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EC–602

B. TECH.

SIXTH SEMESTER EXAMINATION, 2003-2004

DIGITAL COMMUNICATION

Time : 3 Hours *Total Marks : 100*

Note : Attempt **ALL** questions.

1. Attempt any *FOUR* parts of the following :— **(5×4=20)**

   (a) What is Flat Top sampling ? Compare it with natural sampling.

   (b) Define Average Mutual Information between two discrete random variables and show that it is non-negative.

   (c) Design binary Huffman Code for a discrete source of five independent symbols A,B,C,D and E with probabilities 0·4, 0·2, 0·3, 0·08 and 0·02 respectively such that the variance of code-word lengths is minimum.

   (d) Derive channel capacity expression for a Binary Symmetric Channel.

   (e) Show that an n letter Discrete memoryless has maximum entropy of $\log 2^n$.

   (f) Compare the noise performance and bandwidth of PWM, PPM and PAM.

2. Attempt any *FOUR* parts of the following :— **(5×4=20)**

   (a) Explain Granularity and Slope-overload errors in Delta modulation.

   (b) What is Frame Synchronization in digital communication ? Explain how it is achieved using an example.

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(c) Why are non-uniform quantizers needed at all ? How are they implemented ?

(d) What are the functions of a repeater in a PCM system ? Is there something analogous to repeater in analog communication ?

(e) A speech signal of duration 15 sec. is sampled at sampling rate of 10 ks/s and encoded with signal to quantization noise ratio 50 dB. What is the minimum storage needed to store the encoded signal ?

(f) What is T1 system ? Describe it briefly.

3. Attempt any *TWO* parts of the following :—

(a) What do you understand by Inter-symbol Interference (ISI) ? Derive the Nyquist criteria for zero ISI. **(10)**

(b) Given a bit sequence of 0110010, draw the line codes in polar, bipolar (AMI), Manchester and HDB formats. Compare these formats on the basis of inbuilt clocking, bandwidth and noise performance. **(10)**

(c) Consider a finite duration pulse $h(t)$ limited to time $0 \leq t \leq T$.

(i) What is the impulse response of filter matched to the pulse $h(t)$? **(2)**

(ii) If this filter is used to detect $h(t)$ in presence of additive white noise, show that Signal-to-Noise Ratio (SNR) at the output of the filter will be maximum. **(8)**

4. Attempt any *TWO* parts of the following :—

(a) Derive the expression for probability of bit error for coherent BPSK scheme in presence of additive, white, Gaussian noise. **(10)**

(b) (i) Differentiate between coherent and incoherent receptions. (4)

(ii) Giving modulated waveforms, signal space diagrams and probability of bit errors, draw the optimum receiver structures for DPSK and coherent FSK modulation schemes. (6)

(c) Explain the MSK modulation scheme and its optimum receiver structure. How is its noise performance related to that of coherent BPSK ? (10)

5. Attempt any *TWO* parts of the following :—

(a) Show that for single-bit error correcting block code, the columns of its parity check matrix must all be non-zero and distinct. (10)

(b) Consider a (7,4) type systematic cyclic code with generator polynomial $g(X) = 1 + X + X^3$.

(i) Draw the encoder and syndrome calculator circuits. (5)

(ii) Determine the first two rows of its generator matrix. (5)

(c) (i) Consider a rate $r = 1/3$ convolutional code with constraint length L=3 and generators being $g_0 = [100]$, $g_1 = [111]$ and $g_2 = [101]$. Draw its trellis and state diagram. (5)

(ii) Explain sequential decoding of convolutional code. (5)