ROLL NO.

Code: AE67

Subject: DIGITAL COMMUNICATIONS

AMIETE – ET

Time: 3 Hours

DECEMBER 2015

Max. Marks: 100

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

NOTE: There are 9 Questions in all.

- Ouestion 1 is compulsory and carries 20 marks. Answer to 0.1 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.

Choose the correct or the best alternative in the following: **Q.1**

 (2×10)

- a. A CD audio laser-disk system has a frequency bandwidth of 20 Hz to 20 kHz. The minimum sample rate to satisfy the Nyquist criteria is (A) 20 Hz (B) 20 KHz (**C**) 40 Hz (**D**) 40 KHz
- b. The quantizing error of PCM systems for weak signals can be made less significant by (A) Companding (B) Using TDM

(C) Using FDM (**D**) Filtering out Alias Frequency

- c. Using an oscilloscope to display overlaid received data bits that provide information on noise, jitter, and linearity is called
 - (A) Eye pattern (**B**) Constellation pattern (C) Statistical concentration
 - (D) None of these
- d. A source alphabet consists of N symbols with the probability of the first two symbols being the same. A source encoder increases the probability of the first symbol by a small amount ε and decreases that of the second by ε . After encoding, the entropy of the source (A) Increases (**B**) Remains the same

(C) Increases only if N = 2

- (D) Decreases
- e. In PCM system, the number of quantization levels are 16 and the maximum signal frequency is 4 kHz, the bit transmission rate is S

| (A) 64 kbps | (B) 16 Kbp |
|----------------------|---------------------|
| (C) 32 kbps | (D) 8 kbps |

f. The maximum data rate that a medium of 10 kHz and signal to noise ratio of 30dB is roughly -(A) 10 kbps (**B**) 30 kbps (**C**) 100 kbps (**D**) 3 kbps

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- g. The Nyquist sampling rate for the signal g(t) is given by $g(t) = 4 \operatorname{Sin} (200 \, \pi t) \operatorname{sin} (400 \, \pi t) + 3 \operatorname{Sin} (500 \, \pi t)$ (A) 200 (B) 300 (C) 400 (D) 500 h. The main advantage of polar NRZ over Manchester format is: (A) Saving in power (B) Noise immunity (C) Synchronization is lost (D) None of these i. The number of quantization levels required to reduce the quantization noise by
- i. The number of quantization levels required to reduce the quantization noise by a factor of 4

| (A) 1024 | (B) 512 |
|-------------------|----------------|
| (C) 256 | (D) 64 |

j. A communication channel with AWGN operating at a signal to noise ratio, SNR >> 1 and bandwidth B has capacity C1. If the SNR is doubled keeping bandwidth constant, the resulting capacity C2 is given by (approximately)

| (A) 2C1 | (B) C1+B |
|------------------|------------------|
| (C) C1+2B | (D) C1+3B |

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

- **Q.2** a. Draw the block diagram of digital communication system and explain the function of each block. Differentiate the system with analog communication.
 - b. A discrete memoryless source (DMS) has six symbols X_i and their probability of occurrence $P(X_i)$ as follows:

| X_i | | $\underline{P(X_i)}$ |
|-------|---|----------------------|
| X_1 | > | 0.30 |
| X_2 | > | 0.25 |
| X_3 | > | 0.20 |
| X_4 | > | 0.12 |
| X_5 | > | 0.08 |
| X_6 | > | 0.05 |

Using Huffman coding algorithm, find the Huffman codes for the symbols. Calculate the coding efficiency.

- **Q.3** a. State and explain sampling theorem.
 - b. g(t) is a band limited signal with bandwidth f_m Hz and its spectrum is given in Fig (a). Mathematically show that the spectrum of the sampled (at sampling frequency of f_s Hz) version of signal g(t) is as given in Fig (b). (10)

(8)

(6)

(8)

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|-------------|--|--|--|
| | G(w) | $G_{s}(\omega)$ | |
| | $-\omega_{\rm m}$ Fig (a) | Fig (b) | |
| Q.4 | a. Explain Delta modulation with tran are the major limitations of Delta modulationb. Explain the concepts of Robust Quar | smitter and receiver block diagram. What odulation? (10) | |
| Q.5 | a. Consider a binary sequence 101101(using the following signaling formats (i) Unipolar RZ (iii) Polar RZ (v) Bipolar NRZ | (0) (1) (1) | |
| O. 6 | b. Derive the Nyquist criterion for disto a. What is meant by Inter symbol In | rtionless Baseband Binary transmission. (10) terference? What are the effects of Inter | |
| | b. Explain with block diagram and m coherent demodulation of ASK signal | (6) athematical equations the generation and al along with its signal space diagram. (10) | |
| Q.7 | 7 a. What is a matched filter? Derive the expression for impulse response of the Matched filter. (8) | | |
| | b. Explain Gram-Schmidt Orthogonaliz | ation Procedure. (8) | |
| Q.8 | a. Explain with a block diagram the Spectrum. | e working of Frequency hopped spread (7) | |
| | b. What is the difference between Fas Hopping? | t frequency hopping and Slow Frequency (3) | |
| | c. Calculate the processing gain of FHS 2 MHz and instantaneous bandwidth | SS system if the total hopping bandwidth is is 40 kHz. (3) | |
| | d. Mention any two advantages and disa | dvantages of FHSS System. (3) | |
| Q.9 | Write a short note on applications of (i) Waveform Coding Techniques (ii) Spread Spectrum Techniques | : (8×2) | |