BITS, PILANI-DUBAI CAMPUS
Knowledge Village
Semester I, 2005-06
Comprehensive Exam

Course No.: **EEE UC 383** Course Title: **COMMUNICATION SYSTEMS**
Date: 03 January, 2006 Time: 3 hours
Max. Marks: 60 Weightage: 30%

Answer all questions.

1. a) Obtain the Fourier transform of a periodic train of unit impulses with period T. What interesting property do you observe relating this signal and its Fourier transform? Name another signal that shares this property. (4 marks)
   b) Define modulation. Explain the advantages that result from modulating a baseband intelligence signal. (3 marks)

2. a) Explain with appropriate diagrams the generation of a conventional AM signal using a square-law modulator. (5 marks)
   b) Show that the maximum theoretical transmission efficiency that can be obtained in conventional AM is 50%. Derive the formula used. (4 marks)

3. a) A carrier wave $\cos\omega_c t$ is frequency modulated by the signal: $m(t) = \alpha[\cos\omega_m t + \cos 2\omega_m t]$. Determine the expression for the FM wave assuming that a 1-volt signal amplitude produces a frequency deviation of d Hz. Also, determine the maximum changes in instantaneous frequency about the carrier frequency. (4 marks)
   b) Give the representation of a narrowband random process and list its properties. (3 marks)

4. a) A DSB-SC signal corrupted by additive white noise is demodulated by a synchronous detector whose local oscillator output is given by $2\cos(\omega_c t + \varphi)$, where φ is the phase error. Derive the expression for the receiver output signal-to-noise power ratio. Sketch the output SNR versus φ over the range $[0, \pi]$. (4 marks)
   b) Explain the need for pre-emphasis of voice signals in FM transmission. What is the improvement in receiver output SNR obtained using pre-emphasis/de-emphasis? Show the calculations clearly. (3 marks)

5. a) Illustrate the errors that could occur in delta modulation and how they can be overcome. (4 marks)
   b) With neat sketches explain TDM and FDM and give their relative advantages and disadvantages. (5 marks)
   c) Why is a matched filter so called. (2 marks)

6. a) Define mutual information. Obtain the channel capacity of a binary-symmetric channel. (5 marks)
   b) Explain the methods for detecting an FSK signal. (4 marks)

7. a) Define Hamming distance between code words. (2 marks)
   b) Briefly explain how an (n, k) cyclic code is generated. (5 marks)
   c) Give the role of PN sequences in spread-spectrum communication. (3 marks)

BITS-PILANI-DUBAI CAMPUS
Knowledge Village, Dubai
III Year EEE Semester I, 2005-06
Test II (Open Book)

Course No.: **EEE UC 383** Course Title: **COMMUNICATION SYSTEMS**
Date: December 11, 2005 Time: 50 minutes
Max. Marks: 20 Weightage: 10%

Answer all questions.

1. A signal $m_1(t)$ is bandlimited to 3.6 kHz, and three other signals $m_2(t)$, $m_3(t)$, and $m_4(t)$ are bandlimited to 1.2 kHz. These signals are to be transmitted as PAM/TDM signals. Draw the multiplexing arrangement such that each signal is sampled at its Nyquist rate. (4)
2. Explain the term *aperture effect*. How is it minimized? (3)
3. Three identical BSCs are connected in cascade (i.e., in series). The bit error rate for each individual channel is 10^{-4}. Find the overall probability of bit error. (3)
4. A discrete-memoryless source S has four symbols s_1, s_2, s_3, and s_4. The first three symbols have probabilities of occurrence ¼, ½, and 1/8, respectively. Construct a Shannon-Fano code for S and find the code efficiency and redundancy. (4)
5. Show that the syndrome $\boldsymbol{s}$ is the sum (modulo 2) of those rows of matrix $\boldsymbol{H}^T$ corresponding to the error locations in the error pattern. (3)
6. Consider a (7, 4) cyclic code with $g(x) = 1 + x^2 + x^3$. Find the data word corresponding to the code word (1110100). (3)

Good Luck!

BITS, PILANI-DUBAI CAMPUS
Knowledge Village, Dubai
EEE Year III, Semester I, 2005-2006
QUIZ (Closed Book) – VERSION A

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

Date: 17 November 2005 Time: 30 minutes Max. Marks: 10 Weightage: 5%

All questions carry equal marks. Show your calculations clearly in the space provided.

1. A discrete memoryless source X produces five symbols, four of which have probabilities ½, ¼, 1/8, and 1/16. The source entropy is _____

2. The maximum entropy a source having 32 messages can attain is _____ bits.

3. A channel is described by the following channel matrix. (a) Draw the channel diagram. (b) Find the channel capacity.

$$\begin{bmatrix} ½ & ½ & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

4. The capacity of an AWGN channel with a bandwidth of 1 MHz and SNR of 40 dB is _____

5. Find the mutual information of a binary-symmetric channel with transition probability 0.5 and equi-probable input symbol probabilities.

6. A DSB-SC signal corrupted by white noise is demodulated by a synchronous detector having a carrier phase error of φ. The output SNR in terms of γ and φ is _____

7. In FM, the SNR (or threshold) improvement is obtained at the cost of _____

8. In FM (and PM), the output SNR increases by ___ dB for each doubling of the transmission bandwidth. This result is valid only when _____

9. A television signal having a 4.5 MHz bandwidth is sampled at a rate 20% above the Nyquist rate. If the sampled signal is converted to a PCM signal using 256 quantization levels, then the output bit rate is _____

10. In a delta modulation system, the condition for no slope-overload distortion for single-tone message signal is _____

BITS, PILANI – DUBAI CAMPUS
Knowledge Village, Dubai
Semester I, 2005– 2006
Test I (Closed Book)

Course No.: **EEE UC 383** Course Title: **COMMUNICATION SYSTEMS**
Date: October 30, 2005 Time: 50 Minutes
Max. Marks = 20 Weightage = 10%

1. Obtain the Fourier transform of a periodic signal x(t) with period T_0. *(3 marks)*
2. It is desired to generate a DSB-SC signal of the form $s(t) = A_c m(t)\cos\omega_c t$ using a product modulator. However, the available carrier is of the form $\cos^n\omega_c t$ (with $n \geq 2$). For what values of n can we generate the desired DSB-SC signal? *(3 marks)*
3. A conventional single-tone AM signal is given by the expression: $s_{AM}(t)=5\cos 450\pi t+20\cos 550\pi t+5\cos 650\pi t$. Obtain the carrier amplitude, modulating signal frequency, carrier frequency, and the modulation index. *(4 marks)*
4. Explain the effect of receiver carrier phase error in the synchronous detection of an SSB-SC signal. *(3 marks)*
5. Consider an FM signal $s_{FM}(t)=10\cos(\omega_c t+3\sin\omega_m t)$. Let f_m=1 kHz. Calculate the modulation index and find the bandwidth when (a) f_m is doubled, and (b) f_m is decreased by one-half. *(4 marks)*
6. Draw the deemphasis filter used for commercial FM and comment on the choice of its RC time constant. Why is preemphasis/deemphasis not used for conventional AM broadcasting? *(3 marks)*