Department of Electronics & Communication Engineering
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Assignment Sheet 3

Communication System

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Due Date : August 19, 2013
Section : EC-3
Problems : 15

1- Find the Fourier Series of Unipolar Pulse of Unity amplitude and frequency $\omega_0=\frac{2\pi}{T_0}$

2- Find the Fourier Series of Bipolar square wave of unity amplitude and $\omega_0=\frac{2\pi}{T_0}$.

3- Consider the rectangular pulse (gate function) signal defined as
X(t) = A rect $\left(\frac{t}{2T_0}\right)$ = A$\prod\left(\frac{t}{2T_0}\right)$ = $\begin{cases} A & |t| < T_0 \\ 0 & |t| > T_0 \end{cases}$

4- Find the Fourier Transform of X(t)= $e^{-a|t|}$, a>0. And also draw its spectrum.

5- Find Fourier Transform of the following
(i) X(t)= $\cos \omega_0 t$
(ii) X(t)= $\sin \omega_0 t$

6- The Fourier Transform of F[$e^{-t}u(t)$] is equal to $\frac{1}{1+j2\pi f}$ therefore find F$\left[\frac{1}{1+j2\pi t}\right]$.

7- Consider a low-pass random process with a White Noise power spectral density $S_x(\omega) = \frac{N}{2}$ find autocorrelation function $R_x(\tau)$.

8- Find the following two properties of autocorrelation function $R_x(\tau)$ of a random process X(t).
(i)- If X(t) contains a DC component equal to A, then $R_x(\tau)$ will contain a constant component equal to A^2.
(ii)- If X(t) contains a sinusoidal component the $R_x(\tau)$ will also contain a sinusoidal component of same frequency.

9- Consider a pair of stationary process X(t) and Y(t). Show that cross correlation $R_{xy}(\tau)$ and $R_{yx}(\tau)$ of these process have the following properties.
(i)- $R_{xy}(\tau) = R_{yx}(-\tau)$
(ii)- $\left|R_{yx}(\tau)\right| \leq \frac{1}{2}\left[R_x(0) + R_y(0)\right]$

10- The autocorrelation function of an aperiodic power signal is given as $R_x(\tau) = e^{-\left(\frac{\tau^2}{2\sigma^2}\right)}$ determine the power spectral density (psd) and normalized power content of the signal.

11- Find the autocorrelation function of the sine wave signal expressed as below
X(t)= A$\sin(\omega t + \varphi)$

12- For a complex random process $z(t) = z_I(t) + jz_Q(t)$ where $z_I(t)$ and $z_Q(t)$ are real-valued random process given by
$z_I(t) = A\cos(2\pi f_1 t + \theta_1)$
$z_Q(t) = A\cos(2\pi f_2 t + \theta_2)$
Where θ_1 and θ_2 are uniformly distributed over $[-\pi, \pi]$ what is the autocorrelation of (t) ? suppose $f_1 = f_2$? $\theta_1 = \theta_2 = \theta$?

13- Consider a pair of Quadrature-modulated processes $X_1(t) and\ X_2\ (t)$ that are related to wide sense stationary process $X(t)$ as follows
$X_1(t) = X(t)\cos(2\pi f_c t + \theta)$
$X_2(t) = X(t)\cos(2\pi f_c t + \theta)$
Where f_c is carrier frequency and the random variable θ is uniformly distributed over interval $(0,2\pi)$. Moreover θ is independent of $X(t)$ find cross-correlation function of $X_1(t) and\ X_2\ (t)$.

14- Consider the two linear filter connected in cascade. Let $X(t)$ be wide sense stationary process with autocorrelation function $R_X(\tau)$. The random process appearing at the first filter output is V(t) and that of second is Y(t) .
(a) Find autocorrelation function of Y(t).
(b) Find cross-correlation function $R_{VY}(\tau)$ of V(t) and Y(t).

15- PDF is given by $f_X(x) = ae^{-b|t|}$ the value of X lie in the range of $x = -\infty\ to\ x = +\infty$, determine.
(i)- relationship between a and b
(ii)- Cumulative distribution function (CDF).

Do the assignment on A-4 sheets only. Use both side of the page.
After the date of submission, assignment will not be accepted and zero marks will be allotted to the student who fail to submit the assignment on due date.