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No. of Printed Pages—4 **EC-602**

B. TECH.

SIXTH SEMESTER EXAMINATION, 2002-2003

DIGITAL COMMUNICATION

Time : 3 Hours *Total Marks : 100*

Note : Attempt **ALL** the questions.

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

(*a*) An event has six possible outcomes with probabilities $P_1 = \frac{1}{2}$, $P_2 = \frac{1}{4}$, $P_3 = \frac{1}{8}$, $P_4 = \frac{1}{16}$, $P_5 = \frac{1}{32}$ and $P_6 = \frac{1}{32}$. Find the entropy of the system. Also find the rate of information if there are 16 outcomes per second.

(*b*) A discrete source transmits messages x_1, x_2 and x_3 with probabilities 0·3, 0·4 and 0·3. The source is connected to the channel given in the fig. 1. Calculate $H(x)$ and $H(y)$.

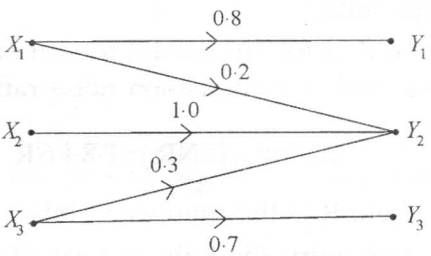

Fig. 1

(*c*) 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.

(*d*) Consider a discrete memoryless source with source alphabet = { S_0, S_1, S_2 } and source statistics { 0·7, 0·15, 0·15 }.

(*i*) Calculate the entropy of the source.

(*ii*) Calculate the entropy of second order extension of the source.

(*e*) State and prove SAMPLING THEOREM ?

(*f*) What is the limitation of Flat Top Sampling and how is it overcome ?

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

(*a*) Explain, with the help of neat diagram, DELTA Modulator.

(*b*) Eight channels, each bandlimited 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.

(*c*) Prove that for sinusoidal modulating signal, the signal to quantization noise ratio in dB is

$$10 \log_{10}(\text{SNR}) = 1{\cdot}8 + 6\,\text{R}$$

where R is the number of bits per sample.

(*d*) Explain, with the help of neat diagram, the PCM System.

(*e*) What is COMPANDING ? Explain A-Law compandor.

(*f*) A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit-rate of the system is equal to 5×10^6 bits per second.

What is the maximum message bandwidth for which the system operates satisfactorily ?

3. Attempt any TWO parts of the following :— **(10 × 2=20)**

(*a*) For the binary sequence 011010110, construct NRZ, RZ, AMI and Manchester Format.

(*b*) 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 microsecond. Find a raised cosine spectrum that satisfies these requirements.

(*c*) What is MATCHED FILTER ? Explain its principle of operation.

4. Attempt any TWO parts of the following :— **(10 × 2=20)**

(*a*) Find the probability of error for detecting the equally likely signals $S_1(t)=\sqrt{\frac{2E}{T}}\cos(\omega_0 t)$ and $S_2(t)=\sqrt{\frac{1}{2}\frac{E}{T}}\cos(\omega_0 t+\pi)$ in AWGN using a correlater receiver.

(*b*) Explain, with the help of neat diagram, the method for generating and demodulating DPSK signals.

(*c*) What is the difference between QPSK and MSK ? Prove that in MSK

$$f_H - f_L = f_0/2$$

5. Attempt any TWO of the following :— **(10 × 2=20)**

(*a*) Consider the (7, 4) Hamming code defined by the generator polynomial

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

The code word 0111001 is sent over a noisy channel, producing the received word 01011001. Determine the syndrome polynomial $S(X)$ for this received word and show that it is identical to the error polynomial $e(X)$.

(*b*) Fig. 2 shows the encoder for a rate $r=\frac{1}{2}$ constraint length $k = 2$ convolutional code. Determine the encoder output produced by the message sequence 10111....

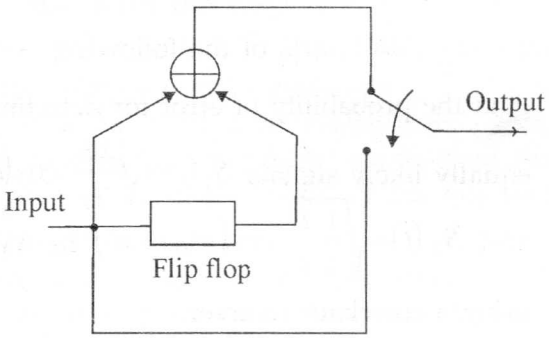

Fig. 2

(*c*) For a (7, 4) Hamming Code, the generator polynomial is

$$g(D)=1+D^2+D^3.$$

Develop the encoder and syndrome calculator.