JUNE 2008

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

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. In TV transmission, picture signal is amplitude modulated and sound signal is frequency modulated. This is done because

(A) It is not possible to frequency modulate the picture signal.
(B) Bandwidth requirement is minimised.
(C) Sound signal is more susceptible to noise than picture signal.
(D) Synchronization of picture frames becomes easier.

b. A Gaussian channel has a bandwidth of 1 MHz and signal power to noise power spectral density (S/N) is 10^5 Hz then the resultant channel capacity is

(A) 138 bits /sec **(B)** 10^6 bits/sec
(C) 138 k bits/sec **(D)** 10 bits/sec

c. If an audio signal of $x(t) = 5\cos 1000\,\pi t$ is quantized using 10 bit PCM, then the signal to quantization noise ratio is

(A) 2×10^5 **(B)** 50 dB
(C) 1.4×10^5 **(D)** 62 dB

d. The advantages of FM over AM are

1. A better noise performance
2. B.W. requirement is less
3. Carrier power is utilized efficiently
4. Less modulating power is required

(A) 1, 3, 4 **(B)** All
(C) 1, 2, 3 **(D)** 2, 3, 4

e. Indicate which of the following pulse modulation is analog

(A) DM **(B)** DPCM

(C) PCM **(D)** PWM

f. A certain transmitter radiates 9 KW of power with the carrier unmodulated and 10.125 KW of power when the carrier is sinusoidally modulated then the modulation index is given by

(A) 0.50 **(B)** 0.25
(C) 0.125 **(D)** 0.64

g. Aperture effect occurs in communication due to

(A) sampling at less than Nyquist rate
(B) Flat top sampling
(C) finite BW of transmission channel
(D) short duration of samples.

h. A base band signal has a spectral range that extends from 20 Hz to 82 KHz. Find the acceptable range of the sampling frequency

(A) $>40\text{Hz}, <82\text{KHz}$ **(B)** $40\text{Hz to } 82\text{KHz}$
(C) $\geq 164\text{KHz}$ **(D)** $\leq 164\text{KHz}$

i. A diode envelope detector has a load of $200\text{K}\Omega$ and a forward resistance of 150Ω. A 50% modulated wave gives an o/p of 1V rms. What is the DC output

(A) 2.83V **(B)** 8.89V
(C) $\frac{0.5}{\pi}\text{V}$ **(D)** $\sqrt{2}\pi\text{V}$

j. Pulse width modulation may be generated

(A) by differentiating PPM **(B)** with a monostable multi-vibrator
(C) by integrating the signal **(D)** with free running multi-vibrator

---

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

Q 2. a. Define noise figure and derive an expression for noise figure? **(8)**

b. The noise present at the input to a two-port network is $1\mu\text{w}$. The noise figure (F) is 0.5dB and receiver gain $(g_a) = 10^{10}$. Calculate
(i) The available noise power contributed by the two port network.
(ii) The noise power available at the output. **(8)**

Q 3. a. Explain the generation method of AM using square law modulator. Draw the spectrum at each stage? **(8)**

b. Define amplitude modulation? Derive an expression for the amplitude modulated wave when the carrier (e_c) is $E_c \sin \omega_c t$ and the modulating signal (e_m) is $E_m \sin \omega_m t$. Draw the amplitude modulated waves for
(i) m = 0% (ii) m = 100% and (iii) m = 200%. **(8)**

Q 4. a. Show that the wide band FM has infinite number of side bands? **(10)**

b. A carrier is frequency modulated by a sinusoidal modulating signal of frequency 2 KHz, resulting in a frequency deviation of 5 KHz. What is the bandwidth occupied by the modulated waveform? If the amplitude of the modulating sinusoid is increased by a factor of 3 and its frequency lowered to 1 KHz, then what is the new bandwidth? **(6)**

Q5. a. With the aid of neat phasor diagrams and circuit diagram, show that the Foster Seeley discriminator has better linearity than balanced slope detector? **(10)**

b. The power spectral density of a modulated signal m(t) is given by $G_m(f) = \dfrac{G_o}{1+\left(f/f_1\right)^2}$ where $f_1 << f_M$. If pre emphasis circuit is to be used, where $|H_P(f)|^2 = k^2 f^2$ then find k^2 when the pre-emphasis is not to increase the B.W. **(6)**

Q6. a. Define signal to noise ratio for a PCM system and derive an expression for signal to quantization noise ratio of PCM system? Explain how dynamic range can be improved in the PCM system? **(8)**

b. The signal $v(t) = \cos 5\pi t + 0.5 \cos 10\pi t$ is instantaneously sampled. The interval between samples is T_s.

(i) Find the Max allowable value for T_s.

(ii) If the sampling signal is $s(t) = 5 \sum_{k=-\infty}^{\infty} \delta(t - 0.1k)$, and the sampled signal $v_s(t) = v(t)\,s(t)$ consists of train of impulses, each with a different strength $v_s(t) = \sum_{k=-\infty}^{\infty} I_k \delta(t - 0.1k)$. Find I_0, I_1 and I_2.

(iii) To reconstruct the signal $v_s(t)$ is passed through a rectangular low-pass filter. Find the minimum filter B.W. to reconstruct the signal with out distortion.
(8)

Q7. a. Describe Adaptive Delta Modulation system with neat block diagram and waveform and explain

how slope overload error can be minimized in ADM? **(8)**

b. What is matched filter and derive impulse response of a matched filter when the input noise is white?
(8)

Q8. a. Define average information and information rate. **(4)**

b. Explain Shanon-Fano algorithm with an example. **(6)**

c. Consider five messages given by the probabilities $\{1/2, 1/4, 1/8, 1/16, 1/16\}$
(i) Calculate entropy.
(ii) Use Shanon-Fano algorithm to develop an efficient code and for that code, calculate average no. of bits/ message. **(6)**

Q9. a. Explain the generation of a block code from an uncoded word $\overline{A} = [a_1 a_2 \ldots\ldots a_k]$.
(8)

b. Derive the Radar range equation to determine the maximum range of a radar set. **(5)**

c. Calculate the max range of a deep-space radar operating at 2.5 GHz and using a peak pulse power of 25 MW. The antenna diameter is 64m, the target cross section $1m^2$ and , because a master amplifier is used, the receiver noise figure is only 1.1 dB. Further more, because of the low PRF to allow pulses to return from long distances, the receiver bandwidth is only 5KHz. **(3)**