BITS PILANI DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY DUBAI

EEE C383 COMMUNICATION SYSTEMS

III yr BE(Hons) EEE — DATE: 02-06-2011

TIME: 3 Hours — **Comprehensive Examination** — MAX MARKS: 60(30%)

*Note : Answer **ALL** questions . Any missing data can be suitably assumed .*

1.Consider the modulating signal $m(t)=\left(2\cos\left(2\pi\times10^3 t\right)+\cos\left(2\pi\times3\times10^3 t\right)\right)$ yielding a AM DSB SC modulated output $S_{DSB-SC}(t)=100m(t)\cos\left(2\pi\times f_c\times t\right)$ where $f_c=1MHz$

a) Determine & Sketch the Spectrum of the modulated signal

b) Determine the average power in the frequency components

c) Consider the coherent demodulation for the modulated signal $S_{DSB}(t)$ with the reinserted carrier being $\cos\left(2\pi\times f_c\times t+\phi(t)\right)$ with phase angle $\phi(t)$ varying over the range $\left(-\frac{\pi}{3},\frac{\pi}{3}\right)$

Obtain the range of variation for the amplitude of the demodulated signal $\hat{m}(t)$

(8 marks)

2. Consider the carrier $S(t)=100\cos\left(2\pi\times10^6 t\right)$ to be angle modulated (FM or PM) by the sinusoidal modulating signal $m(t)=2\cos\left(2\pi\times10^3 t\right)$. If the deviation constants are given to be $k_p=1.5 rad/volt$ & $k_f=6000\pi\ rad/\sec-volt$

a) Obtain the modulation index for FM (β_{FM}) and the modulation index for PM (β_{PM}) respectively.

b) Determine the Bandwidth for both FM & PM using Carson's rule. separately.

c) If the amplitude of $m(t)$ is decreased by a factor of two , how would the answers in the parts (a) & (b) change ?

d) If the frequency of $m(t)$ is increased by a factor of two , re calculate the modulation index as well as the Bandwidth for both FM & PM (8 marks)

3a). Consider a random variable , described by its pdf $f_X(x)$ as shown below.

i) Determine the value of 'k'.

ii) Find the mean and variance for the random variable

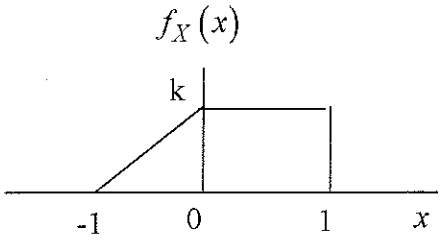

Fig 3

(5 marks)

3b) A random process $Z(t)=X\cos(\omega_0 t)+Y\sin(\omega_0 t)$ where X & Y are two zero- mean random variables each having a variance $\sigma^2=1$.Determine (i) $\mu_Z(t)$ (ii) $R_{ZZ}(\tau)$ and hence show that the random process Z(t) is wide sense stationary. (5 marks)

4 Certain Telemetric signal , bandlimited to 12 KHz , is to be modulated digitally using PCM.
a) calculate the required Nyquist Rate.
b) If the samples are quantized into L = 65,536 levels , determine the number of binary pulses required to encode each sample and also the bandwidth required to transmit the signal
c) However, if the signal is observed to be swinging between (($\pm 1\ V$), calculate the SQNR in dB with uniform quantization
(Assume that the quantization levels exactly accommodate the signal swing within its levels , say L = 65536 in this case. The telemetric signal can be assumed to sinusoidally varying for calculating signal power) (7 marks)

5 For the same demodulator input signal power , establish that the noise performance of DSB – SC system and of the reference baseband system are equal (8marks)

6a) A binary source emits 7 messages $\{m_1, m_2, m_3, m_4, m_5, m_6, m_7\}$ with corresponding probabilities $(0.5, 0.25, 0.125, 0.0625, 0.03125, 0.03125)$. Obtain a binary Huffman Code and calculate its coding efficiency. (6 marks)

