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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** 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. Binary data is transmitted over a band pass channel at a rate of 300 bits per second using non-coherent FSK signaling Scheme with tone frequency 1070 Hz and 1270 Hz. Assuming $A^2/N_0 = 8000$, The Probability of Error is
(**A**) 634×10^{-2} (**B**) 63.4×10^{-2}
(**C**) 6.34×10^{-2} (**D**) 0.634

b. Granular noise is associated with
(**A**) PCM (**B**) DM
(**C**) QAM (**D**) DPCM

c. An Analog signal is sampled at the Nyquist rate and quantized into q levels. The time duration τ of 1-bit of the binary coded signal is
(**A**) Ts/q (**B**) $Ts/\log_{10*}q$
(**C**) Ts/2q (**D**) $Ts/\log_{2*}q$

d. According to Shannon's Theory, Error Probability ($P_e \rightarrow 0$) can be attained by maintaining
(**A**) $R_b = C$ (**B**) $R_b \leq C$
(**C**) $R_b \geq C$ (**D**) $R_b < C$

e Minimum distance (d_{min}) in BPSK constellation diagram is
(**A**) $2\sqrt{E_b}$ (**B**) $\sqrt{E_b}$
(**C**) $\sqrt{2E_b}$ (**D**) None of these

f. A Compact disk (CD) records audio signal digitally by PCM. Assume audio signal's bandwidth to be 15KHz. If signals are sampled at a rate of 10% above Nyquist rate for practical reason and the samples are quantized into 65536 levels, the signaling rate is
(**A**) 528 Kbps (**B**) 1056 Kbps
(**C**) 132 Kbps (**D**) 264 Kbps

g. A communication channel with AWGN has a Bandwidth of 4 KHz and an SNR of 15.The channel capacity is
(A) 64 Kbps   (B) 16 Kbps
(C) 128 Kbps   (D) 32 Kbps

h. For a continuous-time signal $x(t)= 6\cos50\pi t+20\sin300\pi t$. The Nyquist rate is
(A) 200 H_Z (B) 400 Hz
(C) 300 Hz   (D) 800 Hz

i. for a DPSK Scheme, the bit error probability is given by
(A) $0.5\text{erfc}\sqrt{Eb/2000}$ (B) $0.5\text{erfc}\sqrt{Eb/4000}$
(C) $0.5\exp(-E_b/N_0)$ (D) $0.5\exp(-E_b/2000)$

j. The output signal of a matched filter proportional to a shifted version of autocorrelation function of input signal is represented as
(A) $x_o(t) = 2K/N_0 * R(t-\tau)$ (B) $x_o(t) = K/N_0 * R(t-\tau)$
(C) $x_o(t) = K/N_0 * R(-\tau)$ (D) $x_o(t) = K/2N_0 * R(t-\tau)$

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

Q.2 a. Enlist and explain types of communication channels.   **(4)**

b. Define the following terms:-
(i) Mutual Information
(ii) Entropy
(iii) Channel Capacity
(iv) Noise   **(4)**

c. A zero memory source emits seven messages m_1, m_2, m_3, m_4, m_5, m_6 and m_7 with Probabilities 0.30, 0.25, 0.15, 0.12, 0.10, 0.08, 0.00 respectively. Obtain Huffman code for the source. Also find the efficiency and redundancy of the same.   **(8)**

Q.3 a. What are the Practical Difficulties in Signal Reconstruction? Give remedies for it with necessary diagrams.   **(8)**

b. Explain Utility of Time Division Multiplexing.   **(4)**

c. A signal m(t) of bandwidth B = 4KHz is transmitted using a binary companded PCM with μ=100. Find SNR for L= 64 and L= 128.   **(4)**

Q.4 a. What are the advantages of DPCM? Explain with the help of neat sketches the DPCM transmitter and receiver. How SNR is improved in DPCM compared to PCM.   **(8)**

b. Define Quantization and Quantization error? Derive the expression for Quantization error.   **(8)**

Q.5 a. Obtain PSD of NRZ uni-polar, NRZ-polar, and NRZ-bipolar. Compare and
comments.   **(8)**

b. Explain followings with Examples.   **(8)**
(i) Eye Diagram
(ii) Timing Jitter

Q.6 a. Compare BPSK and QPSK in tabular forms.   **(4)**

b. Write a note on: - M-ary modulation technique.   **(6)**

c. Explain with neat sketches digital modulation formats.   **(6)**

Q.7 a. What is usefulness of GRAM-SCHMIDT Procedure? Explain the stepwise
GRAM-SCHMIDT Procedure to construct orthogonal (orthonormal) set.   **(8)**

b. Explain in details maximum likelihood estimation.   **(8)**

Q.8 a. What are the characteristic of spread spectrum signals? Explain with suitable
diagrams frequency hopping spread spectrum techniques.   **(10)**

b. Define the following:
(i) Processing Gain
(ii) Chip rate
(iii) PN sequence.   **(3)**

c. If the message signal bandwidth is 4 MHz, Processing Gain is 400, find out the
spread spectrum signal bandwidth.   **(3)**

Q.9 a. Write a technical note on "Applications of digital Modulation techniques". **(8)**

b. Write a technical note on "Applications of Spread Spectrum techniques".   **(8)**