Code No: 07A50405 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
DIGITAL COMMUNICATIONS
Common to Electronics And Telematics, Electronics And Communication Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Compare FSK & PSK systems.
   (b) Compare different m-ary techniques. [8+8]

2. (a) What is the entropy of X, where X represents the outcome of a single roll of a fair die?
   (b) Prove that the entropy for a discrete source is a maximum when the output symbols are equally probable. [8+8]

3. A convolutional encoder has a single shift register with two stages,(K=3) three modulo-2 adders and an output multiplexer. The generator sequence s of the encoder are as follows. $g^{(1)}$=(0,1, 1) ; $g^{(2)}$=(1, 0,1),$g^{(3)}$=(1,1,1).Draw the block diagram of the encoder. Construct the state diagram of the above encoder. [16]

4. Binary data is transmitted over an RF Band pass channel with a usable band width of 10MHz at a rate of 4.8×10^6 bits/sec using an ASK signaling method. The carrior amplitude at the receiver antenna is 1 mv and the noise power spectral density at the receiver input is $10^{-5}/W/Hz$.
   (a) Find the error probability of a coherent receiver?
   (b) Find the error probability of a non-coherent receiver? [16]

5. Explain the Shannon-fano coding algorithm using an example. [16]

6. Explain with neat diagram adaptive Delta modulation transmitter and receiver. [16]

7. The threshold value of the input signal power to noise ratio $(S/N)_i$ in PCM system is defined as the value of $(S/N)_i$ for which the value of $(S/N)_0$ is 1 dB below its maximum:
   (a) Show that the threshold occurs when $Pe \approx \left[\frac{1}{16(2^{2N})}\right]$
   (b) Plot P_e versus N, for N = 2, 4, 6 and 8
   (c) Sketch the threshold value of $(S/N)_i$ versus N for which N = 2, 4, 6 and 8. [Assume that a PSK signalling scheme is used] [6+5+5]

8. The polynomial $x^{15}+1$ when factored gives
   $x^{15}+1=(x^4+x^3+1)(x^4+x^3+x^2+x+1)(x^4+x+1)(x^2+x+1)(x+1)$

(a) Construct a systematic (15,2) code using the generator polynomial $g(x)=(x^4+x^3+x^2+x+1)(x^4+x+1)\ (x^4+x^3+1)(x+1)$

(b) List all the code words. [8+8]

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Code No: 07A50405 **R07** **Set No. 4**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Define the following
   (a) information
   (b) entropy [8+8]
2. Derive probability of error for
   (a) ASK and
   (b) PSK systems. [16]
3. A DMS X has 4 symbols x_1, x_2,x_3,x_4 with $p(x_1)=1/2$, $p(x_2)=1/4$, $p(x_3)=1/8= p(x_4)$.
   (a) construct Shannon fano code
   (b) repeat for the Huffman code and compare the results. [16]
4. Construct all the possible systematic code words for (15,5) cyclic code with the following generator polynomial $g(x)=x^{10}+x^8+x^5+x^4+x^2+x+1$. Derive the encoder circuit for this. [16]
5. Explain PSK &DPSK. Compare both. [16]
6. Explain:
   (a) Channel noise
   (b) Quantisation noise in DM & derive expression for them? [16]
7. A convolutional encoder has a single shift register with two stages,(K=3) three modulo-2 adders and an output multiplexer. The generator sequence s of the encoder are as follows.
   $g^{(1)}=(0,1,1)$; $g^{(2)}=(1,0,1)$,$g^{(3)}=(1,1,1)$. Draw the block diagram of the encoder. Construct the trellis diagram. [16]
8. A signal m(t) Band limited to 4 kHz is sampled at twice the Nyquist rate & its samples transmitting by PCM. An output SNR of 47 dB is required:
   (a) Find N and minimum value of Si/Ni of operation is to be above Threshold
   (b) Calculate minimum system Band width required and find signalling rate needed to achieve the given output SNR. [8+8]

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Code No: 07A50405 **R07** **Set No. 1**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Consider the binary symmetric channel. let P_0 denote the probability of choosing binary symbol X_0=0 and let P_1 = 1- P_0 denote the probability of choosing binary symbol X_1=1. Let p denote the transition probability of the channel. Calculate the average mutual information between the channel input and channel output.[16]

