

**ANALOG COMMUNICATION SYSTEMS**

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

**PART – A**

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Derive the expression for the percentage power saving in AM-SSB-SC with respect to AM-DSB-FC under Tone Modulation.

(b) A periodic symmetric square wave signal of period 2 Sec is defined as:

$$m(t) = \begin{cases} +1 & \text{for } 0 \leq t < 1 \text{ sec} \\ -1 & \text{for } 1 \text{ sec} \leq t < 2 \text{ sec} \end{cases}$$

It modulates a Carrier  $2\cos(2\pi \times 10^4 t)$  using AM-DSB-FC. Find the side band power of the resulting Modulating signal.(c) An FM signal  $x(t) = 5\cos[2\pi \times 10^6 t + 5\sin(2\pi \times 10^3 t)]$  is sent through a circuit whose  $output = (input)^2$ . Find the bandwidth of the output of the circuit.

(d) Explain why PM is not used for Broadcasting.

(e) Define the power spectral density of: (i) Band limited white noise. (ii) Band pass white noise.

(f) A Two port network with an available gain  $g_a(f)$  is driven by a noisy resistor. Find the expression for the available noise power at the output of the network.

(g) Explain why a PWM signal cannot be demodulated directly with an LPF, even though its magnitude spectrum resembles that of PAM signal.

(h) Find the Trigonometric Fourier series coefficient  $a_n$  of  $s(t) = \sum_k \delta(t - kT_s)$ .

(i) A discrete memory less source with entropy 2 bits/message is connected to a communication channel. If the conditional entropy of the source is 1 bit/message, find the rate at which the information is conveyed to the user if the message rate of the source is 500.

(j) Find the capacity of the channel whose noise matrix is a square matrix and having all the elements of the matrix same.

**PART – B**

(Answer all five units, 5 X 10 = 50 Marks)

**UNIT – I**2 (a) Derive the expression for the Modulation efficiency of the AM signal  $f(t) = A[1 + m \cdot x(t)]\cos\omega_c t$ , where 'm' is the Modulation index and 'x(t)' is the base band signal.

(b) Explain the Principle involved in generating AM-DSB-SC signal using Ring modulator.

(c) An AM modulator has an output given by  $x(t) = A\cos 400\pi t + B\cos 380\pi t + B\cos 420\pi t$ . The un-modulated carrier power is 100 watts and the Transmission efficiency of the AM signal is 40%. Find A and B.**OR**

3 (a) Explain the process of Modulation and Demodulation in QAM.

(b) A DSB SC Modulated signal  $X(t) = A \cdot m(t) \cdot \cos 2\pi f_c t$  is synchronously demodulated using a local carrier  $\cos(2\pi f_c t + \theta)$ . Find the maximum value of the ratio between the output power and input power of the Demodulator.

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**UNIT – II**

- 4 (a) Justify that one form of Angle modulation can be obtained from the other.  
 (b) Justify that the Angle modulation is a Non-linear modulation method.  
 (c) An Angle Modulated signal is given by  $X(t) = 10\cos[2\pi \cdot 10^6 t + 5 \sin(2\pi \cdot 10^3 t)]$ . Assuming it as PM signal, find the Modulation Index and Band width if: (i) Modulating signal frequency is doubled.  
 (ii) Modulating signal frequency is halved.

**OR**

- 5 (a) In an Armstrong Modulator, an NBFM signal with carrier frequency 200 KHz and frequency deviation 25 Hz is passed through a cascade of frequency multiplier 1 (Multiplication factor = 64), a mixer with one of the input as 10.8 MHz, Local Oscillator and another frequency multiplier 2 (Multiplication factor = 48). Find the frequency deviation and the carrier frequency of the signal at the output of the frequency multiplier 2.  
 (b) Derive Carson's rule for the Bandwidth of an FM signal.

**UNIT – III**

- 6 Verify that both AM-DSB-SC and AM-SSB-SC are of same noise performance.

**OR**

- 7 (a) Find the Noise bandwidth of an RC low pass filter and the relation with its 3dB bandwidth.  
 (b) An amplifier operating over the frequency range of 445 KHz to 460 KHz has a 200 Kohms input resistor. What is the r.m.s noise voltage at the input of the amplifier if the ambient temperature is 17°C?

**UNIT – IV**

- 8 (a) Explain about Aperture effect distortion.  
 (b) Explain the method of converting PPM signal into PWM signal.  
 (c) A baseband signal  $m(t)$  band limited to 10 KHz is sampled using Flat Top sampling. What is the maximum allowed width of the sample so that the signal can be recovered without any distortion?

**OR**

- 9 (a) Derive and plot the Magnitude spectrum of PWM signal.  
 (b) Explain the principle of signal recovery through Holding.

**UNIT – V**

- 10 (a) Derive the expression for the capacity of a BSC.  
 (b) A memory less source has the alphabet  $\{-5, -3, -1, 0, 1, 3, 5\}$  with corresponding probabilities  $\{0.05, 0.1, 0.1, 0.15, 0.05, 0.25, 0.3\}$ . If the source is quantized according to the quantization rule  $Q(-5) = Q(-3) = -4$ ;  $Q(-1) = Q(0) = Q(1) = 0$ ;  $Q(3) = Q(5) = 4$ , find the entropy of the quantized source.

**OR**

- 11 (a) Derive Hartley-Shannon's Law.  
 (b) An analog signal is band limited to 4 KHz and is sampled at its Nyquist rate. The samples are quantized into 4 levels. Find the information rate of the source if (i) The probability of occurrence of the inner two levels are three times that of the extreme two levels. (ii) All the levels are equally likely.

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