BCSE 2nd Year 2nd Semester Examination 2015

Data Communication Systems

Time : Three Hours | Full Marks : 100

Answer question 1 and any three questions from the rest

1. a) List the various line coding schemes associated within Uni-Polar, Bipolar, Bi-phase Coding category. Describe the Multi-level Coding Scheme 2B1Q 4

b) State the number of bits to represent a signal using PCM Coding with L quantization levels. What is the maximum data rate of such a line coded digital signal where bandwidth of the corresponding analog signal is B. What is the minimum required bandwidth for fixed data rate N And signal levels L for communicating this signal. 4

c) List the various Categories of Line Coding Schemes. Illustrate with diagram the difference between Manchester and Differential Manchester Coding Schemes. 8

d) State the Time-Scaling Property, Symmetry Property and Time-Shifting Property of Fourier Transform. Here provide a proof of the Symmetry Property. 8

e) State and prove the time convolution and the frequency convolution theorems. 8

f) Prove the convolution of a function f(t) with the impulse function $\delta(t)$ produces the function f(t). Here provide proof for conversion of impulse function to its frequency domain representation. 8

2) a) Find the fourier transform of a Gate Function where

$f(t) = K$ where $|t| < \pi/2$

$= 0$ elsewhere

Represent this result as a Sampling Function.

b) Find the fourier transform of signum function where

$Sgn(t) = 1, \quad t > 0$

$= -1, \quad t < 0$ (10 + 10)

3. a) If the noise signal at the input of the detector is $n_c(t) \cos(w_c(t)) - n_s(t) \sin(w_c(t))$ where w_c is the carrier frequency . Derive an expression for noise signal after low pass filtering of the signal obtained after multiplying the signal with the carrier $\cos(w_c t)$ in the synchronous detector. Derive an expression of this power density spectrum of this output noise signal. If this power density spectrum value of output noise signal is $(\eta / 4)$, derive the output noise power of a DSB-SC system for a baseband signal at the output of the detector where the modulating signal frequency is f_m . If the input noise power of such a signal is ηf_m , derive an expression for the ratio of output noise power to that of the input. 12

b) Derive an expression for the input signal and output signal power where the modulated signal at the input of the detector is $f(t) \cos(w_c t)$. Derive an expression for ratio of output signal power to that of the input. Use this expression and the expression of ratio of noise powers obtained from answer of part a), to derive a value for the figure of merit for the DSB-SC system. 8

4. a) What is Carson's Rule of bandwidth definition of single-tone wideband FM ? Provide an expression for this bandwidth based on the frequency deviation and the modulation index of the FM signal. Here modulation index is defined as $(\Delta \omega / \omega_m)$ and the Bandwidth of the signal is defined as $2 (\Delta \omega + \omega_m)$ Provide an interpretation of the narrow band and the wide band signal cases based on the derived expression. 8

b) In a FM system, the audio frequency is 500 Hz and the voltage is 2.4V and the frequency deviation is 4.8 kHz. Calculate the modulation index applicable to this situation. Also if the voltage is increased to 7.2 V, provide the updated frequency deviation and modulation index values. 12

5. a) If the generator matrix for (7,4) block code is G

[[1 0 0 0 1 1 0], [0 1 0 0 0 1 1], [0 0 1 0 1 0 1], [0 0 0 1 1 1 1]]

Where $G = [I_4 \mid P]$ and the parity check matrix $H = [P^T \mid I_{7-4}]$. Show a procedure for calculating the syndrome corresponding to the received word [1 1 1 1 0 1 0]. 10

b) Consider a (7,4) block code, the data is 1010 with corresponding polynomial representation $d(x) = x^3 + x$ and the generator polynomial $g(x) = x^3 + x^2 + 1$. Specify the codeword corresponding to the data ? How is this generated. Derive a generator matrix for this code. 10

6. a) Describe the generic model of a Spread Spectrum Digital Communication System.

b) Describe with an example a Frequency Hopping Spread Spectrum Signal

c) Discuss the advantages and disadvantages of CDMA. (8 + 7 + 5)

7. Write Short Notes on any two of the following (10 + 10)

a) Go Back N and Selective Repeat ARQ protocol. .

b) QPSK & QAM system of digital modulation.

c) Multi-Level and Multi-Line Coding

d) Figure of Merit measure in Noise Performance