IMPORTANT QUESTIONS

Q.1. State and prove Shannon Hartley theorem and discuss bandwidth and S/N trade off

Q.2 Find the Fourier components of half rectified wave.

Q.3 Find Fourier Transform of $x(t) = e^{-at}. u(t)$ and plot its magnitude and phase spectrum

Q.4 Prove convolution theorem and Parseval's relation for energy signals.

Q.5 Describe in detail correlation, cross-correlation and autocorrelation.

Q.6 An analog signal having 4 kHz bandwidth is sampled at 1.5 times the nyquist rate and each sample is quantized into one of equally likely levels. Assume that the successive samples are statistically independent.

    I) What is information rate of this source?

    II) Can output of this source be transmitted without errors over an AWGN channel with a   bandwidth of 10 kHz and an S/N ratio of 20 dB?

    III) Find the S/N ratio required for error free transmission for 4 kHz bandwidth.

Q.7 Apply Huffman Coding for the system
$$[X]=[x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7]$$
$$[P]=[.4 \quad .2 \quad .12 \quad .08 \quad .08 \quad .08 \quad .04]$$
Also find Coding efficiency. [Assume binary coding scheme]

Q.8 Discuss in detail (I) Noisy channels (II) Effect of medium on information

Q.9 Joint probability density of two random variables X & Y is given by
$$F(x) = \{ \; c\,(x+2y) \qquad\qquad \text{when } x = 0, 1, 2 \quad y=1,2,3,4$$
$$0 \qquad\qquad\qquad\qquad \text{Otherwise}\}$$

Find
(a) value of c
(b) P (Y=3/X=2)
(c) P(X=0/Y=4)
(d) Marginal Probability density of X & Y

Q.10 State and prove Baye's theorem.

Q.11 The p.d.f. of a random variable X is given by, $f_X(x) = \begin{cases} \frac{1}{2\pi} & 0 \le x \le 2\pi \\ 0 & otherwise \end{cases}$

Find the mean value, mean square value, variance and standard deviation

Q.12 Explain the difference between optimum filter and matched filter. Find expression for impulse response of a matched filter.

Q.13 Write notes on (I) Central limit theorem (II) Cyclic codes

Q.14 Describe linear block codes with example.

Q.15 Describe linear filtering of random signals.

Q.16. Find the autocorrelation of a continuous time signal given by x(t)=A ract(t/2)

Q.17 What is Fourier Series? Derive relationship between trigonometric and exponential Fourier series coefficients. What are conditions for Fourier series to exist?

Q.18 In a factory five machines A1, A2, A3, A4 & A5 produce 10%, 15%, 20%, 25% & 30% of items respectively. The percentage of defective items produced by them is 5%, 4%, 3%, 2% & 1% respectively. An item is selected at random is found to be defective. What is probability that it was produced by machine A1?

Q.19 State and prove central limit theorem.

**Q.20** State and prove Baye's theorem.

Q.21 Consider Rayleigh function: $f(x) = \begin{cases} x.e^{-\frac{x^2}{2}}, & x \ge 0 \\ 0, & otherwise \end{cases}$

(i) Prove that *f(x)* is a density fuction
(ii) Find distribution function (c.d.f.) $F_X(x)$.
(iii) Find P(0.5<x<2)

Q.22 Show that for two statistically independent random variables g(x) and h(y),
$$E\{g(x).h(y)\}=E\{g(x)\}. E\{h(y)\}$$

Q.23 What is entropy? Show that entropy is maximum when all the messages are equi- probable for M=2

Q.24 A discrete source transmits messages x_1 , x_2 , x_3 with probabilities 0.4,0.3 and 0.4 The source is connected to the channel given in figure. Calculate all the associated entropies and mutual information. (12)
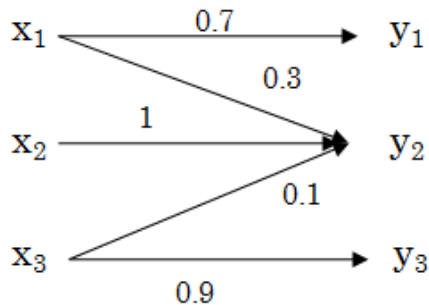
Q.25   a) If Fourier transform of   x(t) is X(ω). Then find Fourier transform (F.T.) of
$$y(t) = x(t) \, \cos(w_o t)$$
   b) Define autocorrelation.
   c) Define with suitable mathematical formulation (i) Entropy (ii) Rate of information (iii) Channel Capacity (iv) Coding efficiency (v) mutual information
   d) Explain significance of probability density function (p.d.f).
   e) Differentiate between probability of joint occurrence and conditional probability of two events.
   f) Define ergodic process in brief.
   g) Differentiate between time average and ensemble average.
   h) What is information and what are units of information?
   i) What are various properties of information?
   j) Define rate of information.
   k) What is the channel capacity of binary symmetric channel?
   l) What is random variable?
   m) State various properties of probability.
   n) State Cumulative distribution function and its properties.