6b) Write a brief note on the matched filter (4marks)

7a) The data input to a BPSK modulator is appearing at the rate of 6000 symbols /sec..If the carrier signal is $e(t) = \cos(2\pi \times 12 \times 10^3 t)$ draw the modulated waveform for a typical data variation 1 , 0, 0, 1, ... (4marks)
7b) Write a note on slope overload noise in Delta Modulation (5marks)

_____GOOD LUCK_____

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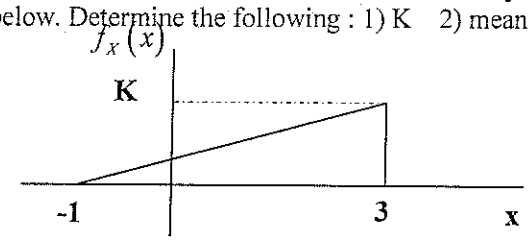
EEE C 383 COMMUNICATION SYSTEMS

III yr BE(Hons) EEE — DATE: 17-04-2011

TIME: 50 MINS — **TEST II (Open Book)** — MAX MARKS: 30 (15%)

*Note : Answer **ALL** questions . Any missing data can be suitably assumed .*

1	a) From first principles , show that a linearized PLL can demodulate an FM signal input $s(t) = A_c Cos\left(\omega_c t + k_f \int_{-\infty}^{t} m(\tau)d\tau\right)$. b)If now , to such a PLL $S_1(t)$ given as an input signal where $s_1(t) = \cos\left(5000\pi\ t - 10\ t\ e^{-t}\right)$, find the PLL output $y(t)$.The VCO constant of the PLL is K_v=2. Assume the PLL to be under Lock condition	3+4=7
2	Consider a Random variable X described by its probability density function (pdf) as given below. Determine the following : 1) K 2) mean & 3) Variance  	8
3	Consider the Random Process $X(t) = A\cos(\omega t + \theta)$,where 'A' and 'θ' are independent RVs Uniformly distributed in the ranges (-1,1) and (0,2π) respectively. Show that the random process is a Wide Sense Stationary (WSS) process . Determine the mean function $\bar{X}(t)$	7
4	Two processes are said to be in-***coherent*** if their cross correlation function $R_{xy}(\tau) = 0$. Consider two Random processes given by $X(t) = A\cos(\omega t + \varphi)$ and $y(t) = B\cos(n\omega t + n\phi)$ where n= integer $\neq 1$ and A , B and ω are constants and φ is uniformly distributed in (0,2π) . Show that the two processes x(t) & y(t) are incoherent.	8

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BITS PILANI DUBAI

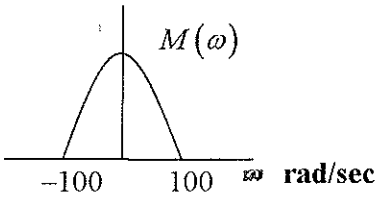
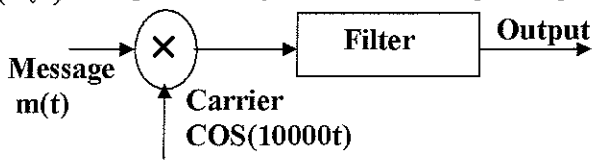
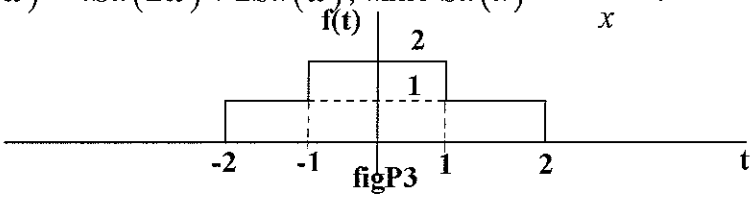
DUBAI INTERNATIONAL ACADEMIC CITY DUBAI

