Registration Number:

B.E. DEGREE (FULL TIME) END SEMESTER EXAMINATION – NOVEMBER 2011

ELECTRONICS AND COMMUNICATION ENGINEERING BRANCH

23

FIFTH SEMESTER – (REGULATIONS R 2008)

EC 9301 – DIGITAL COMMUNICATION TECHNIQUES

Duration : 3 Hours Max. Marks = 100

Answer **ALL** the questions.

PART- A (10 x 2 = 20 marks)

1. List out the advantages of Raised cosine pulse shaping in comparison to ideal sinc pulse shaping solution.
2. Draw a typical eye pattern for binary baseband transmission and mark the impact of noise and timing jitter.
3. What are the factors that contribute to carrier offset in digital communication receivers.
4. Highlight the difference between decision directed and non-decision directed signal parameter estimation.
5. Obtain the entropy of two unbiased coins tossed together.
6. What is the Mutual Information of a BSC channel when source entropy is 1 and channel error probability is 0.5.
7. Draw the structure of the syndrome calculator for the $g(X) = 1 + X + X^3$.
8. What is the significance of free distance and its impact on the error correction capability.
9. What is the motivation to go for Trellis Coded Modulation.
10. Draw the tanner graph for the given H matrix

$$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

PART – B (5 x 16 = 80 marks)

11. (i) State and explain the Shannon's Information Capacity theorem for a continuous channel subject to bandwidth and power constraints. Bring out its implications with the help of the Bandwidth – energy efficiency diagram. 8

(ii) A discrete memoryless source has an alphabet of seven symbols with probabilities for its output, as described below:

Symbol	S_0	S_1	S_2	S_3	S_4	S_5	S_6
Probability	0.25	0.25	0.125	0.125	0.125	0.0625	0.0625

Obtain the Huffman code for this source, moving a combined signal as high as possible. Calculate the variance and efficiency of the coding scheme. 8

12a. (i) Given the data stream 1110010100, sketch the transmitted waveform for the following line codes: (a) Bipolar RZ and (b) Manchester. 4

(ii) Consider a random binary sequence where bits are statistically independent and equally likely. Derive the power spectral density for the NRZ bipolar format and plot it. 12

'OR'

12b. The binary data $\{b_k\}$ = 11100101 , k = 0,1,2....7, are applied to the input of a modified duobinary system without precoder. Construct the modified duobinary system output. If the received signal differs from the transmitted signal at instant k = 4, determine the decoded output at the receiver. Repeat the above for modified duobinary with precoder. Assume the previous precoded outputs at k= -1 and k= -2 are 1 and 1 respectively.

13a. (i) Derive the Decision-Directed carrier phase estimate and draw the block diagram of a double-sided PAM signal receiver that incorporates the phase estimator. 8

(ii) Explain with suitable diagrams the concept and implementation of an Early-Late gate synchronizer for obtaining the symbol timing estimate. 8

'OR'

13b. The tap weights of a tapped delay line equalizing filter are determined by transmitting a single impulse as a training signal. Let the equalizer be a three tap filter. Let $\{x(k)\}$ = { -0.5, 0.1, 1.0, -0.2, 0.05 } for k = -2, -1, 0, 1 and 2, respectively , denote the set of received samples corresponding to the single impulse sent through the channel. Use a Zero Forcing Algorithm to determine the tap weights. Using the weights determine the residual ISI and values of the equalizing pulse at the sample instants $k = \pm 2$ and ± 3.

14a. The generator polynomial of a (7,4) Hamming code is defined by,

$$g(X) = 1 + X + X^3$$

Determine the systematic codeword for the message sequence (1 0 0 1) using the polynomial division method.

If the received sequence is (0 1 1 1 1 0 1), determine the syndrome using the polynomial division method.

'OR'

14b. Consider a rate – ½, non-systematic Convolutional Code with $g^{(1)} = \{1,0,1\}$ and $g^{(2)} = \{1,1,1\}$. Determine the encoder output corresponding to the data sequence { 1 1 0 }. Assume suitable number of tail bits to reset encoder. If the fourth bit of the encoded sequence is altered during transmission, demonstrate the error correcting capability of the Viterbi algorithm.

15a. (i) Demonstrate the Ungerboeck set partitioning for a 16-QAM signal set. 6

(ii) Explain with suitable diagrams how you can implement the Viterbi decoding process for decoding Trellis Coded Modulation Symbols using the Add-Compare-Select module. 10

'OR'

15b. Given a 2D single parity code defined by $d_i \oplus d_j = p_{ij}$. The input data is assumed to be unbiased and the channel measurements obtained are as shown in the table below. The AWGN noise variance is 1.2. Carry out a Soft decoding process based on LLR and estimate the transmitted data.

x_1=0.75	x_2=0.05	x_{12} = 1.25
x_3=0.10	x_4=0.15	x_{34} = 1.0
x_{13}=3.0	x_{24}=0.5	-

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