Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 08

M.Tech.(ECE) (Sem.–2)

INFORMATION THEORY & CODING

Subject Code : EC-509

Paper ID : [E0568]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTION TO CANDIDATES :

1. **Attempt any FIVE questions out of EIGHT questions.**
2. **Each question carries TWENTY marks.**

Q1. a) Consider a sequence of letters of the English alphabet with their probabilities of occurrence as given by :

Letter	*a*	*i*	*l*	*m*	*n*	*o*	*p*	*y*
Probability	0.1	0.1	0 . 2	0.1	0.1	0.2	0.1	0.1

Compute the Huffman Code for this alphabet. Find the average code word length.

b) State and prove SAMPLING THEOREM. What is the limitation of Flat Top Sampling and how is it overcome?

Q2. a) Let Z take values 0 and 1 with probabilities 1 – p and p. Let X, which is independent of Z, take values 1, 2, ..., n with probabilities $q = [q_1, q_2 \ldots . q_n]$.

Let

$$Y = XZ.$$

a) Find the entropy of Y in terms of the entropies of X and Z.

b) Find the p and q that maximize H(Y).

c) Suppose X and Y are the input and output of a discrete memory less channel. For fixed p, what is the capacity C(p) of the channel? What value of p maximizes C(p)?

Q3. a) A compact disc (CD) records audio signals digitally by using PCM. Assume that the audio signal bandwidth equals 15 kHz.

a. If the Nyquist samples are uniformly quantized into L = 65,536 levels and then binary-coded, determine the number of binary digits required to encode a sample.

b. If the audio signal has average power of 0.1 watt and peak voltage of 1 volt. Find the resulting signal-to-quantization-noise ratio (SQNR) of the uniform quantiser output in part (a).

c. Determine the number of binary digits per second (bit/s) required to encode the audio signal.

d. For practical reasons, signals are sampled at a rate well above the Nyquist rate. Practical CDs use 44,100 samples per second. If L = 65, 536, determine the number of bits per second required to encode the signal, and the minimum bandwidth required to transmit the encoded signal.

b) What is meant by aliasing? What can be done to reduce aliasing?

Q4. a) Explain, with the help of neat diagram, DELTA Modulator. What are slope overload and Granular Noise problems in Delta Modulation? How these problems can be avoided?

b) Define and explain the parameters of eye diagram. Mention its usage in digital communication systems. How it is used to know the information about a channel.

Q5. a) Explain Inter symbol interference. Discuss its causes and method to reduce it.

b) Explain Nyquist criterion to get Zero Inter symbol interference.

c) A Binary PAM wave is to be transmitted over a low pass channel with an absolute Maximum Bandwidth of 75 kHz. The bit duration is 10 μs. Find the raised cosine spectrum that satisfies these requirements.

Q6. a) Explain Quadrature Phase Shift Keying (QPSK) modulation and demodulation techniques.

b) Eight channels, each band limited to 5 KHz, are to be time division multiplexed. Each sample is coded with 6-bit words. Find the output rate in bits/second and the required bandwidth.

Q7. a) What is meant by Geometric representation of modulation signals? What is the effect of noise on these representations?

b) In practical communication systems out of BASK, BFSK and BPSK which modulation technique will you prefer and why?

c) How FSK modulation and demodulation is done? Explain using block diagrams of modulation and demodulation.

Q8. a) The generator polynomial of a cyclic code is $g(x) = 1+x+x^3$. Obtain one code vector in non systematic and systematic form.

b) For the convolutional encoder diagram as shown in Fig., the information sequence is d = 10011. Find the output sequence using time domain approach.

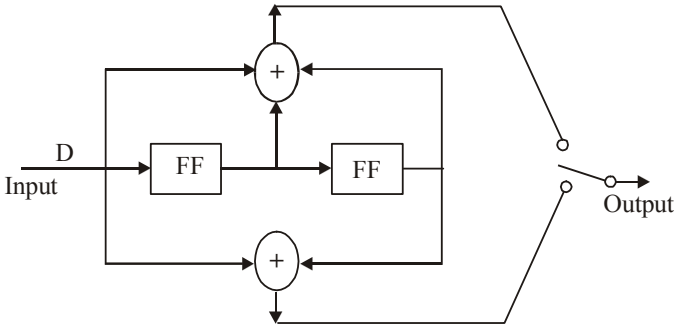

Fig.