2. (a) Show the geometrical representation of m-ary psk signals.
   (b) Draw the block diagram of QPSK receiver. [8+8]

3. Construct the state diagram for the following encoder. Starting with all zero state,trace the path that correspond to the message sequence 1011101. Given convolutional encoer has 3 shift registers with two stages, two modulo-2 adders and an output multiplexer. The generator sequences of the encoder are as follows.
   $g^{(1)}$=(1, 1,1, 1) ; $g^{(2)}$=(1, 1, 0,1). [16]

4. A source emits one of four possible symbols during each signaling interval. The symbols occur with the probabilities. p1=0.4,p2= 0.3,p3= 0.2,p4=0.1.Find the information gained by observing the source emitting each of these symbols. [16]

5. (a) Draw the Block diagram of DPCM system.
   (b) A voice frequency signal band limited to 3 KHz is transmitted with the use of the DM system. The prf is 30,000 pulses/second and step size is 40 mV. Determine the maximum permissible speech signal amplitude to avoid error. [8+8]

6. The polynomial $x^{15}+1$ when factored gives
   $x^{15}+1 = (x^4+x^3+1)(x^4+x^3+x^2+x+1)(x^4+x+1)(x^2+x+1)(x+1)$
   (a) Construct a systematic (15,5)code using the generator polynomial $g(x)=(x^4+x^3+x^2+x+1)(x^4+x+1)(x^2+x+1)$
   (b) What is the minimum distance of the code?
   (c) How many random errors per code word can be corrected? [16]

7. A satisfically independent sequence of equiprobable binary digits is transmitted over a channel having finite Band width using rectangular signalling waveform is taken. The bit rate is 'r_b' and the channel noise has a PSD Gn(f) given by
   $Gn(f) = Go\left[1+(f/f_1)^2\right]^{-1}$. Find the transfor function of the optimum receiver and calculate the Pe. [16]

8. For a DM system, signal sampled at 76 KHz and $A_{max} = 4$

   (a) Assuming that the signal is sinusoidal determine output signal power & SNR.

   (b) Determine the minimum transmission Band width? Derive the relations. [16]

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Code No: 07A50405 **R07** **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What is quantization error? How does it depend upon the step size? Suggest some methods to overcome the difficulties encountered depending on the modulating amplitude swing? [16]

2. (a) A source emits one of 4 symbols s_0,s_1,s_2, s_3 with probabilities 1/3,1/6,1/4,1/4 respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source.
   (b) Prove that the entropy for a discrete source is a maximum when the output symbols are equally probable. [8+8]

3. For a (6,3) systematic linear block code the three parity check bits c4 , c5, c6 are formed from the following equations: c_4=d_1 (xor) d_3 ; c_5= d_1 (xor) d_2 (xor) d_3; c_6= d_1 (xor) d_2 .
   (a) Write down the generator matrix G
   (b) suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits. [8+8]

4. A convolutional encoder has two shift registers two modulo-2 adders and an output multiplexer. The generator sequences of the encoder are as follows: $g^{(1)}4$=(1,1,0); $g^{(2)}$=(0,1, 1). Draw the block diagram of the encoder. Construct the state diagram for the above encoder. [16]

5. Write down the modulation waveforms for transmitting binary information over base band channels for the following schemes:
   (a) ASK
   (b) PSK
   (c) FSK
   (d) DPSK [16]

6. Explain the operation of matched filter and derive $P_e = \frac{1}{2} erfc\left[\sqrt{\frac{Eb}{No}}\right]$ for it ? [16]

7. Derive the channel capacity theorem for discrete channels. [16]

8. Derive:
   (a) $\frac{E\{xo^2(t)\}}{E\{nq^2(t)\}} = \frac{3}{8\pi^2}\left(\frac{f_s}{f_x}\right)^3$

(b) $\left(S/N_q\right)_0 = \frac{\left(8/3\pi^2\right)\left(fs/fx\right)^3}{1+\frac{6Pef_S^{12}}{\pi^2 f_x f_l}}$

Where f_S^1 - sampled interal
f_1,f_x → lower & upper cut off frequencies. [8+8]

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