BITS, PILANI-DUBAI
Dubai International Academic City

Third-Year EEE, I Semester, 2007-2008
Comprehensive Examination (Closed Book)
Course No. : EEE UC383
Course Name: COMMUNICATION SYSTEMS
Date: 27 Dec 2007 Duration: 3 hours Marks: 60 Weightage: 30%

Note:- *Answer all questions*

1. (a) State Parseval's theorem. (2)
   (b) Explain clearly why it would not be possible to broadcast a modulating signal (message) by simply adding it to a continuous wave carrier. (3)

2. (a) Explain why DSB-SC modulation was not used for commercial radio broadcasting. (3)
   (b) A nonlinear device satisfying a cubic law relationship between the output and input, namely $v_o(t) = a_0 + a_3 v_i^3(t)$, is available. Show how this device can be used to produce a conventional AM signal of the form $A(1 + k_a m(t))\cos \omega_c t$. Assume that a stable crystal oscillator with frequency f_o is available. (5)

3. (a) A single-tone LSB-SSB signal with carrier frequency 100 kHz and message frequency 1 kHz is passed through an ideal envelope detector. Sketch the LSB-SSB signal as well as the output of the envelope detector. (3)
   (b) Name and distinguish between the two types of FM. Give the details of the frequencies and bandwidth of the signals used in commercial FM radio broadcasting. What is preemphasis and why is it employed in FM broadcasting? (2+3+2)

4. (a) Explain the operation of a phase-locked loop (PLL). Show how a PLL can be used to demodulate a PM signal. (4+3)
   (b) A random variable X is uniformly distributed over the interval $[-2, 2]$. It is desired to quantize X such that the quantization noise variance is 30 dB below that of X. Find the minimum number of bits required for quantization. (4)

5. (a) Discuss the disadvantages of a fixed step size delta modulator. How can they be overcome? (4)

(b) N baseband message signals are translated to different frequency regions without overlap, yielding N bandpass messages. Explain how these can be transmitted and received using a TDM scheme. (5)

6. (a) Obtain the capacity of an AWGN channel with a bandwidth of 1 MHz and an S/N ratio of 40 dB. (4)
   (b) Write a brief note on the QPSK signal and its generation. (5)

7. (a) Write a brief note on the concept of spread spectrum communication. (3)
   (b) What is meant by a maximal-length sequence? Consider the maximal-length sequence 0011101 of length $N = 7$ generated using a shift register of length 3. Show how the balance and run properties are satisfied by this sequence. (5)

(Paper ends)

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THIRD YEAR EEE, I SEMESTER, 2007-2008
TEST-2 (OPEN BOOK)
Course No: EEE UC383 Course Name: Communication Systems
Duration: 50 minutes **Max. Marks: 40** **Weightage: 20%** **Date: 26.11.07**

Answer all questions
Permitted material: Text book by BP Lathi and Class Notes (No photocopies allowed, only originals)

1. Explain the PM process. What is the unit of the phase sensitivity constant k_p? (3+2 = 5 marks)

2. Given a 5 kHz modulating signal frequency, for what frequency deviation does the carrier disappear for the first time? (4 marks)

3. Show how an FM signal can be demodulated using a PM demodulator. (5 marks)

4. Sketch the FM wave for a square wave modulating signal. (4 marks)

5. Consider two events A and B with probabilities $P(A) = 0.9$ and $P(B) = 0.8$, respectively. Obtain the minimum value that $P(A \cap B)$ can have. (4 marks)

6. Let X be a Gaussian random variable with mean 10 and standard deviation 2. Write the expression for its pdf. Also sketch the pdf. (3+2 = 5 marks)

7. An AM receiver operates with a tone modulation, and the modulation index μ=0.3. The message signal is $20\cos 1000\pi t$. (a) Compute the output SNR relative to the baseband performance γ. (b) Determine the improvement (in decibels) in the output SNR that results if μ increased from 0.3 to 0.7. (4+4 = 8 marks)

8. It is found that by increasing the transmitter power, the receiver output SNR increases in both conventional AM as well as in FM systems. Comment on how the mechanism for this increase in the output SNR is different in both the cases. (5 marks)

Good Luck!

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Third-Year EEE, I Semester, 2007-2008
Test – 1 (Closed Book)
Course No. / Course Name: EEE UC383 / Communication Systems
Date: 07 Oct 2007 Duration: 50 min Marks: 30 Weightage: 15%

Note:- *Answer all questions*

1. Obtain the Hilbert transform of the Hilbert transform of $m(t)$. (5 marks)
2. A signal $v_i(t) = 0.01\cos(2\pi f_m t) + 0.01\cos(2\pi f_c t)$ volts is applied to a nonlinear circuit with input-output characteristic defined by $v_o(t) = 10v_i(t) + 5v_i^2(t)$.
   (i) Determine and sketch the spectrum of the output signal assuming $f_m = 1$ kHz and $f_c = 1000$ kHz. Label the spectral details correctly. (4 marks)
   (ii) Specify the bandpass filter required to extract the AM signal from $v_o(t)$. (3 marks)
   (iii) What is the percentage modulation of the resultant AM signal? (4 marks)
3. Analyze the effect of carrier phase error in the coherent detection of an USB SSB-SC signal. (8 marks)
4. An AM radio transmitter radiates 5 kW power when the modulation percentage is 60% and the modulating signal is a single tone. What is the carrier power? (6 marks)