BITS, PILANI-DUBAI CAMPUS
Knowledge Village, Dubai
EEE III Year, I Semester, 2006-2007
Comprehensive Exam (Closed Book)

Course No.: **EEE UC383** Course Title: **Communication Systems**
Date: 19 Dec 2006 Time: 3 hours Max. Marks: 60 Weightage: 30%
Note: *Answer all questions.*

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1. (a) Assuming a quarter wave antenna, what would be the required antenna height for effective radio communication at 30 MHz?
   (b) State Rayleigh's energy theorem.
   (c) Define the term multiplexing. Distinguish between TDM and FDM with the aid of block diagrams. (2+1+3)

2. (a) Explain why DSB-SC modulation scheme was not adopted for commercial voice/music signal broadcasting.
   (b) Define modulation (power) efficiency of an AM transmitter. Show that the maximum modulation efficiency for a square-wave modulating signal is 50%.
   (c) Show that a signal and its Hilbert transform have the same energy content. (2+3+2)

3. (a) Obtain the expression for a single-tone phase-modulated wave. What is its modulation index?
   (b) What is Carson's rule? Give the details of the frequency and bandwidth of the signals used in commercial FM radio broadcasting.
   (c) Show how a PM signal can be demodulated using an FM demodulator. (3+2+2)

4. (a) Define a stationary process.
   (b) Write a brief note on the modeling of bandpass noise.
   (c) Explain the noise performance of an AM receiver using envelope detection. (1+2+4)

5. (a) What are the important conclusions drawn regarding the performance of an FM system in the presence of AWGN? (No derivations required)
   (b) Name the types of analog pulse modulation. Sketch the modulated signal waveforms for each of them corresponding to a single-tone modulating signal.
   (c) Draw the block diagram of a PCM system for transmitting/receiving a speech signal. (2+3+2)

6. (a) Explain the working of an adaptive delta modulation system with the help of block diagrams.
   (b) Explain the generation and detection of an FSK signal with the help of block diagrams. (5+4)

7. (a) Define a matched filter. Why is it so called?
   (b) What are the limits on the entropy of a source comprised of 32 messages? Under what conditions are these limits attained?
   (c) Discuss the Lempel-Ziv algorithm with the help of an example. (1+3+4)

8. (a) Check whether the code $C = \{000, 001, 101\}$ is a linear code or not. Define the terms Hamming distance and Hamming weight.
   (b) Explain the concept of spread-spectrum communication. Name the two main types of spread-spectrum systems and the type of modulation they employ. What is Jamming Margin?
   (c) State Shannon's capacity theorem. (3+5+1)

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EEE III Year, I Semester
Quiz (Closed Book)

Course No.: **EEE UC383** Course Title: **Communication Systems**
Date: 05 Oct 2006 Time: 30 minutes Max. Marks: 10 Weightage: 5 %
Note: *Answer all questions. Show the working in the space provided.*

Version - B

1. Define modulation. List the advantages and disadvantage(s) of modulating a baseband signal. (2 marks)

2. A modulating signal having frequency components in the range 30 Hz - 3400 Hz is transmitted using SSB-SC modulation in which the LSB is transmitted. It is recovered using a synchronous detector with carrier frequency error of 15 Hz. What is the nature of the recovered signal from the point of view of perception as well as its frequency content? (2 marks)

3. A baseband message signal of bandwidth 15 kHz is converted into a conventional AM signal using a square-law device. What is the minimum required value of carrier frequency for satisfactory operation of the modulator? (1 mark)

4. An AM signal is detected using an envelope detector. The carrier frequency and modulating signal frequency are 1 MHz and 1 kHz, respectively. An appropriate value for the time constant of the envelope detector is (choose the correct alternative and justify in the space provided below): (a) 500 μs (b) 20 μs (c) 2 ns (d) 1μs (1.5 marks)

5. A message signal $m(t)$ bandlimited to the frequency f_m has a power of P_m. The power of the output signal in fig. 1 is (choose the correct alternative and justify in the space provided below): (a) $\frac{P_m \cos\theta}{2}$ (b) $\frac{P_m}{4}$ (c) $\frac{P_m \sin^2\theta}{4}$ (d) $\frac{P_m \cos^2\theta}{4}$ (1.5 marks)

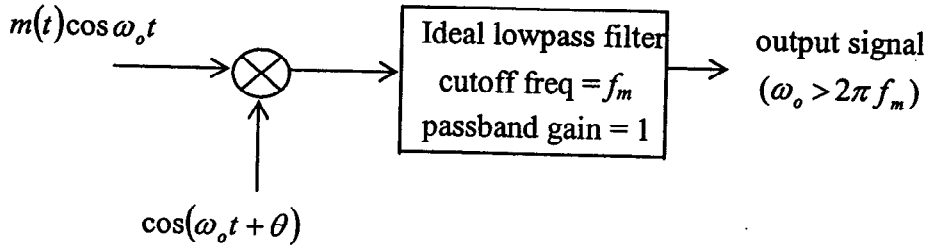

Fig.1

6. Draw the block diagram of an SSB-SC modulator using phase-shift method. Give the relative advantages and disadvantages of this method over the filter method of SSB-SC generation. (2 marks)

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Knowledge Village, Dubai

EEE III Year, I Semester, 2006-2007

Test-I (Closed Book)

Course No.: **EEE UC383** Course Title: **Communication Systems**

Date: 15 Oct 2006 Time: 50 minutes Max. Marks: 20 Weightage: 10 %

Note: *Answer all questions.*

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1. A 5 MHz carrier is modulated by a 5 kHz sine wave. Sketch the result in both the time and frequency domains for each of the following modulation types. Time and frequency scales are required but amplitude scales are not. (a) DSB full-carrier AM (b) DSB-SC AM (c) SSB-SC AM (USB). (3 marks)
2. Give the effects of carrier frequency and phase errors in the coherent detection of a DSB-SC signal. (3 marks)
3. Suppose a non-linear device is available for which the output voltage and input voltage are related by the cubic law: $v_o = a_1 v_i + a_3 v_i^3$, where a_1 and a_3 are constants. Show how this device may be used to produce a standard AM signal with a carrier frequency of ω_c. (Hint:- You may be requiring a frequency multiplier). (4 marks)
4. With the help of a neat sketch give the working of an envelope detector circuit for AM signals. Also illustrate the effects of inappropriate choice of RC time constant. (4 marks)
5. A phase modulator with k_p = 3 rad/V is modulated by a sine wave with an RMS voltage of 4 V at a frequency of 5 kHz. Calculate the phase modulation index. (3 marks)
6. Sketch the block diagram of a narrowband phase modulator. (3 marks)