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Total number of printed pages – 3

B. Tech
PCEC 4305

Sixth Semester Back Examination – 2015

DIGITAL COMMUNICATION TECHNIQUES

BRANCH : EC, ETC

QUESTION CODE : M 177

Full Marks – 70

Time : 3 Hours



*Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.*

1. Answer the following questions : 2 × 10
- (a) A signal $x(t)$ is band limited to 2 KHz. Find the Nyquist sampling rate for $x(2t)$ and $x(t - 3)$.
 - (b) A communication channel of bandwidth 75 KHz is required to transmit binary data at a rate of 0.1 Mb/s using raised cosine pulses. Determine the roll off factor.
 - (c) What is the output SNR of a DM system for 1 kHz sinusoid sampled at 32 kHz without slope overload and followed by a 4 kHz post-reconstruction filter ?
 - (d) Calculate the mean square value of quantization noise for a PCM system.
 - (e) Explain the usefulness of DPSK with respect to BPSK. Also specify which has more error rate and why ?
 - (f) Explain timing jitter.
 - (g) Source coding improves the average information per bit, justify.
 - (h) Calculate the average information content in the English language, assuming that each of the 26 characters in the alphabet occurs with equal probability.

P.T.O.

- (i) For the received pulse $P_r(t)$, let $P_r[0] = 1$, $P_r[1] = -0.3$, $P_r[2] = 0.1$, $P_r[-1] = -0.2$, $P_r[-2] = 0.05$. Design a three tap equalizer.
- (j) For a fixed channel bandwidth and same ISI compare PCM and DM.
2. (a) The T1 carrier system used in digital telephony multiplexes 24 voice channels based on 8 bit PCM. Each voice signal is usually put through a low pass filter with the cut off frequency of about 3.4 kHz. The filtered voice signal is sampled at 8 kHz. In addition a single bit is added at the end of the frame for the purpose of synchronization. Calculate : 6
- (i) the duration of each bit,
- (ii) the resultant transmission rate, and
- (iii) the minimum required transmission bandwidth.
- (b) A binary channel with bit rate $R_b = 36,000$ b/s is available for PCM voice transmission. Find appropriate values of the sampling rate f_s , the quantization level L , and the binary digits n , assuming $f_M = 3.2$ kHz. 4
3. (a) Derive the expression for output signal to thermal noise ratio for a DM system. 7
- (b) Find the probability of error for a synchronous PSK system. 3
4. (a) Give the signal space representation of BFSK. Compare BPSK with that of BFSK with respect to BW and noise immunity. 5
- (b) What is "minimum" in MSK ? Show that MSK has phase continuity. 5
5. (a) Find the power spectral density of a NRZ data given by $p(t) = \pm V_b$ for $|t| \leq (T_b / 2)$. 5
- (b) Realize optimum filter using correlator. Compare with matched filter. 5
6. (a) Show that the channel capacity of an ideal AWGN channel with infinite bandwidth is given by $C_\infty = 1.44 \left(\frac{S}{\eta} \right)$ bps where S is the average signal power and $(\eta/2)$ is the power spectral density of white Gaussian noise. 5
- (b) An analog signal with a bandwidth of 4 kHz is sampled at 1.25 times the Nyquist rate, and each sample is quantized into one of 256 equally likely

levels. Assume that the successive samples are statistically independent. Find the information rate of the source. Can the output of the source be transmitted without error over an AWGN channel with a bandwidth of 10 kHz and an (S/N) ratio of 20 dB. 5

7. (a) Explain Nyquist criterion for Zero ISI. 4
- (b) Derive an expression for peak signal to rms noise output voltage ratio and show how the integrator enhances the signal relative to noise. Assume the voltage to be $s(t)$ with amplitude V volt, time constant of the integrator to be $RC = \tau$ and the input noise to the baseband receiver is white. 6
8. Write short notes on any **two** of the following: 5 × 2

- (a) Eye diagram
- (b) Adaptive delta modulation
- (c) Lempel-Ziv Coding
- (d) Optimum Threshold.

