BITS, Pilani-Dubai
Dubai International Academic City, Dubai

BE (Hons.) Third Year EEE, I Semester, 2008-2009

Test 1 (Closed Book)
Course No. / Course Title: EEE C383 / Communication Systems
Date: 09 Oct 2008 Duration: 50 min Max. Marks: 30 Weightage: 15%

Note:-
Answer all questions.
State assumptions made, if any.

1. Explain briefly why DSB-SC modulation scheme was not adopted for commercial radio broadcasting? (3 marks)
2. Why has SSB-SC with carrier added to it not been adopted for commercial radio broadcasting instead of conventional AM? (2 marks)
3. We have seen in the class how a square-law device can be used to generate an AM signal. Consider, instead, a cubic-law device that satisfies the input-output relationship $v_o(t) = a_1 v_i(t) + a_3 v_i^3(t)$, where $v_i(t)$ and $v_o(t)$ are the input and output signals respectively and a_1 and a_3 are constants. You are provided with a modulating signal $m(t)$ and a stable oscillator source that generates the signal $A_o \cos \omega_o t$. Show how the above may be used to generate a DSB-SC signal operating at a carrier frequency ω_c. What should be the relationship between ω_o and ω_c to achieve this? Illustrate your approach with an appropriate block diagram as well as the spectrum at the output of the cubic-law device. (8 marks)
4. Show that a conventional AM signal can be demodulated using coherent detection. Give the block diagram for the detector as well as the analysis. What is the upper limit on the modulation index for successful detection using this approach? (4 + 1 = 5 marks)
5. Draw the circuit of a basic envelope detector. Explain with a neat diagram what happens when an envelope detector with a very high RC time constant (compared to the time period of the modulating signal) is used to demodulate a single-tone AM wave. (2 + 3 = 5 marks)
6. Starting from first principles, derive the expression for a single-tone phase-modulated wave. Also obtain the modulation index of the PM wave. Sketch a single-tone PM wave with reference to the modulating signal.(4 + 1 + 2 = 7 marks)

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THIRD YEAR EEE, FIRST SEMESTER, 2008-2009
TEST II (OPEN BOOK)

Course No./ Course Title: EEE C383 / COMMUNICATION SYSTEMS
Date: 09 Nov 2008 Max. Marks: 20 Weightage: 10 % Duration: 50 min

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Note: ***Answer all questions.***

1. Consider an AM system and an FM system with the following specifications: Both are transmitting a single-tone modulating signal of frequency f_m at a carrier frequency f_c. The maximum frequency deviation of the FM system is set to four times the bandwidth required for the AM signal. The strengths of the frequency components at $f_c \pm f_m$ are the same for both the systems. Find the modulation indices for both the systems.
   Some Bessel function values (you may not need all of them):
   $J_0(5) = -0.178, J_3(2) = 0.129, J_1(8) = 0.235, J_1(10) = 0.043, J_5(5) = 0.261$
   (5 marks)
2. Compute the power contained in the sidebands of the FM signal $s_{FM}(t) = 10\cos(\omega_c t + 5\sin\omega_m t)$ as a percentage of its total power. You may have to make use of one or more of the Bessel function values given in Problem 1 to arrive at the solution. (5 marks)
3. Explain how a nonlinear device, such as a diode, can be used to act as a frequency tripler. (5 marks)
4. The SNR of a DSB-SC signal in the presence of bandlimited uniform spectrum density noise at the input of the demodulator is 15 dB. A coherent detector followed by a filter is used to recover the baseband signal. Calculate the maximum SNR (in dB) at the output. What is the new value of output SNR if there is a phase error of 45° between the transmitter and receiver carrier signals? (5 marks)

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BE (Hons.) EEE, III Year, First Semester, 2008-09
Surprise Quiz # 1

Course Title: Communication Systems Course No.: EEE C 383
Marks: 10 Weightage: 5% Duration: 20 minutes

Name: _____

ID No.: _____

Answer all questions:

