ROLL NO. _____

Code: AE67/AE118 **Subject: DIGITAL COMMUNICATIONS**

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2016** **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. A source generates three symbols with probability 0.25, 0.25, 0.50 at a rate of 3000 symbols per second. Assuming independent generation of symbols, the most efficient source encoder would have average bit rate of
(A) 6000 bits/sec **(B)** 4500 bits/sec
(C) 3000 bits/sec **(D)** 1500 bits/sec

b. A bandlimited signal is sampled at the Nyquist rate. The signal can be recovered by passing the samples through
(A) An RC filter
(B) An envelope detector
(C) A PLL
(D) An ideal low-pass filter with the appropriate bandwidth

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. In binary data transmission DPSK is preferred over PSK because
(A) A coherent carrier is not required to be generated at the receiver
(B) For a given energy per bit, the probability of error is less
(C) The 180^0 phase shifts of the carrier are unimportant
(D) More protection is provided against impulse noise

e. The bit rate of digital communication system is R kbit/s. The modulation used is 32-QAM. The minimum bandwidth required for ISI free transmission is
(A) R/10 Hz **(B)** R/10 KHz
(C) R/5 Hz **(D)** R/5 KHz

f. The input to a matched filter is given by

$$s(t) = \begin{cases} 10\sin(2\pi \times 10^6 t), & 0 < t < 10^{-4}\ \text{sec} \\ 0, & \text{otherwise} \end{cases}$$

the peak amplitude of the filter output is
(A) 10 volts **(B)** 5 volts
(C) 10 millivolts **(D)** 5 millivolts

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. A BPSK scheme operating over an AWGN channel with noise power spectral density of $N_0/2$, uses equiprobable signals

$$s_1(t) = \sqrt{\frac{2E}{T}}\sin(w_C t) \quad \text{and} \quad s_1(t) = \sqrt{\frac{2E}{T}}\sin(w_C t)$$

over the symbol interval (0, T). If the local oscillator in a coherent receiver is ahead in phase by 45^0 with respect to the received signal, the probability of error in the resulting system is

(A) $Q\left(\sqrt{\frac{2E}{N_0}}\right)$ **(B)** $Q\left(\sqrt{\frac{E}{N_0}}\right)$

(C) $Q\left(\sqrt{\frac{E}{2N_0}}\right)$ **(D)** $Q\left(\sqrt{\frac{E}{4N_0}}\right)$

i. Which of the following technique uses M different carrier frequencies that are modulated by the source signal? At one moment, the sign modulates one carrier frequency; at the next moment, the signal modulates another carrier frequency
(A) Frequency Division Multiplexing
(B) Direct Sequence Spread Spectrum
(C) Frequency Hopped Spread Spectrum
(D) Time Division Multiplexing

j. In a baseband communication link, frequencies upto 3500 Hz are used for signalling. Using a raised cosine pulse with 75% excess bandwidth and for no inter symbol interference, the maximum possible signalling rate in symbols per sec is
(A) 1750 **(B)** 2625
(C) 4000 **(D)** 5250

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

Q.2 a. Sketch the block diagram of a digital communication system and explain the functionality of each block. **(6)**
b. Write advantages and disadvantages of digital communication. **(6)**
c. Comment upon channels for digital communications. **(4)**

Q.3 a. Explain practical Flat-top sampling for low pass analog signal and explain aperture effect and how it can be compensated. **(8)**
b. Find the Nyquist rate and the Nyquist interval for the signal $g(t) = \text{sinc}(200t) + \text{sinc}^2(200t)$. **(2)**
c. Twenty-four voice signals are sampled uniformly and then time-division multiplexed. The sampling operation uses flat-top samples with 1 μs duration. The multiplexing operation includes provision for synchronization by adding an extra pulse of sufficient amplitude of 1 μs duration. The highest frequency

component of each voice signal is 3.4 kHz. (a) Assuming a sampling rate of 8 kHz, calculate the spacing between successive pulses of the multiplexed signal. (b) Repeat your calculation assuming the use of Nyquist rate sampling. **(6)**

Q.4 a. Sketch the block diagram of PCM system and explain the functionality of each block. **(5)**

b. Determine and illustrate the partition and quantization levels of a 4-bit, uniform midrise quantizer with ±1 volt Full scale (FS) range. For the sequence {0.2, −0.3, −0.7, 0.08, 0.25, 0.5, 0.8, 0.95}, determine the quantized sequence. Also determine the mean square quantization error and Signal to Quantization Noise ratio (SQNR). **(7)**

c. A Differential pulse code modulation system uses a linear predictor with a single tap. The normalized autocorrelation function of the input signal for a lag of one sampling interval is 0.75.The predictor is designed to minimize the prediction error variance. Determine the processing gain attained by the use of this predictor. **(4)**

Q.5 a. Explain Nyquist criterion for distortionless Base-Band Binary transmission. **(5)**

b. What do you mean by eye pattern? How and where it is used? **(5)**

c. Describe adaptive equalization for data transmission. **(6)**

Q.6 a. What do you mean by Inter symbol Interference (ISI)? How the effect of ISI can be reduced? **(6)**

b. Compare coherent and non-coherent digital modulation techniques. **(6)**

c. Highlight the role of synchronization in digital modulation. **(4)**

Q.7 a. Consider the four signals $s_1(t)$, $s_2(t)$, $s_3(t)$ and $s_4(t)$ as shown in Fig.7.1. 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. **(6)**

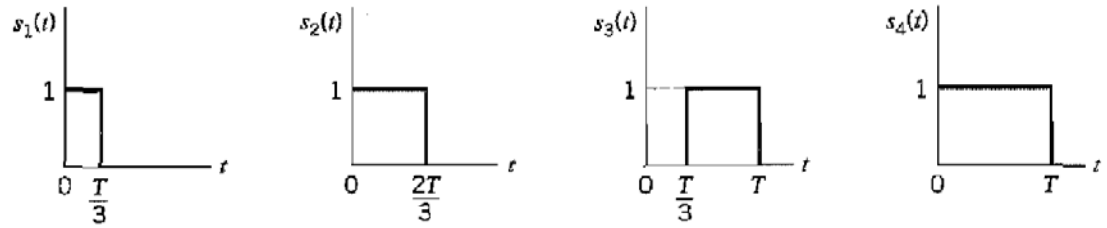

Fig.7.1

b. Draw the block diagram of Correlative receiver and explain function of each block. **(4)**

c. Discuss detection of known signals in noise. **(6)**

Q.8 a. What is spread spectrum. Sketch the model of direct sequence spectrum system with BPSK modulation and analyze it. **(6)**

b. Write short note on any **TWO**: **(2×5=10)**

(i) Signal space dimensionality

(ii) Probability of error

(iii) Processing gain

Q.9 a. Explain practical Digital Hierarchy based on T1 carrier system. **(8)**

b. Explain applications of Spread spectrum modulation. **(8)**