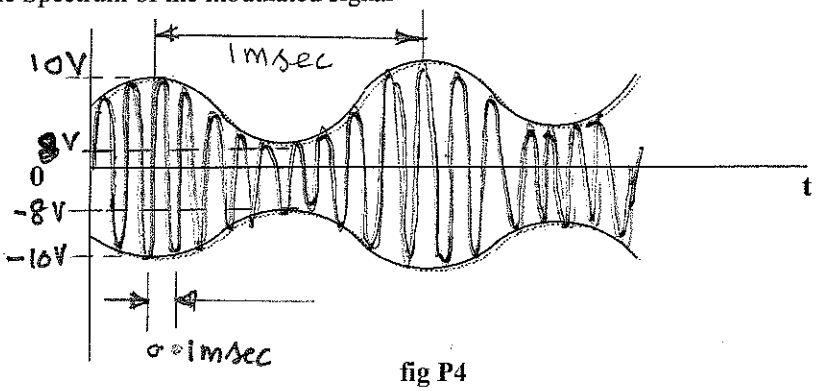
EEE C 383 COMMUNICATION SYSTEMS

III yr BE(Hons) EEE — DATE: 27-02-2011

TIME: 50 MINS — **TEST I** — MAX MARKS: 30 (15%)

*Note : Answer **ALL** questions . Any missing data can be suitably assumed .*

1	In the lab , using a product modulator , it is desired to generate a DSB-SC signal of the form $s(t) = A_c\, m(t)\, \cos(\omega_c t)$ where A_c: Carrier amplitude , ω_c: Carrier frequency & $m(t)$: modulating signal , However , the available Carrier is of the form $\cos^3 \omega_c t$ only . (Refer the figures provided below) . Hence, to build the above modulator with this carrier, a multiplier and a suitable filter are used. a) Explain whether it would be possible to generate the DSB – SC signal. b) If so, What kind of filter is required? (mention the type along with the cut-off frequency) c) Sketch the signal spectra at the outputs of the Multiplier and the Filter d) If the Carrier available is $\cos^2(\omega_c t)$, is it possible to get the DSB SC output? Explain.   Hint : $4\cos^3(x) = 3\cos(x) + \cos(3x)$	8
2	Consider a signal coherent demodulator being used for demodulating the Double sideband Suppressed carrier signals. Draw the coherent demodulator block diagram and in such a process , if the carrier reinserted is given to be $Cos(\omega_c t + \Delta\theta)$, discuss the effect of $\Delta\theta$ (lack of synchrony in phase) upon the demodulated output	6
3	Consider the signal $f(t)$ as shown in **fig P3**. Show that its Fourier Transform is $F(\omega) = 4Sa(2\omega) + 2Sa(\omega)$, where $Sa(x) = \dfrac{\sin(x)}{x}$.  figP3 Hint : Fourier transform of $f(t) = F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt$	5

4	Consider a modulating signal **m (t)** amplitude modulating a carrier to produce the **AMFC** output as shown in **fig P4.** Determine the following : a) The modulating frequency b) the carrier frequency c) Modulation index d) Unmodulated Carrier Output e) Modulated Carrier Output and f) the Spectrum of the modulated signal  **fig P4**	6
5	Explain the working of an envelope of an envelope detector and establish the condition to be met by the modulating signal to avoid diagonal clipping	5

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BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
BE (Hons.) ECE III Year, I Semester, 2010-2011
Quiz 2 (Closed Book)

Course No.: **EEE C383** Course Title: **Communication Systems**

Date: 4-05-2011 Time: 20 min Max. Marks: 10 Weightage: 5%

Student Id : **Name :**

Note: Answer all questions. Appropriate assumptions may be made wherever necessary

1. A random process X(t) is given by X(t) = A ,where A is a random variable with uniform distribution over the interval (-1,1) , Sketch the ensemble of this process. Find the auto correlation function . Is the process wide sense stationary ? Is the process ergodic ? (4marks)

