{ (bits for each element)} \times 30 \text{ (frames per second)} \times 60 \text{ (sec per minute)} \times 2.5 \text{ (minutes)/8 (bits per byte)} = 28125 \text{ bytes; } 28125/1024 = 27.46582 \text{ Kbytes; } 27.46582/1024 = 0.02682 \text{ Megabytes [5]}$

**Problem 4 [35 points]**

- a.  $10011101.011101_2 = 1x2^7 + 0x2^6 + 0x2^5 + 1x2^4 + 1x2^3 + 1x2^2 + 0x2^1 + 1x2^0 + 0x2^{-1} + 1x2^{-2} + 1x2^{-3} + 1x2^{-4} + 0x2^{-5} + 1x2^{-6} = 157.453125 [9]$
- b.  $485.23_{10} = 111100101.00111010111000010100011110101 [4] \text{ on the answer and } [5] \text{ on the steps}$

485/2	242	1
242/2	121	0
121/2	60	1
60/2	30	0
30/2	15	0
15/2	7	1
7/2	3	1
3/2	1	1
1/2	0	1

$0.23 \times 2 = 0.46$ ;  $0.46 \times 2 = 0.92$ ;  $0.92 \times 2 = 1.84$ ;  $0.84 \times 2 = 1.68$ ;  $0.68 \times 2 = 1.36$ ;  $0.36 \times 2 = 0.72$ ;  $0.72 \times 2 = 1.44$ ;  $0.44 \times 2 = 0.88$ ;  $0.88 \times 2 = 1.76$ .....

- c.  $1574_8 = 1x8^3 + 5x8^2 + 7x8^1 + 4x8^0 = 892_{10} = 1101111100_2 [2] \text{ for the answer and } [2] \text{ for the steps}$

892/2	446	0
446/2	223	0
223/2	111	1
111/2	55	1
55/2	27	1
27/2	13	1
13/2	6	1
6/2	3	0
3/2	1	1
1/2	0	1

- d.  $100011111_2 = 11F_{\text{HEX}} [4]$   
 $1111_2 = F_{\text{HEX}}$   
 $0001_2 = 1_{\text{HEX}}$   
 $0001_2 = 1_{\text{HEX}}$
- e.  $1C8B_{16} = 1x16^3 + Cx16^2 + 8x16^1 + Bx16^0 = 7307 [9]$