

DipIETE – ET (NEW SCHEME) – Code: DE63**Subject: DIGITAL COMMUNICATIONS**

Time: 3 Hours

DECEMBER 2011

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.
- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. For the message signal $g(t) = 10 \cos 2000\pi t + 20 \sin 4000\pi t$, what is the minimum sampling rate?

- (A) 8000 samples/sec (B) 4000 samples/sec
(C) 2000 samples/sec (D) 1000 samples/sec

b. The average code word length of a memory less source is 2.5 and entropy is 2.25bits/symbol. The efficiency of the source encoder is _____

- (A) 0.75 (B) 0.9
(C) 1.10 (D) 0.25

c. In a digital communication system, which of the following is not considered as one of the basic signal processing operation?

- (A) Source coding (B) Channel coding
(C) Multiplexing (D) Modulation

d. A PCM system consists of a uniform quantizer of mid-rise type followed by a 7-bit binary encoder. The signal to quantizing noise ratio of the system is _____

- (A) 40.2 dB (B) 12.6 dB
(C) 34.8 dB (D) 43.8 dB

e. The signal waveform that produces zero ISI (Inter Symbol Interference) is _____

- (A) $\sin(2\pi B_0 t)$ (B) $\text{sinc}(2\pi B_0 t)$
(C) $\cos(2\pi B_0 t)$ (D) None of these.

- f. The bandwidth of a differential Phase Shift Keying (DPSK) modulated signal is same as that of a _____
- (A) BPSK signal (B) QPSK signal
(C) FSK signal (D) ASK signal
- g. In the design of matched filter for the baseband demodulation, if the signal waveform is $s(t)$ of duration T sec, then the impulse response of the filter will be _____
- (A) $h(t) = s(t-T)$ (B) $h(t) = s(T+t)$
(C) $h(t) = s(T-t)$ (D) $h(t) = s(2T-t)$
- h. The processing gain of spread spectrum communication system which employs DSSS-BPSK, with an information bit rate of 4k bits/sec and a chip rate of 2.5 mega chips per second is _____.
- (A) 10000 (B) 1600
(C) 4000 (D) 625
- i. In a digital radio, for each voice channel the PCM uses the bit rate of _____
- (A) 64k bits/sec (B) 32k bits/sec
(C) 16k bits/sec (D) 8k bits/sec
- j. Each frame in a T-1 carrier system consists of _____
- (A) 8 bits (B) 192 bits
(C) 193 bits (D) 24 bits

**Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.**

- Q.2** a. State Nyquist sampling theorem for low pass signals. The spectrum of a low pass signal is given in Fig.1. The signal is sampled using ideal sampling method. Draw the spectrum of the sampled signal if the sampling rate is
(i) $2W$ samples/sec (ii) $1.5W$ samples/sec. (6)

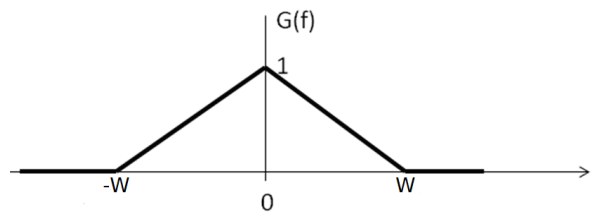


Fig. 1

- b. 24 voice signals are sampled uniformly and then time division multiplexed. The sampling operation uses the flat-top samples with 1microsec duration and the multiplexing operation includes provision for Synchronization by adding an extra pulse of sufficient amplitude and also 1micro second. Assuming a sampling rate of 8kHz, calculate the spacing between successive pulses of the multiplexed signal. (4)
- c. Describe Flat-Top sampling? What is aperture effect and how it is eliminated?(6)

Q.3

- a. Explain the terms:
(i) Information
(ii) Uniquely Decodable Codes
(iii) Prefix codes (3×2=6)
- b. Consider a discrete memory less source (DMS) with source alphabet of four symbols, $S = [s_1, s_2, s_3, s_4]$ with probabilities [0.6, 0.15, 0.15, 0.10]. Compute
(i) The Huffman Code for this source. For the obtained codes, calculate
(ii) The average code word length. (3+3)
- c. A voice grade channel has a bandwidth of 4000 Hz. Calculate the minimum SNR required to support information transmission through the channel at the rate of 16000 bits/sec. (4)

Q.4

- a. A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is 50 Mega bits/sec. What is the maximum message bandwidth for which the system operates satisfactorily? Find the output signal-to-quantization noise ratio when a sinusoidal wave of 2MHz frequency is applied to the input (6)
- b. Describe the working of a delta modulation system with neat block diagrams. Obtain an expression for the no slope overload condition in delta modulation system for a sinusoidal input signal. (10)

Q.5

- a. For the binary stream of data 101001101 draw the waveforms for:
(i) Uni Polar NRZ. (ii) Polar NRZ code. (iii) Bipolar NRZ code (6)
- b. Explain the working of a Precoded Duo-binary system with a suitable block diagram. For the input binary data 0010110, obtain
(i) The pre-coder output
(ii) Duo binary coder output and
(iii) Duo binary decoder output. (10)

Q.6

- a. Draw the block diagrams of the modulator and demodulator of a differential PSK system and explain its working. The bit stream 10010011 is to be transmitted using DPSK technique. Determine the encoded sequence and transmitted phase sequence. Also find the decoded sequence. (8)

- b. Derive an expression for probability of bit error of a binary coherent FSK receiver. A coherent FSK system transmits binary data at the bit rate of 3 Mbits/sec. In the absence of the noise, the amplitude of the received signal is 1 microvolt. During the transmission, White Gaussian Noise of zero mean and two sided power spectral density 10^{-20} watts/hertz is added to the signal. Find the probability of bit error. (8)
- Q.7** a. Describe the working of a correlation receiver with a block diagram. (6)
- b. What are matched filters? State and explain the properties of the matched filters. (10)
- Q.8** a. Verify the balance and run properties for the PN sequence 1011100. (4)
- b. Describe with block diagrams of transmitter and receiver, the Direct Sequence Spread Binary PSK system. (8)
- c. A slow FH/MFSK system has the number of bits per MFSK symbol is 4 and the number of MFSK symbols per hop is 5. Calculate the processing gain of the system. (4)
- Q.9** a. With a neat block diagram of an optic fiber link, explain the working of an optical fiber communication system. (6)
- b. What are the various diversity techniques used in a digital radio to combat the effects of multipath fading. (6)
- c. What are the advantages of CDMA over TDMA? (4)