

Unit 6 - Week-3- Power Efficiency, (DSB-SC) Modulation and Demodulation, Carrier Phase Offset Example for (DSB-SC), Costas Receiver

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

Week-3- Power Efficiency, (DSB-SC) Modulation and Demodulation, Carrier Phase Offset Example for (DSB-SC), Costas Receiver

Lec 13- Power of Amplitude Modulated (AM) Signals

Lec 14- Double Sideband (DSB) Suppressed Carrier (SC) Modulation

Lec 15-Double Sideband(DSB) Suppressed Carrier (SC) Demodulation

Lec 16- Carrier Phase Offset Example for Double Sideband(DSB) Suppressed Carrier(SC) Demodulation.

Lec 17 - Phase Synchronization using Costas receiver for demodulation of DSB-SC signals.

Quiz : Assignment-3

Feedback For Week 3

Solution - 3

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-3

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

Due on 2020-02-19, 23:59 IST.

1) Let $X(f) = \frac{1}{\pi f} * \frac{1}{\pi f}$, where $*$ denotes convolution. Let $x(t)$ denote the inverse Fourier transform of $X(f)$. Then $x(t)$ equals **1 point**

$x(t) = \begin{cases} -1, & \text{for } t \geq 0 \\ 1, & \text{for } t < 0 \end{cases}$

$x(t) = \pi \left(\frac{\sin(\pi t)}{\pi} \right)$

$x(t) = e^{-t} u(t)$

$x(t) = \begin{cases} -1, & \text{for } t \neq 0 \\ 0, & \text{for } t = 0 \end{cases}$

No, the answer is incorrect. Score: 0

Accepted Answers:

$x(t) = \begin{cases} -1, & \text{for } t \neq 0 \\ 0, & \text{for } t = 0 \end{cases}$

2) Let $X_i(f)$ denote the Fourier Transform of $x_i(t)$, for $i = 1, 2$. Then, $\int_{-\infty}^{\infty} x_1(t)x_2^*(-t) dt$ equals **1 point**

$\int_{-\infty}^{\infty} X_1(f)X_2(f) df$

$\int_{-\infty}^{\infty} X_1^*(f)X_2(f) df$

$\int_{-\infty}^{\infty} X_1(f)X_2^*(f) df$

$\int_{-\infty}^{\infty} X_1(f)X_2^*(-f)df$

No, the answer is incorrect. Score: 0

Accepted Answers:

$\int_{-\infty}^{\infty} X_1(f)X_2^*(-f)df$

3) If $m(t)$ has Fourier transform $M(f)$, the Fourier transform of $m(t)\sin(2\pi f_c t)$ is **1 point**

$\frac{1}{2}M(f - f_c) + \frac{1}{2}M(f + f_c)$

$\frac{j}{2}M(f - f_c) + \frac{j}{2}M(f + f_c)$

$-\frac{j}{2}M(f - f_c) + \frac{j}{2}M(f + f_c)$

$\frac{1}{2}M(f - f_c) - \frac{1}{2}M(f + f_c)$

No, the answer is incorrect. Score: 0

Accepted Answers:

$-\frac{j}{2}M(f - f_c) + \frac{j}{2}M(f + f_c)$

4) Consider the Gaussian pulse $g(t) = e^{-kt^2}$. Let its Fourier transform be denoted by $G(f)$. Demonstrate that $\frac{d}{df}G(f) = -\alpha fG(f)$. What is the value of the constant α ? **1 point**

$\sqrt{\frac{\pi}{k}}$

$k\sqrt{\pi}$

$\frac{2\pi^2}{k}$

1

No, the answer is incorrect. Score: 0

Accepted Answers:

$\frac{2\pi^2}{k}$

5) Consider the signal $x(t) = 2 \text{sinc } 4t$ where $\text{sinc } x = \frac{\sin(\pi x)}{\pi x}$. The Fourier transform of the signal is **1 point**

2 for $|f| \leq 2$ and 0 otherwise

$\frac{1}{2}$ for $|f| \leq 2$ and 0 otherwise

$\frac{1}{2}$ for $|f| \leq 1$ and 0 otherwise

2 for $|f| \leq \frac{1}{2}$ and 0 otherwise

No, the answer is incorrect. Score: 0

Accepted Answers:

$\frac{1}{2}$ for $|f| \leq 2$ and 0 otherwise

6) Given the message signal $m(t)$ and carrier frequency f_c , the modulation $x(t) = A_c m(t) \cos(2\pi f_c t)$ is termed as **1 point**

Double sideband suppressed carrier (DSB-SC)

Single Side Band (SSB)

Vestigial Side Band (VSB)

Quadrature Carrier Multiplexing (QCM)

No, the answer is incorrect. Score: 0

Accepted Answers:

Double sideband suppressed carrier (DSB-SC)

7) The power efficiency of an amplitude modulated (AM) signal for a sinusoidal message signal with modulation index μ is **1 point**

$\frac{\mu^2}{2+\mu^2}$

$\frac{1}{1+\mu^2}$

$\frac{1}{2+\mu^2}$

$\frac{\mu^2}{1+\mu}$

No, the answer is incorrect. Score: 0

Accepted Answers:

$\frac{\mu^2}{2+\mu^2}$

8) Consider the AM signal $A(1 + k \sin(2\pi f_m t)) \cos(2\pi f_c t)$ with power efficiency $\frac{1}{9}$ and total power 1. The expression for the AM signal is, **1 point**

$2 \left(1 + \frac{1}{3} \sin(2\pi f_m t) \right) \cos(2\pi f_c t)$

$\frac{4}{3} \left(1 + \frac{1}{2} \sin(2\pi f_m t) \right) \cos(2\pi f_c t)$

$\frac{1}{3} \left(1 + \frac{1}{2} \sin(2\pi f_m t) \right) \cos(2\pi f_c t)$

$\frac{3}{4} \left(1 + \frac{1}{4} \sin(2\pi f_m t) \right) \cos(2\pi f_c t)$

No, the answer is incorrect. Score: 0

Accepted Answers:

$\frac{4}{3} \left(1 + \frac{1}{2} \sin(2\pi f_m t) \right) \cos(2\pi f_c t)$

9) Consider the message signal $m(t) = \cos(20\pi t)$. Let carrier frequency $f_c = 1$ kHz and carrier amplitude $A_c = 20$. With 50% modulation, what is the approximate power efficiency of the AM signal? **1 point**

50%

20%

11.11%

5.88%

No, the answer is incorrect. Score: 0

Accepted Answers:

11.11%

10) Consider the envelope detector with load resistance R_L and capacitance C , employed to detect an AM signal with carrier frequency f_c and message frequency f_m . It is desirable that **1 point**

$R_L C \ll \frac{1}{f_m}$

$R_L C \ll \frac{1}{f_c}$

$R_L C \gg \frac{f_m}{f_c}$

$R_L C \ll \frac{f_m}{f_c}$

No, the answer is incorrect. Score: 0

Accepted Answers:

$R_L C \ll \frac{1}{f_m}$