

Unit 17 - 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

Course outline

How does an NPTEL online course work?

Week-0

Week 1-Basic tools for communication, Fourier Series/Transform, Properties, Parseval's 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

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

Lec 71- Power Spectral Density(PSD) for WSS Random Process

Lec 72- PSD Application in Wireless

Lec 73- WSS Random Process Through LTI System

Lec 74- Special Random Processes

Lec 75- Gaussian Process Through LTI System

Quiz : Assignment-12

Feedback For Week 12

Solution-12

Assignment-12

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2020-04-22, 23:59 IST.

1) A random process $X(t)$ is

1 point

- Signal with auto-correlation equal to impulse
 A random variable for every instance of time t
 Signal with spectrum that is flat over the entire frequency
 A Gaussian random random variable with zero-mean

No, the answer is incorrect.
Score: 0

Accepted Answers:
A random variable for every instance of time t

2) Consider the signal $X(t) = a \cos(2\pi f_c t + \theta)$ is

1 point

- Strict sense stationary
 Always Wide Sense Stationary
 Wide Sense Stationary when θ is uniformly distributed in $[-\pi, \pi]$
 A Wide Sense Stationary when θ is uniformly distributed in $[0, \frac{\pi}{2}]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
Wide Sense Stationary when θ is uniformly distributed in $[-\pi, \pi]$

3) A real wide-sense stationary random process $X(t)$ must satisfy

1 point

- $E\{X(t)\}$ is constant
 $E\{X^2(t)\}$ is constant
 $E\{X(t)X(t + \tau)\}$ depends only on the shift τ
 All of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
All of these

4) The power spectral density of a WSS random process is

1 point

- Fourier transform of the random process
 Fourier transform of the auto-correlation function
 Square of the Fourier transform of the random process
 Constant in the frequency domain

No, the answer is incorrect.
Score: 0

Accepted Answers:
Fourier transform of the auto-correlation function

5) Consider $X(t)$ to be white Gaussian noise with zero mean. Its autocorrelation function $R_{XX}(\tau)$ is of the form

1 point

- $\frac{\eta}{2} \delta(\tau)$
 $\frac{\eta}{2}$
 $\frac{\eta}{2} e^{-a|\tau|}$, $a > 0$
 $\frac{\eta}{2} \frac{\sin(a\eta\tau)}{\pi\tau}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{\eta}{2} \delta(\tau)$

6) Consider $X(t)$ to be white Gaussian noise with zero mean. Its power spectral density $S_{XX}(f)$ for $-\infty < f < \infty$ is of the form

1 point

- $\frac{\eta}{2} \frac{\sin(2\pi f)}{2\pi f}$
 $\frac{\eta}{2}$
 $\frac{\eta}{2} \delta(f)$
 $\frac{\eta}{2} e^{-a|f|}$, $a > 0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{\eta}{2}$

7) Consider a random process $X(t)$ with auto-correlation $R_{XX}(\tau) = \frac{1}{2a} e^{-a|\tau|}$, with $a = 10$ kHz. What is approximate bandwidth that contains 80% of the signal power?

1 point

- 3.3 kHz
 4.9 kHz
 6.7 kHz
 8.2 kHz

No, the answer is incorrect.
Score: 0

Accepted Answers:
4.9 kHz

8) Consider WSS random process $X(t)$ with auto-correlation $R_{XX}(\tau)$ given as input to LTI system with impulse response $h(t)$. The auto-correlation of the output is

1 point

- $R_{XX}(\tau) * h(\tau)$
 $R_{XX}(\tau) * h^2(\tau)$
 $R_{XX}(\tau) * h(\tau) * h(-\tau)$
 $R_{XX}(\tau) * h(\tau) * h(\tau)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $R_{XX}(\tau) * h(\tau) * h(-\tau)$

9) Consider WSS random process $X(t)$ with power spectral density $S_{XX}(f)$ given as input to LTI system with transfer function $H(f)$. The power spectral density of the output is

1 point

- $S_{XX}(f)H(f)$
 $S_{XX}(f)H^2(f)$
 $S_{XX}(f) * H(f)$
 $S_{XX}(f)|H(f)|^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $S_{XX}(f)|H(f)|^2$

10) Consider $X(t)$ to be white Gaussian noise with zero mean and auto correlation function $\frac{\eta}{2} \delta(\tau)$. It is passed through an LTI system whose impulse response is $h(t) = \text{sinc}(2Wt)$. What is the power of the output random process $Y(t)$?

1 point

- $4\eta W$
 $\frac{\eta}{8W}$
 $\frac{\eta}{4W}$
 $\frac{\eta^2}{2W}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $\frac{\eta}{4W}$