Answer

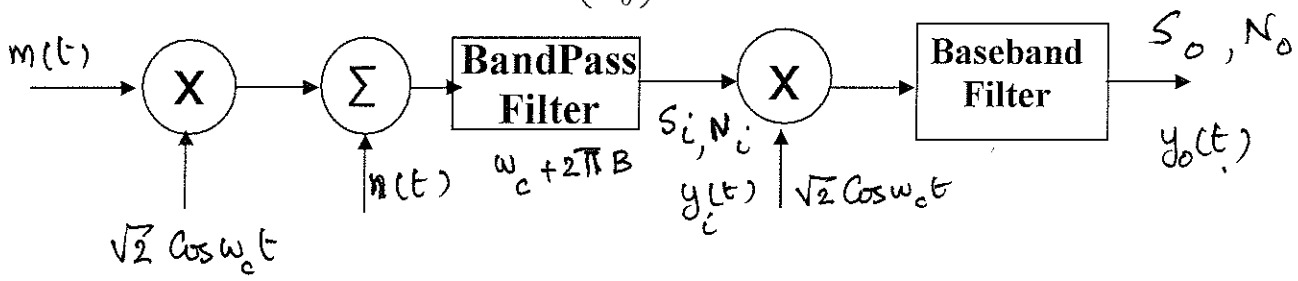
2. Two random variables X & Y are defined as follows : X = Cosθ and Y=sinθ θ is a random variables uniformly distributed over the range (0,2,π.) Show that X &Y are uncorrelated but not independent (3 Marks)

Answer

3.For a DSB SC system with a channel noise Power Spectral density $S_n(\omega) = 10^{-10} Watts / Hz$ and a baseband signal of bandwidth 4000 Hz , it is required that the receiver output SNR to be at least 30 dB.. The receiver is as shown in Fig P3.

Calculate S_i ,the Signal Power received at the receiver input and the output Noise Power N_0 (3 Marks)

Hint : Output SNR (in dB) = $10\log_{10}\left(\frac{S_0}{N_0}\right)$



Answer :

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
BE (Hons.) ECE III Year, I Semester, 2010-2011
Quiz I (Closed Book)

Course No.: ECE C383 Course Title: Communication Systems

Date: 23-03-2011 Time: 20 min Max. Marks: 10 Weightage: 5%

Student Id : **Name :**

Note: Answer all questions. Appropriate assumptions may be made wherever necessary

1. Find the Hilbert Transform of $-\cos\omega t + j\sin\omega t$ (1 marks)

Answer

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2. Consider two voice signals $m_1(t)$ & $m_2(t)$ each bandlimited to 4KHz.With the help of a block diagram show that it is possible to implement both the voice signals to amplitude modulate the same carrier and yet totally occupying only 8 kHz bandwidth. Hint: Generate sidebands such that each sideband contain different information (3 Marks)

Answer

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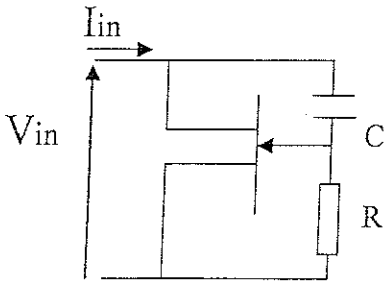
3. Calculate the input impedance $Z_{in} = \frac{V_{in}}{I_{in}}$ for the circuit , given $g_m = 10^{-6}$ mhos; C = 1 pF

R = 1 kilo ohm. Assume $i_g \simeq 0$ (3 marks)

Answer :



5. Consider the FM signal $S_{FM}(t) = 10\cos\left(2\pi \times 10^6 t + 2\pi \times 10^4 \int \cos\left(2\pi \times 10^3 t\right)dt\right)$

Calculate a) modulation index β b) the bandwidth using Carson's rule (3 marks)

Answer