

Unit 5 - Week 2- Cross- and Auto-correlation, (ESD), Introduction to Amplitude Modulation (AM), Spectrum of AM, Envelope Detection, Power Efficiency, (DSB-SC) Modulation and Demodulation

Course outline
How does an NPTEL online course work?
Week-0
Week 1-Basic tools for communication, Fourier Series/Transform, Properties, Parsevals Relation, Properties of Fourier Transform, LTI Systems
Week 2- Cross- and Auto-correlation, (ESD), Introduction to Amplitude Modulation (AM), Spectrum of AM, Envelope Detection, Power Efficiency, (DSB-SC) Modulation and Demodulation
<input type="radio"/> Lec 08- Auto-Correlation of Signal
<input type="radio"/> Lec 09- Example of Auto-Correlation of Signal
<input checked="" type="radio"/> Lec 10- Introduction to Amplitude Modulation(AM)
<input type="radio"/> Lec 11- Spectrum of Amplitude Modulated (AM) Signals
<input type="radio"/> Lec 12- Envelope Detection for AM Signals
<input type="radio"/> Quiz : Assignment-2
<input type="radio"/> Feedback For Week 2
<input checked="" type="radio"/> Solution-2
Week-3- Power Efficiency, (DSB-SC) Modulation and Demodulation, Carrier Phase Offset Example for (DSB-SC), Costas Receiver
Week-4 Quadrature Carrier Multiplexing (QCM) and Demodulation of QCM signals, Single Sideband Modulation (SSB), Hilbert Transform
Week-5 Generation of SSB , Complex pre-envelope of QCM, VSB , Introduction to AM
Week-6 Narrowband FM Generation, Spectrum of FM Signals, Carson's Rule for FM Bandwidth, Narrowband FM Generation, FM Demodulation, Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion
Week 7- Signal Reconstruction from Sampled Signal ,Introduction to Pulse Amplitude Modulation, Spectrum of PAM Signal and Reconstruction, Quantization, Uniform Quantizers – Midrise and Midtread, Quantization noise, Lloyd Max Quantization Algorithm, Non-uniform Quantizers
Week 8- Delta Modulation, Differential Pulse Code Modulation, Frequency Mixing and Translation in Communication Systems, Heterodyne and Super Heterodyne Receivers, Frequency Division Multiplexing, Time Division Multiplexing, T1 TDM System: Case Study
Week 9 - Basics of Probability, Conditional Probability, Independent Events - Mary-PAM Example, Independent Events-Block Transmission, Independent Events-Multiantenna Fading
Text Transcripts
DOWNLOAD VIDEOS
Week 10- Bayes Theorem, Maximum A posteriori Probability (MAP) Receiver, Random Variables and PDF, Power of Fading Wireless Channel, Mean & Variance of Random Variables and Application:Average & RMS Delay Spread
Week 11 - Transformation of Random Variables, Gaussian Random Variable ,Special Case: IID Gaussian Random Variables, Application: Uniform Linear Arrays, Random Processes and (WSS) and WSS Example
Week 12- Power Spectral Density(PSD) for WSS Random Process, PSD Application in Wireless, WSS Random Process Through LTI System, Special Random Processes and Gaussian Process Through LTI System

Assignment-2

The due date for submitting this assignment has passed. Due on 2020-02-12, 23:59 IST.
 As per our records you have not submitted this assignment.

1) Consider $x(t) = \cos\left(2t + \frac{\pi}{4}\right)$. The coefficients of its Fourier series are 1 point

$\frac{j}{2\sqrt{2}} + \frac{-j}{2\sqrt{2}}$
 $\frac{1}{2\sqrt{2}} + \frac{1}{2\sqrt{2}}$
 $\frac{1+j}{2\sqrt{2}} + \frac{1-j}{2\sqrt{2}}$
 $\frac{1}{2} + \frac{-1}{2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{1+j}{2\sqrt{2}} + \frac{1-j}{2\sqrt{2}}$

