AMIETE – ET (OLD SCHEME)

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

DECEMBER 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: (2x10)

a. Noise figure of a receiver is 1.6. Its equivalent noise temperature will be

(A) 464 K **(B)** 174 K
(C) 160 K **(D)** 0.16 K

b. A broadcast radio transmitter radiates 10 kilowatt, when the modulation percentage is 60. The carrier power will be

(A) 8.47 kilowatt. **(B)** 6 kilowatt.
(C) 600 kilowatt. **(D)** 3.65 kilowatt.

c. The FM wave is represented by the voltage equation $u = 12\sin\left(6\times10^{8}t + 5\sin 1250\,t\right)$. The maximum deviation of the FM wave will be

(A) 60 Hz **(B)** 1250 Hz
(C) 6×10^{8} Hz **(D)** 995 Hz

d. A signal f(t) is band-limited to 4 KHz. The Nyquist rate for sampling of the signal $f(t)+2f^{3}(t)$ is given by

(A) 28 KHz **(B)** 8 KHz
(C) 24 KHz **(D)** 12 KHz

e. The channel capacity of a Gaussian channel of infinite band width is given by (where S is the signal power and $\eta/2$ is the PSD of white noise)

(A) ∞ bits/sec **(B)** $2.88\left(S/\eta\right)$ bits/sec
(C) $1.44\left(S/\eta\right)$ bits/sec **(D)** $\log_2\left(1+S/\eta\right)$ bits/sec

f. For a (n, k) Block code, the generator matrix dimension is given by

(A) $k\times n$ **(B)** $n\times k$
(C) $k\times k$ **(D)** $n\times n$

g. For a continuous wave RADAR with transmit frequency of 5 GHz, the Doppler frequency seen by a stationary radar when the target radial velocity is 100 Km/hour is

(A) 413 Hz **(B)** 463.5 Hz
(C) 927 Hz **(D)** 500 Hz

h. The pulse duration in a pulsed RADAR is 1μsec. The range resolution in this case is no better than

(A) 150 m **(B)** 3 Km
(C) 1.5 Km **(D)** 300 m

i. The value of $J_0^2(x)+2\sum_{n=1}^{\infty} J_n^2(x)$ is (where $J_n(x)$ is the Bessel function of nth order and first kind)

(A) 1 **(B)** $\frac{1}{2}$
(C) ∞ **(D)** 0

j. The Hilbert transform of a signal f(t) is given by

(A) $\frac{1}{2\pi}\int_{-\infty}^{\infty}\frac{f(\tau)}{(t-\tau)}d\tau$ **(B)** $\frac{1}{2\pi}\int_{-\pi}^{\pi} f(\tau)(t-\tau)d\tau$

(C) $\frac{1}{\pi}\int_{-\infty}^{\infty}\frac{f(\tau)}{(t-\tau)}d\tau$ **(D)** $\frac{1}{2\pi}\int_{-\pi}^{\pi}\frac{f(\tau)}{(t-\tau)}d\tau$

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

Q 2. a. Explain the working of Ring Modulator in detail. **(8)**

b. For tone modulation, determine the upper limit of RC time constant in an envelope detector. **(8)**

Q 3. a. An angle-modulated signal with carrier frequency $\omega_c = 2\pi\times10^5$ rad/s is described by the equation
$Y_{EM}(t) = 10\cos(\omega_c t + 5\sin 3000t + 10\sin 2000\pi t)$

(i) Find the frequency deviation Δf.
(ii) Find the deviation ratio β.
(iii) Find the phase deviation $\Delta\phi$.
(iv) Estimate the bandwidth of $Y_{EM}(t)$. **(8)**

b. Derive an expression for WBFM signal starting from first principle. Also draw its spectrum for modulation index $m_f = 2$. **(8)**

Q 4. a. Signals $g_1(t) = 10^4\,\text{rect}(10^4 t)$ and $g_2(t) = \delta(t)$ are applied as the inputs of an ideal low-pass filters $H_1(\omega) = \text{rect}(\omega/40{,}000\pi)$ and $H_2(\omega) = \text{rect}(\omega/20{,}000\pi)$

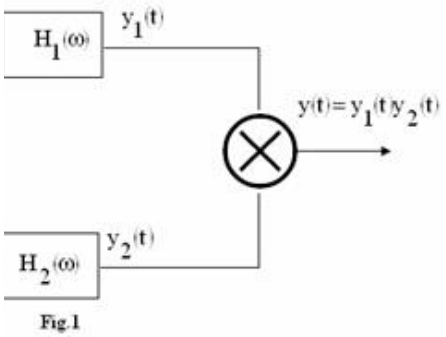

Fig.1

The output $y_1(t)$ and $y_2(t)$ of these filters as shown in Fig.1 are multiplied to obtain the signal $y(t) = y_1(t)y_2(t)$. Find the Nyquist rate of $y_1(t), y_2(t)$, and $y(t)$. **(10)**

b. Explain the difference between Natural sampling and Flat-top sampling. **(6)**

Q5. a. A zero-memory source emits messages m_1 and m_2 with probabilities 0.8 and 0.2 respectively. Find the Huffman binary code for this source as well as for its second order extension. Determine the code efficiencies in each case. **(8)**

b. For a (6, 3) code the generator matrix $\underline{G}$ is

$$\underline{G} = \begin{bmatrix} 100 & 101 \\ 010 & 011 \\ 001 & 110 \end{bmatrix}.$$

The receiver receives $\underline{r} = 100011$. Determine the corresponding data word if the channel is Binary symmetric channel and the maximum-likelihood decision is used. **(8)**

Q6. a. Derive the radar range equation and discuss the factors influencing maximum range. **(8)**

b. Draw block diagram of a monochrome television receiver and explain its working. **(8)**

Q7. a. Explain shot noise, thermal noise and white noise. **(6)**

b. Determine and plot the pdf of envelope of narrow band noise. **(6)**

c. A receiver connected to an antenna whose resistance is 50Ω has an equivalent noise resistance of 30Ω. Calculate the receiver's noise figure in dB and its equivalent noise temperature. **(4)**

Q8. a. Explain the companding in a PCM system. Also derive an expression for signal to quantization noise ratio in a PCM system. **(8)**

b. Write a short note on FM stereophonic broadcasting. **(8)**

Q9. Write a short notes on:

(i) Relationship between Bandwidth and SNR for a communication system. **(8)**
(ii) Need of modulation in a Radio transmission. **(4)**
(iii) Slope overload distortion in DM system. **(4)**