1. Obtain the Hilbert transform of $m(t) = e^{j\omega_0 t}$. (4 marks)
2. For a single tone modulating signal of frequency 1 kHz and a carrier signal of 10 kHz, sketch the following:
   (a) The corresponding SSB-USB signal as a function of time;
   (b) The spectrum of the above SSB-USB signal; and
   (c) The output of an ideal envelope detector used to detect the above SSB-USB signal. (2 + 2 + 2 = 6 marks)

BITS, Pilani-Dubai
BE (Hons.) EEE, I Semester, 2008-2009

Communication Systems EEE C383
Surprise Quiz #2

Name: _____

ID No.: _____

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1. A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is 50 Mb/s. What is the maximum message bandwidth for which the system operation is satisfactory? (5 marks)
2. A signal $m(t) = \cos 200\pi t + 2\cos 320\pi t$ is ideally sampled at $f_s = 300$ Hz. If the sampled signal is passed through an ideal low-pass filter with a cutoff frequency of 250 Hz, what frequency components will appear in the output? (5 marks)

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai

B.E. (Hons.) EEE Third Year, I Semester 2008-2009
Comprehensive Examination

Course Name: Communication Systems **Course No.: EEE C383**
Duration: 3 hours Max. Marks: 60 Weightage: 30 %

Note:- *Answer all questions. Appropriate assumptions may be made, where necessary.*

1) Show that the total power of a single-tone AM wave is $P_t = P_c\left(1+\frac{\mu^2}{2}\right)$, where P_c is the carrier power. (4)
2) List the relative advantages and disadvantages of AM and FM. (3)
3) An information signal $m(t) = 5\cos 1000\pi t$ is transmitted using single-sideband suppressed carrier and is demodulated using a synchronous demodulator. Noise with two sided power spectral density 10^{-4} W/Hz adds to the signal during transmission. Find the SNR at the output of the receiver, in dB. Derive the expression used. (7)
4) The pdf of a random variable X is given by $f_X(x) = ke^{-ax}u(x)$ where a is a positive constant. Find the value of the constant k. (3)
5) A TV signal has a bandwidth of 5 MHz. If this signal is converted to PCM with 1024 quantizing levels, find the bit rate of the resulting PCM signal. Assume that the signal is sampled at a rate 25 % above the Nyquist rate. (5)
6) What is aperture effect distortion in flat-topped sampling? How is this distortion overcome? (3)
7) Derive the expression for entropy of a discrete memoryless source of N messages. Assume that the probabilities of occurrence of the messages are known before hand. (5)
8) Define the following: (i) Hamming weight of a code word and (ii) Hamming distance between code words. Also give the relationship between the two. (4)
9) Discuss briefly the coherent detection of a BPSK signal. (4)
10) Write a brief note on Quadrature Amplitude Modulation. (4)
11) Define the following terms: (i) Hilbert transform of a signal, (ii) ergodic process, (iii) matched filter, (iv) AWGN, (v) redundancy of a code. (10)
12) Fig. 1 below shows a four-stage feedback shift register. The initial state of the register is 1000. Find the output sequence of the shift register. Using this result, demonstrate the balance property and run property of a PN sequence. (8)

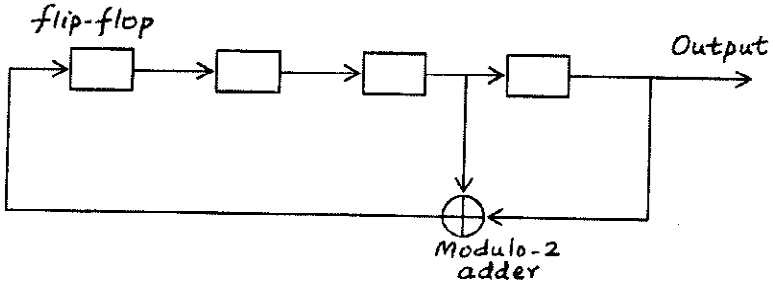

Fig. 1 for Q (12)

Good Luck!