AMIETE – ET (OLD SCHEME)

Code: AE15 **Subject: COMMUNICATION ENGINEERING**
Time: 3 Hour **Max. Marks: 100**

JUNE 2009

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.**
- **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. Unwanted energy, usually of random nature, present in a transmission system, due to any cause is called

(A) noise. **(B)** random signal.
(C) information. **(D)** carrier.

b. For a receiver of noise figure F operating at T_o, K, the equivalent noise temperature is given by

(A) $F(T_o - 1)$. **(B)** $(F-1)(T_o - 1)$.
(C) $T_o(F-1)$. **(D)** $\frac{T_o}{F}$.

c. Modulation index of an AM wave with $E_m = 160V, E_c = 200V$ is

(A) 40%. **(B)** 80%.
(C) 125%. **(D)** 360V.

d. If there are $M = 2^N$ (N an integer) equally likely and independent messages, then information bits in each message is

(A) 2^N. **(B)** $\log_2 N$.
(C) $2\log_2 M$. **(D)** N.

e. The Hamming distance of an orthogonal code of k information bits is equal to

(A) 2^k. **(B)** 2^{k-1}.
(C) 2^{k+1}. **(D)** 2^{-k}.

f. If sampling of 20 Hz bandwidth signals is at Nyquist rate using 3 bits per sample, then the bit rate (bits/s) is

(A) 17. **(B)** $\frac{20}{3}$.
(C) 60. **(D)** 120.

g. The nonlinear device with $y = kx^2$ type characteristics used in a square-law AM demodulator is a

(A) diode. **(B)** capacitor.
(C) resistor. **(D)** comparator.

h. An amplitude-modulated signal, carrier plus double sideband is passed through a filter before transmission to the receiving end in the

(A) PCM system. **(B)** VSB system.
(C) SSB system. **(D)** DSB system.

i. The amplitude-to-step-size ratio is 128 in a linear delta modulation for a sinusoid of frequency 800 Hz. To avoid slope-overload, the sampling rate f_s must be

(A) $\geq 640\text{KHz}$. **(B)** $\geq 6.25\text{Hz}$.
(C) =102.4 KHz. **(D)** $\leq 102.4\text{KHz}$.

j. In a PCM system, the error between a digit sent and the actual signal at that instant is random and is called

(A) distortion. **(B)** random noise.
(C) nonlinear noise. **(D)** quantisation noise.

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

Q 2. a. Determine the noise figure of a microwave amplifier operating with a bandwidth of 27 MHz and internal noise power of $1\times10^{-13}\,\text{W}$. **(8)**

b. Obtain a relationship between the noise figure and noise temperature of a two-port network (like an amplifier). **(8)**

Q 3. a. Derive an expression for the instantaneous value of FM signal voltage $e_{FM}(t)$ in terms of its amplitude A, modulation index m_f, carrier frequency ω_c and modulating signal frequency ω_m. Sketch a typical FM wave. **(8)**

b. A certain AM transmitter radiates 3 kW at 6 MHz with the carrier unmodulated and 3.735 kW when the carrier is sinusoidally modulated with 15 KHz signal. Calculate the modulation index, sideband frequencies, powers and the bandwidth. **(8)**

Q 4. a. Explain briefly

(i) How voltage variable capacitor is used to frequency modulate an LC oscillator?
(ii) Armstrong system as an indirect method of frequency modulation. **(8)**

b. A 25 MHz carrier is modulated by a 400 Hz audio sine-wave. If the carrier voltage is 4V and the maximum deviation is 10 KHz, find the expressions for instantaneous voltage for frequency modulated and phase-modulated waves. Write the new expressions if the modulating frequency is now changed to 2 KHz, with no other change. **(8)**

Q 5. a. Compare wideband FM and narrowband FM. **(8)**

b. Explain the meaning of the following terms:

(i) Discriminator.
(ii) Frequency division multiplexing.
(iii) Suppressed carrier.
(iv) Power and bandwidth saving. **(8)**

Q 6. a. State and explain the sampling theorem for low-pass signals. How can the original signal be recovered? **(8)**

b. With the help of a block-diagram, explain the working of a linear delta modulator. **(8)**

Q 7. a. Describe the basic error control coding that detects and corrects errors. **(5)**

b. State Shannon theorem for the capacity of a Gaussian channel. What is its implication if a non-Gaussian channel is used? **(6)**

c. Show that for n = 3 type repeated codes the matrix $\overline{H}$ is given by $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$. **(5)**

Q 8. Explain how codewords are formed and represented in

(i) Hadamard code **(6)**
(ii) Hamming code **(5)**
(iii) Cyclic code **(5)**

Q 9. a. Write briefly about the following:

(i) factors influencing colour transmission
(ii) phased-array radar **(8)**

b. Calculate the Doppler frequency seen by a stationary CW Doppler radar operating at 5GHz transmit frequency when the target radial velocity is 100Km/h. Will this radar be able to provide audio-range signals for booking speeding motorists by highway police patrol? **(8)**