EE2023 Signals & Systems Quiz

Semester 1 AY2011/12

Date : 6 October 2011 **Time Allowed : 1.5 hours**

Instructions :

1. Answer all 4 questions. Each question carries 10 marks.
2. This is a closed book quiz.
3. No programmable or graphic calculators allowed.
4. Please enter your name and matric number in the spaces below.
5. Please staple this page to your written answer scripts.

Name : _____

Matric # : _____

Lecture Group # : _____

Question #	Marks
1	
2	
3	
4	
Total Marks	

For your information :
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Group 2 : A/Prof Ng Chun Sum
Group 3 : A/Prof Tan Woei Wan
Group 4 : Prof Lawrence Wong

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Answer all 4 questions. All questions carry equal marks. Total marks : 40

Q1. Consider the periodic signal $x(t)$ given by the expression

$$x(t) = (2+2j)e^{-j3t} - 3je^{-j2t} + 5 + 3je^{j2t} + (2-2j)e^{j3t}$$

a) What is the fundamental period and fundamental frequency of $x(t)$?
b) Sketch the amplitude and phase spectra of $x(t)$.
c) Is $x(t)$ a real signal ? Justify your answer.
d) What is the power of $x(t)$?

Q2. Derive the Fourier transform of the signal $x(t)$ shown in Figure Q-2-1.

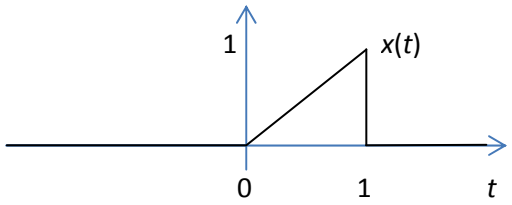

Figure Q2-1

[Hint: rect(t/T) $\Leftrightarrow$ T.sinc(fT) and $u(t) \Leftrightarrow 0.5[\delta(f) + 1/(j\pi f)]$

Derive the Fourier transform of the periodic signal $y(t)$ shown in Figure Q2-2.

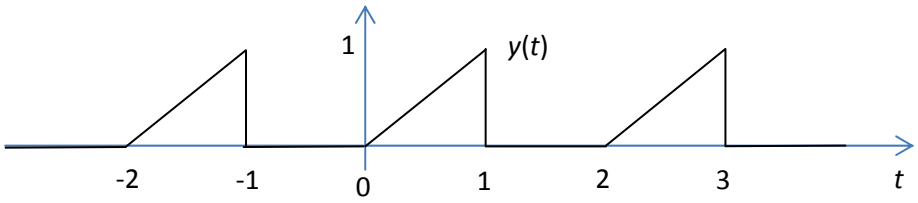

Figure Q2-2

Q3. A signal is modeled by $x(t) = 2rect\left(\frac{t}{2}\right) \ast rect\left(\frac{t}{2}\right)$ where $\ast$ denotes convolution. Determine the spectrum, $X(f)$, of $x(t)$. Sketch and label the Energy Spectral Density (ESD) and Power Spectral Density (PSD) of $x(t)$ for frequencies between -2Hz and 2Hz.

Q4. Consider 2 signals, $x_1(t) = \sin 4\pi t, x_2(t) = 2\cos 8\pi t$. Suppose $y(t) = x_1(t)x_2(t)$. Write down the Fourier Transforms, $X_1(f)$, $X_2(f)$ and $Y(f)$ where $X_1(f) \Leftrightarrow x_1(t)$, $X_2(f) \Leftrightarrow x_2(t)$ and $Y(f) \Leftrightarrow y(t)$. Sketch their amplitude spectra.

Assume that $y(t)$ is sampled with a sampling frequency of $f_s = 10$ Hz. Sketch the amplitude spectrum of the sampled signal. Can $y(t)$ be reconstructed completely from the sampled signal?