Code: AE-15 **Subject: COMMUNICATION ENGINEERING**

JUNE 2007

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. Energy content of atmospheric noise varies as

(A) 1/f **(B)** f

(C) $1/f^2$ **(D)** f^2

b. The optimum time constant of an envelope detector of AM DSB FC is given by the relation

(A) $\frac{1}{RC} \le \frac{\omega_m m_a}{\sqrt{1-m_a^2}}$ **(B)** $\frac{1}{RC} \ge \frac{\omega_m m_a}{\sqrt{1-m_a^2}}$

(C) $RC \le \frac{\omega_m m_a}{\sqrt{1-m_a^2}}$ **(D)** $RC \ge \frac{\omega_m m_a}{\sqrt{1-m_a^2}}$

c. Inductive reactance FET using RC network behaves as an inductance of value

(A) CR **(B)** $g_m CR$

(C) CR/g_m **(D)** $1/(g_m CR)$

d. A signal at the input to a μ-law (μ=255) compressor is positive with its voltage one half the maximum value. What proportion of the maximum output voltage is produced.

(A) 0.576 V_o **(B)** 0.676 V_o

(C) 0.876 V_o **(D)** 0.976 V_o

e. A telephone line has a bandwidth 3.2 KHz and an SNR of 35 dB. A signal is transmitted down this line using a four level code. The maximum theoretical data rate is

(A) 12.8 Kbps **(B)** 37.2 Kbps

(C) 12.8 Mbps **(D)** 37.2 Mbps

f. How many Hamming bits are required for a block length of 21 message bit?

(A) 14 bits **(B)** 5 bits
(C) 6 bits **(D)** 2 bits

g. An FM detector produces a peak to peak output voltage of 1.2V from an FM signal that is modulated to 10 KHz deviation by a sinewave. The detector sensitivity is
(A) 60 μV/Hz **(B)** 120 μV/Hz
(C) 30 μV/Hz **(D)** 80μV/Hz

h. A tuned circuit tunes the AM radio broadcast band from 540 KHz to 1700 KHz. If its bandwidth at 10 KHz at 540 KHz, its bandwidth at 1700 KHz is
(A) 15.7 KHz **(B)** 16.7 KHz
(C) 17.7 KHz **(D)** 18.7 KHz

i. A typical low cost monochrome receiver has a video bandwidth of 3 MHz. Its horizontal resolution in lines is
(A) 240 lines **(B)** 337 lines
(C) 80 lines **(D)** 140 lines

j. If antenna diameter in a radar system is increased by a factor of 4, the maximum range will increase by
(A) $\sqrt{2}$ **(B)** 2
(C) 4 **(D)** 8

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

Q.2 a. What is the need for modulation in a Radio Transmission? Explain the modulation techniques:
(i) Amplitude Modulation
(ii) Frequency Modulation **(8)**

b. How do we detect/demodulate an AM signal. Explain by using a Diode detector. **(8)**

Q.3 a. Distinguish between NB FM and AM signals. **(4)**

b. Discuss the effect of modulation index(β) of FM bandwidth. Show the spectrum for small β and large fm and large β and small fm where fm is the modulating signal frequency. **(5)**

c Derive an expression for WBFM signal starting from first principles. **(7)**

Q.4 a. Show that the mean squared noise voltage of an RC circuit is given by KT/C. **(8)**

b. For an FM system, with baseband signal m(t), and the bandwidth of waveform given by:

$$B = 2\left[\int_{-\infty}^{\infty} v^2 G(v)dv \Big/ \int_{-\infty}^{\infty} G(v)dv\right]^{1/2}.$$

Show that the bandwidth is proportional to $C^2m^2(t)$, where C is a constant. **(8)**

Q.5 a. What is aperture effect distortion in flat topped sampling? How do you overcome this distortion? **(6)**

b. Explain continuously Variable slope delta modulator. **(6)**

c. The pulse rate in a DM system is 56 kbps. The input signal is $5\cos(2\pi 1000t) + 2\cos(2\pi 2000t)$. Find the minimum value of step size which will avoid slope overload distortion. What would be the disadvantage of choosing a value of larger than the minimum? **(4)**

Q.6 a. What is Quadrature Amplitude Shift keying? Explain with a constellation diagram. **(6)**

b Explain a QASK Generator and QASK receiver? What is the bandwidth of QASK signal? **(6)**

c. Compare the various digital carrier modulation techniques. **(4)**

Q.7 a. What is minimum Hamming distance? Distinguish between soft and hard decision decoding. Show that soft decision decoding can provide a 3dB coding gain compared to hard decision decoding. **(10)**

b. For a binary memoryless source with two symbols x_1 and x_2, Prove that H(x), the entropy is maximum when x_1 and x_2 are equiprobable. **(6)**

Q.8 a. Explain the need of coding. Explain in detail the Block Codes and their advantages. **(8)**

b. Derive the relationship between Bandwidth and SNR for a communication system. How does channel capacity vary when BW $\rightarrow \infty$ **(8)**

Q.9 Write explanatory notes on

(i) Radar Range equation
(ii) Color TV Receiver
(iii) FM Stereophonic broadcasting
(iv) Shannon's limit **(4x4)**