T.E. (ETRX) Sem V (R)
Digital Communication & Coading Techniques

Con. 5531-09. (REVISED COURSE) SP–8540

(3 Hours) [Total Marks : 100

29/12/09
2:30 to 5:30

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data if **required**.

1. (a) Define the following terms :— 10
   (i) Systematic and non-systematic code
   (ii) Hamming weight and Hamming distance
   (iii) Entropy and redundancy
   (iv) Code rate.
   (b) Differentiate between (any **two**) :— 10
   (i) QASK and QPSK
   (ii) BPSK and BFSK
   (iii) Coherent and non-coherent code detection.

2. (a) Explain the central limit theorem for random variables. 6
   (b) A three digit message is transmitted over a noisy channel having a probability of error P(E) = 2/5 per digit. Find out corresponding PDF and CDF. Also find the probability of more than one error. 8
   (c) For a source transmitting two independent messages m_1 and m_2 having probabilities of P and (I-P) respectively, prove that entropy is maximum when both the messages are equally likely. Also plot the variation of entropy H as a function of probability (P) of one of the messages. 6

3. (a) Explain any source coding technique to increase average information per bit. 6
   (b) A discrete memoryless source has five symbols x_1, x_2, x_3, x_4 and x_5 with probabilities 0·4, 0·19, 0·16, 0·15 and 0·15 respectively attached to every symbol. 8
   (1) Construct a shannon. Fano code for the source and calculate code efficiency.
   (2) Repeat same for Huffman code.
   (c) State and explain in brief:– 6
   (i) Shannon's theorem
   (ii) Shannon-Hartley theorem.

4. (a) The generator polynomial of a (7, 4) cyclic code is $x^3 + x + 1$. 10
   (i) Sketch an encoder for the same
   (ii) Construct the generator matrix for a systematic cyclic code and find the code word used for the message.
   { 1 1 0 1 (LSB) } using the generator matrix.
   (iii) Verify the result using division method.

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(b) A K = 3, p = ½ convolutional encoder can be described by the impulse response of the paths given by $g_1 = (1, 1, 1)$, $g_2 (1, 0, 1)$. **10**

(i) Draw the block diagram of the encoder and obtain the output for data { 1 0 0 1 1 (LSB) }

(ii) Sketch the code tree and trace the path corresponding to the message sequence in (i).

(iii) Draw the trellis diagram for the encoder.

5. (a) What is duo-binary encoding ? Explain with the neat block diagram. How the duo-binary encoding reduces the bandwidth requirements. **10**

(b) Why MSK is called 'Shaped QPSK' ? Justify with relevant expressions or waveforms. Discuss the merits of MSK over QPSK. **10**

6. (a) Derive the expression for signal to noise ratio of Integrate and Dump receiver filter. **10**

(b) Derive an expression for error probability of Matched filter. **10**

7. (a) Explain with neat block diagram, direct sequence spread spectrum technique. What is processing Gain and Jamming Margin ? **10**

(b) Sketch block diagram of FH / MFSK system. With illustrative figures, distinguish between slow frequency hopping and fast frequency hopping. What is chip rate for the two systems ? **10**
