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

DECEMBER 2007

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 best alternative in the following: (2x10)

a. Air for wireless communication and wire for landline communication are called

(A) channels. **(B)** transmitters.
(C) information sources **(D)** receivers.

b. The type of noise associated with all amplifying or active devices is the

(A) solar noise **(B)** man-made noise
(C) shot noise **(D)** cosmic noise

c. If the SNRs at the input and output of a receiver are 36 dB and 20 dB respectively, then the receiver noise figure will be
(A) 1.8 dB **(B)** 16 dB
(C) –16 dB **(D)** 56 dB

d. For a modulating sinusoidal voltage with $E_m = 140V$, the AM wave has $E_{max} = 340V$. The modulation index is

(A) 0.5 **(B)** 0.8
(C) 0.6 **(D)** 0.7

e. By Carson's rule, the bandwidth of an FM signal (of modulating frequency f_m and maximum frequency deviation δ proportional to $E_m f_c$) is

(A) $2\delta + f_m$ **(B)** $2\delta + 2f_m$
(C) $\delta + 2f_m$ **(D)** $\delta + f_m$

f. The average information per message interval for M different and independent messages $m_1, m_2 \ldots$ with probabilities of occurrence $p_1, p_2 \ldots$ is given by

(A) $\sum_{k=1}^{M} \log_2 p_k$ **(B)** $\sum_{k=1}^{M} \log_2\left(\frac{1}{p_k}\right)$
(C) $\sum_{k=1}^{M} \frac{1}{p_k}\log_2 p_k$ **(D)** $\sum_{k=1}^{M} p_k \log_2\left(\frac{1}{p_k}\right)$

g. Distortion of modulation envelope and sideband overlap with adjacent channels are caused when modulation index m of AM is

(A) m > 1 **(B)** m < 1
(C) m = 1 **(D)** m = 0

h. Indicate the digital system of modulation

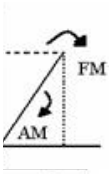
(A) PAM **(B)** PCM
(C) PFM **(D)** PWM

i. A sinusoid of amplitude A, frequency f has a maximum slope = $2\pi fA$ while passing through zero. To avoid slope-overload in linear delta modulation with step-size S, it must satisfy the condition

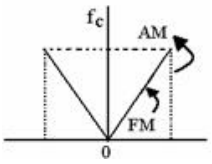
(A) $Sf_s \geq 2\pi fA$ **(B)** $\frac{Sf_s}{fA} \geq 2$

(C) $f_s \geq \frac{\pi fA}{S}$ **(D)** $f_s \geq 2\pi fAS$

j. The triangular noise distribution for FM, called the noise triangle, and the corresponding AM distribution are represented as



(A) **(B)**



(C) **(D)**

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

Q 2. a. Sketch an AM wave for m < 1 and draw its frequency spectrum. Show that total power $P_t = P_c\left(1+\frac{1}{2}m^2\right)$, where P_c is carrier power and m is modulation index. **(8)**

b. Consider an amplifier operating at $27^\circ C$ over the frequency range of 455 to 460 KHz, having a 200 KΩ input resistor. Find the rms noise voltage at the input of the amplifier. **(4)**

c. A receiver connected to an antenna of 50Ω has an equivalent noise resistance of 30Ω. Calculate the noise figure (dB) and the equivalent noise temperature of the receiver operating at $27^\circ C$. **(4)**

Q 3. a. List the advantages of FM over AM and of AM over FM for communication. **(8)**

b. For the FM wave: $e_{FM} = 6\sin\left(157\times10^6 t + 50\sin 12571.4t\right)$ V, what are the values of amplitude, carrier and modulating signal frequencies in Hz? Find the modulation index, maximum frequency deviation, and the power dissipated in a 10Ω resistor. **(8)**

Q 4. a. What are pre-emphasis and de-emphasis operations? Why are they used? Explain the function of a typical pre-emphasis circuit. Why de-emphasis must also be used? **(8)**

b. Suppose a carrier of angular frequency ω_c is amplitude modulated by a sinusoid of angular frequency ω_m to give a resultant waveform: $f_1(t) = A(1+m\cos\omega_m t)\cos\omega_c t$. If one of the sidebands is removed to give waveform $f_2(t)$, show that the

amplitude of $f_2(t)$ is given by: $A(t) \cong A\left(1+\frac{m}{2}\cos\omega_m t\right)$. **(8)**

Q5. a. Explain the difference between Natural Sampling and Flat-top Sampling, with illustrative waveforms. **(8)**

b. Explain the principle of Adaptive Delta Modulation. How does it differ from Linear Delta Modulation? **(8)**

Q6. Write short notes on:

(i) PCM **(6)**
(ii) PWM **(5)**
(iii) Moving target indicator **(5)**

Q7. Explain the following terms with respect to information theory

(i) Block-codes
(ii) Systematic codes
(iii) Hamming distance
(iv) Entropy **(4 x 4)**

Q8. a. With the help of a block-diagram, explain briefly the function of a pulsed radar. **(8)**

b. Consider a radar operating at 1.25 GHz using peak pulse power of 3MW to detect targets of $1m^2$ radar cross-section at a range of 185.2 km. Determine the smallest diameter D of the reflector antenna, if the minimum acceptable power by receiver is $2\times10^{-13}\,W$ and effective antenna area = $0.5\ D^2$. **(8)**

Q9. a. Explain the terms referred to in television:

(i) Compatibility in colour TV
(ii) Blanking pulse
(iii) Scanning
(iv) Synchronisation pulse **(8)**

b. An analog signal is band limited to B Hz, sampled at the Nyquist rate and the samples are quantised into 4 levels Q_1 to Q_4 (messages) assumed independent and occurring with probabilities $p_1 = p_4 = \frac{1}{8}$ and $p_2 = p_3 = \frac{3}{8}$. Find the information rate R of the source. If the four levels have equal probability of occurrence, will there be an improvement on R? **(8)**