كفر الشيخ

Kafrelsheikh University
Faculty of Engineering
Department of electrical engineering
Subject: Signals Processing
Instructors: **Dr. Bedir B. Yousif** **2nd Year**

Date: 21/5/2016
Time allowed: **3 Hours**
Full mark: 90 Mark
Final term Exam: two pages
Academic Number: ECE

**Solve all the following questions:-**

* Any missing data could be reasonably assumed and books &notes are not allowed.

**Solve the following questions:-**

**Question one** (30 mark)

1. Classify the following signal $f(t)=e^{-|t|}$, if its power or energy signal for $(-\infty, \infty)$
2. If $\varphi_1(t) = e^{-|t|}, \varphi_2(t) = 1 - Ae^{-2|t|}$ Find the constant $A$ for orthogonality over the duration $(-\infty, \infty)$.
3. If $\varphi_0(t) = 1,\ \varphi_1(t) = t, and\ \varphi_1(t) = \frac{3}{2}t^2 - \frac{1}{2}$,. Represent $f(t)=|t|$ over (-1,1) using this set of orthogonal functions.
4. Find the total harmonic distortion, the average power , amplitude and phase line spectra for periodic signal $f(t)=2t$ over the period (0,1) if n=0,1,2,3,4,5.
5. Drive an expression for a power signal using Parseval's theorem in the form using exponential Fourier series coefficient and trigonometric Fourier series coefficients?
6. Determine the average power of $f(t)=2sin(100t)$. using a- General formula

b- Trigonometric Fourier series coefficients Parseval's theorem?

c- Exponential Fourier series coefficient Parseval's theorem?

**Question Two** (30 mark)

1- Find the generalized Fourier series for the following periodic signal in Fig. 1 If the basis function set is $\cos(\frac{n\pi}{4}t)$ and Find the second and third harmonic distortion.

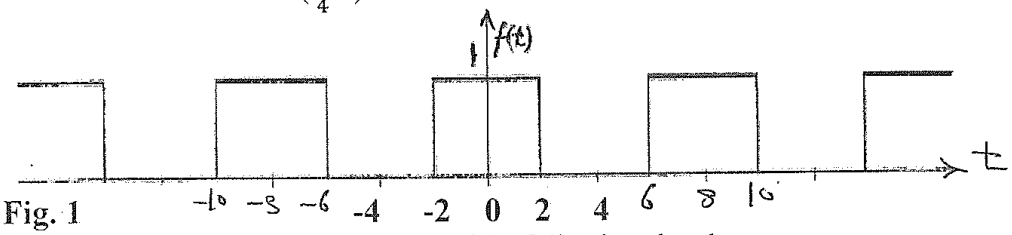


**Fig. 1**

2- Plot the spectral density function of the following signal

$$f(t) = \begin{cases} 1 - \dfrac{|t|}{\tau} & ,|t| \le \tau \\ 0, & |t| \le \tau \end{cases}$$

3- From the given spectral density function $F(\omega) = \frac{0.5}{a+j(\omega-\omega_0)} + \frac{0.5}{a+j(\omega+\omega_0)}$. Find *f(t)*

4- Drive an expression for natural sampled signal in time and frequency domain with sketching the waveforms and avoid the aliasing problem?

5- For a given magnitude and phase spectrum functions $|F(\omega)| = \pi$ : if $-W_0 \leq \omega \leq W_0$ and $|F(\omega)| = 0$; otherwise and $\varphi(\omega) = \frac{\pi}{2}; if\ \omega \leq 0$; and $\varphi(\omega) = \frac{-\pi}{2} if\ \omega > 0$ .

6- A 64 level quantizer for a signal y(t)=15 sin 500t + 20 sin 2000t. (a) Find the band width of analog and digital signal (b) signal to noise ratio

**Question Three** (30 mark)

1- A signal $f(t) = \text{sinc}(5\pi t))$ is sampled using spaces impulses at rate of (i) 5 Hz, (ii) 10 Hz; (iii) 20 Hz. For each of the three cases:
   (a) Sketch the sampled signal
   (b) Sketch the spectrum sampled signal.
   (c) Explain whether you can recover the sinal g(t) from the sampled signal.

2- A television signal (video and audio) has a bandwidth of 4MHz. This signal is sampled, quantized, and binary encoded to obtain a digital signal.
   (a) Determine the sampling rate if the signal is to be sampled at a rate 10% above the Nyquist rate.
   (b) If the samples are quantized into 512 levels, determine the number of binary pulses required to encode each sample.
   (c) Determine the binary pulse rate (bits per second) of the binary-coded signal, and the minimum bandwidth required to transmit this digital signal.
   (d) Determine the signal to noise ratio.
   (e) Find the number of levels that will required to make the signal to noise ratio ≥70 dB

3- Find the signal x(t) corresponding to the spectral density function in Fig. 2

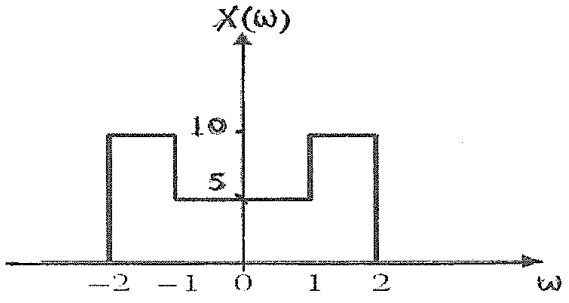


**Fig. 2**

**Best wishes of success**
**Dr. Bedir yousif**