

AMIETE – ET (Current & New Scheme)

Time: 3 Hours

December - 2017

Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- 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. What conditions must be fulfilled in a good digital communication system?

(A) High data rate	(B) High fidelity
(C) Low transmit power	(D) All of these
- b. Let us consider the operation of a modem on an ordinary telephone line. The SNR is usually about 1000. The bandwidth is 3.4 KHz. What is channel capacity?

(A) 32 kbps	(B) 34 kbps
(C) 38 kbps	(D) 40 kbps
- c. The line code that has zero dc component for pulse transmission of random binary data is

(A) Non-return to zero (NRZ)	(B) Return to zero (RN)
(C) Alternate mark inversion (AM)	(D) None of these
- d. What is the bit rate, if the baud rate is 400 for a QPSK signal?

(A) 4000 bps	(B) 6000 bps
(C) 8000 bps	(D) 10000 bps
- e. An analog signal is sampled, quantized, and encoded into a binary PCM wave. The number of representation levels used is 128. A synchronizing pulse is added at the end of each code word representing a sample of the analog signal. The resulting PCM wave is transmitted over a channel of bandwidth 12 kHz using a quaternary PAM system with raised-cosine spectrum. The roll-off factor is unity. What is the rate (bps) at which information is transmitted through the channel.

(A) 44 kbps	(B) 34 kbps
(C) 24 kbps	(D) 14 kbps
- f. Matched filter technique is used to

(A) increase SNR	(B) decrease SNR
(C) SNR is not affected	(D) None of these
- g. Which of the following technique expands the bandwidth of a signal by replacing each data bit with n bits.

(A) Frequency Division Multiplexing	(B) Direct Sequence Spread Spectrum
(C) Frequency Hopped Spread Spectrum	(D) Time Division Multiplexing

- h. What is the baud and minimum bandwidth necessary to pass a 10 kbps binary signal using amplitude shift keying?
 (A) Bandwidth=10000 and Baud=5000
 (B) Bandwidth=5000 and Baud=5000
 (C) Bandwidth=5000 and Baud=10000
 (D) Bandwidth=10000 and Baud=10000
- i. The detector that minimizes the error probability is called
 (A) Maximum likelihood detector (B) Minimum likelihood detector
 (C) Both (A) and (B) (D) None of these
- j. For a QPSK modulator with an input data rate (f_b) equal to 10 Mbps and a carrier frequency 70 MHz, the bit rate in both the I and Q channels are
 (A) $f_{bQ}=10\text{Mbps}$, and $f_{bI}=5\text{Mbps}$ (B) $f_{bQ}=10\text{Mbps}$ and $f_{bI}=10\text{Mbps}$
 (C) $f_{bQ}=5\text{Mbps}$ and $f_{bI}=10\text{Mbps}$ (D) $f_{bQ}=5\text{Mbps}$ and $f_{bI}=5\text{Mbps}$

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

- Q.2** a. Explain working of digital communication system with neat diagram. (5)
- b. Explain Telephone channel, Optical Fibers and Satellite Channel used in Digital Communications. (5)
- c. Show that mutual information of a channel is $H(X, Y) = H(X) + H(Y) - H(X, Y)$ where (6)
- $$H(X, Y) = \sum_{j=0}^{j-1} \sum_{k=0}^{k-1} p(x_j, y_k) \left[\log_2 \left(\frac{1}{p(x_j, y_k)} \right) \right]$$
- Q.3** a. Explain practical natural sampling in time and frequency domain for low pass analog signal. (8)
- b. Consider a signal $g(t)$ having the upper Cut-off frequency, $f_u = 100\text{KHz}$ and the lower Cut-off frequency $f_l = 80\text{ KHz}$, what is the sampling rate of band pass signal. (2)
- c. Three independent message signals of bandwidths 1KHz, 1KHz and 2KHz respectively are to be transmitted using TDM scheme. Determine (6)
- (i) Commutator segment arrangement
 (ii) Speed of the commutator if all the signals are sampled at its Nyquist rate
 (iii) Minimum Transmission bandwidth
- Q.4** a. Write advantages and disadvantages of PCM system. (3)
- b. Derive mathematical expression for Quantization Noise and Signal to Noise ratio of mid- rise type uniform quantizer in PCM system. (7)
- c. Show that the maximum output signal-to-noise ratio of a delta modulator is proportional to the cube of sampling rate. (6)

- Q.5** a. Explain raised cosine spectrum. (4)
- b. A binary wave using polar signalling is generated by representing symbol 1 & 0 by a pulse of amplitude +1V & -1V respectively. In both cases the pulse duration equals the bit duration. The signal is applied to a low pass RC filter with transfer function $H(f) = \frac{1}{1 + j\left(\frac{f}{f_0}\right)}$, where f_0 is the cut-off frequency of the low pass RC filter (7)
- Construct eye pattern for the filter for (i) Alternating 1s and 0s (ii) A long sequence of 1s followed by long sequence of zeros.
- c. Explain Adaptive equalization for data transmission (5)
- Q.6** a. Explain concept and Signal space diagram of QPSK Modulation. (7)
- b. Explain generation and detection of Binary FSK modulation (5)
- c. For a BPSK modulator with a carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine the maximum and minimum upper and lower side frequencies, draw the output spectrum, determine the minimum Nyquist bandwidth, and calculate the baud rate. (4)
- Q.7** a. Consider the three signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ defined as follows. (6)
- $$s_1(t) = \begin{cases} 2, & 0 \leq t \leq 1 \\ 0, & \text{elsewhere} \end{cases}; s_2(t) = \begin{cases} -4, & 0 \leq t \leq 2 \\ 0, & \text{elsewhere} \end{cases}; \text{ and } s_3(t) = \begin{cases} 3, & 0 \leq t \leq 3 \\ 0, & \text{elsewhere} \end{cases}$$
- Use Gram-Schmidt Orthogonalization Procedure to find the orthonormal basis for this set of signals. Also express the signals in terms of the basis functions.
- b. Explain geometric interpretation of signal (5)
- c. Explain Matched Filter receiver with neat diagram. (5)
- Q.8** a. Write various advantages and disadvantages of spread spectrum. (4)
- b. Explain generation of Psuedo-Noise (PN) Sequence. What are the properties of PN sequence? Explain any two properties of PN sequence (6)
- c. Explain model of direct sequence spectrum system with BPSK modulation. (6)
- Q.9** a. Explain practical digital hierarchy based on T1 carrier system. (8)
- b. Write merits and demerits of Direct Sequence and frequency hopping spreading methods (4)
- c. Explain following two applications of Spread spectrum in brief. (4)
- (i) CDMA Radio (ii) Wireless LAN