2) Let $X(f)$ denote the Fourier transform of the signal $x(t)$. The Fourier transform of its auto-correlation $R_{xx}(\tau)$ is 1 point

$X(f)^2$
 $|X(f)|^2$
 $|X(f)|$
 $X(f)X(-f)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $|X(f)|^2$

3) Consider the signal $x(t) = e^{-at}u(t)$. Its auto-correlation function $R_{xx}(\tau)$ is 1 point

$\frac{1}{2a} e^{-a\tau}u(\tau)$
 $\frac{1}{2a} e^{-a|\tau|}$
 $\frac{1}{2a} e^{-a\tau}$
 $e^{-2a\tau}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{1}{2a} e^{-a|\tau|}$

4) Consider the signal $x(t) = e^{-at}u(t)$. Its energy spectral density $S_{xx}(f)$ is 1 point

$\frac{1}{2a} e^{-af}u(\tau)$
 $\frac{1}{a+j2\pi f}$
 $\frac{1}{a^2+4\pi^2 f^2}$
 $a^2 + 4\pi^2 f^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{1}{a^2+4\pi^2 f^2}$

5) Consider the serial RC circuit with output denoting the voltage across the capacitor. Its impulse response, i.e. output for unit impulse input voltage, is 1 point

$\frac{R}{C} e^{-\frac{C}{R}} u(t)$
 $\frac{1}{RC} e^{-\frac{t}{RC}} u(t)$
 $\frac{C}{R} e^{-\frac{Rt}{C}}$
 $\left(1 - e^{-\frac{t}{RC}}\right) u(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{1}{RC} e^{-\frac{t}{RC}} u(t)$

6) Consider the trigonometric series representation of a periodic signal $x(t)$ with fundamental frequency f_0 given as $a_0 + \sum_{n=1}^{\infty} (a_n \cos(2\pi n f_0 t) + b_n \sin(2\pi n f_0 t))$. The coefficients b_n are given as 1 point

$2f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) \sin(2\pi n f_0 t) dt$
 $2f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) \cos(2\pi n f_0 t) dt$
 $f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) \sin(2\pi n f_0 t) dt$
 $f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) e^{-j2\pi n f_0 t} dt$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $2f_0 \int_{-\frac{1}{2f_0}}^{\frac{1}{2f_0}} x(t) \sin(2\pi n f_0 t) dt$

7) Fourier series can be found for 1 point

Continuous time aperiodic signals
 Discrete time periodic signals
 Continuous time periodic signals
 Discrete time aperiodic signals

No, the answer is incorrect.
Score: 0

Accepted Answers:
Continuous time periodic signals

8) Consider the signal $x(t) = \text{sgn}(t)$, which is defined as 1 point

$$\text{sgn}(t) = \begin{cases} 1 & t > 0 \\ 0 & t = 0 \\ -1 & t < 0 \end{cases}$$

Its Fourier transform is

$2\pi \text{sgn}(f)$
 $j2\pi f$
 1 for $|f| \leq 1$ and 0 otherwise
 $\frac{1}{j\pi f}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{1}{j\pi f}$

9) Consider the Gaussian filter $x(t) = e^{-at^2}$. Its Fourier transform is 1 point

$\sqrt{\frac{\pi}{a}} e^{-\frac{x^2}{a}}$
 $\sqrt{\pi a} e^{-4a\pi^2 f^2}$
 $\sqrt{\frac{a}{\pi}} e^{-4a|f|}$
 $\frac{1}{1+a^2 4\pi^2 f^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\sqrt{\frac{\pi}{a}} e^{-\frac{x^2}{a}}$

10) Let $X(f)$ denote the Fourier transform of the signal $x(t)$. The Fourier transform of $x(t)e^{j2\pi f_c t}$ is 1 point

$X(f + f_c)$
 $\frac{d}{df} X(f) \Big|_{f=f_c}$
 $X(f - f_c)$
 $X(f)e^{j2\pi f_c}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $X(f - f_c)$