ROLL NO. ___________________

Code: AE67 Subject: DIGITAL COMMUNICATIONS

AMIETE – ET

Time: 3 Hours **DECEMBER 2012** **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. Rather than sending the absolute value of each sample, it is possible to achieve a smaller transmission bit-rate by sending the difference between consecutive samples. This is known as ______________.

(A) delta modulation **(B)** delta–sigma modulation
(C) adaptive delta modulation **(D)** differential PCM

b. Reversible or lossless coding is a type of coding for which the exact data can be recovered after decoding. This type of coding is used by ________________.

(A) PCM encoding **(B)** Huffman encoding
(C) Shano-Fano encoding **(D)** Both **(B)** and **(C)**

c. The error represented by the difference between the original and quantized signals set a fundamental limitation to the performance of PCM systems known as _________________.

(A) dynamic range **(B)** quantization noise
(C) detection-error **(D)** correction-error

d. What does a logic 1 DM bit indicate?

(A) The message signal's amplitude is decreasing.
(B) The feedback signal's amplitude is greater than the message signal's amplitude.
(C) The feedback signal's amplitude is constant.
(D) The feedback signal's amplitude is less than the message signal's amplitude.

e. The digital data is directly coded at a much higher frequency. The code is generated pseudo-randomly, the receiver knows how to generate the same code and correlates the received signal with that code to extract the data. Which type of spread spectrum is this?

(A) Frequency hopping **(B)** Time hopping
(C) Direct sequence **(D)** None of these

f. A digital transmission has an error probability of 1 x 10^{-5} and is 1 x 10^{8} lo
Its expected number of error bits is

(A) 1 x 10^{3} **(B)** 1 x 10^{5}
(C) 1 x 10^{4} **(D)** 1 x 10^{8}

g. The bit rate of the PN code is called

(A) Chipping Frequency (fc) **(B)** Information rate (fi)
(C) Chip **(D)** Epoch

h. The minimum Hamming distance between the codes 0000,0101,1010 and 1111 is

(A) 0 **(B)** 1
(C) 2 **(D)** 4

i. The asymptotic value of *Eb/N*0 required to achieve the data rate equal to the channel capacity when the channel bandwidth tends to infinity is equal to__________

(A) −1.6 dB **(B)** -3dB
(C) 0 dB **(D)** infinite

j. The probability of error of QPSK is ________ BPSK

(A) higher than **(B)** equal to
(C) lower than **(D)** either higher or lower to

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

Q.2 a. Define entropy, joint entropy, mutual information, self information and obtain the condition for the maximum value of entropy. **(8)**

b. Consider the random variable:

X =

x1	x2	x3	x4	x5	x6	x7
0.49	0.26	0.12	0.04	0.04	0.04	0.02

(i) Find a binary Huffman code for X.
(ii) Find the expected codelength for this encoding.
(iii) Find a ternary Huffman code for X. **(8)**

Q.3 a. On the basis of your study on Sampling Process throw some light on the Practical Aspects of Sampling and Signal Recovery. **(8)**

b. A digital communication system is to carry a single voice signal using linearly quantised PCM. What PCM bit rate will be required if an ideal anti-aliasing filter with a cut-off frequency of 3.4KHz is used at the transmitter and the signal to quantization noise ratio is to be kept above 50dB. **(8)**

Q.4 a. List the main attributes of a speech codec.

b. Specify a baseband Nyquist channel which has a piecewise linear amplitude response, an absolute bandwidth of 10KHz and its appropriate for a baud rate of 16Kbaud. What is the channel's excess bandwidth? **(8)**

Q.5 a. (i) The BPSK modulation is used in a channel that adds white noise with single- sided PSD N_0 =10^{-10} W/Hz. Calculate the amplitude A of the carrier signal to give Pe=10^{-6} for a data rate of 100 Kbps. **(4)**

(ii) Find E_b/N_0 in dB to provide $P_e = 10^{-6}$ for BPSK and coherent FSK. **(4)**

b. What is a CPFSK modulation scheme? How it is related with the MSK modulation scheme? Explain MSK transmission and reception. **(8)**

Q.6 a. What is waveform coding? Explain its salient characteristics. Draw the RZ-UNIPOLAR, NRZ-BIPOLAR, MANCHASTER, NRZ-Unipolar for the data stream 11100101011. **(8)**

b. With the help of block diagram Elaborate Baseband binary data transmission system. **(8)**

Q.7 a. Obtain the transfer function and impulse response of matched filter. **(8)**

b. What is the sampling instant signal to noise ratio at the output of a filter matched to a triangular pulse of height 10mV and width 1msec if the noise at the input to the filter is white with a power spectral density of 10nV^2/Hz. **(8)**

Q.8 a. A baseband binary communication system transmits a positive rectangular pulse for digital ones and a negative triangular pulse for digital zeros. If the (absolute) widths, peak pulse voltages and noise power spectral density at the input of an ideal correlation receiver. Find the probability of bit error. **(8)**

b. Consider an FH/MFSK system, let the PN generator be defined by a 20-stage linear feedback shift register with a maximal length sequence. Each state of register dictates a new centre frequency within the hopping band. The minimum step size between centre frequencies is 200Hz. The register clock rate is 2KHz. Assume that 8-ary FSK modulation is used and that the data rate is 1.2Kbits/sec.

(i) What is the hopping bandwidth?

(ii) What is the chip rate?

(iii) How many chips are there in there in each data symbol?

(iv) What is the processing gain? **(8)**

Q.9 Write a short note on any **<u>TWO</u>** of the following:

(i) Applications of digital modulation techniques in mobile communication.

(ii) Applications of spread-spectrum modulation techniques in cellular communications.

(iii) M12 Multiplexer. **(8+8)**