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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3085 Roll No.

B.Tech

(SEM V) ODD SEMESTER THEORY EXAMINATION 2009-10

PRINCIPLES OF COMMUNICATION

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt all questions.*

1 Attempt any **four** parts of the following : **5×4=20**

(a) Consider a system with input $x(t)$ and output $y(t)$ given by

$$y(t) = x(t) \sum_{n=-\infty}^{\infty} \delta(t - nT) = x(t)\,\delta_T(t)$$

where $\delta_T(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$:

(i) Is this system linear ?

(ii) Is this system time-invariant ?

(b) Explain the difference in the following :

(i) Linear and nonlinear systems

(ii) Time - invariant and time-varying system.

(iii) Causal and non-causal systems.

(c) Show that unit impulse response of an ideal low pass filter is non-causal.

(d) What do you mean by power signals ? Find the power of the following signals :

(i) $x(t) = A\cos\omega_0 t$

(ii) $x(t) = a + f(t)$, where a is constant and $f(t)$ is a power signal with zero mean value.

(e) Explain the following :

(i) Base - band signal

(ii) Pass - band signal

(iii) Modulation and Demodulation

(iv) Analog and Digital communication.

(f) State the sampling theorem and explain. How will you recover the signal from its samples ?

2 Attempt any **two** parts of the following : **10×2=20**

(a) A multiple-tone modulating signal $f(t)$, consisting of three frequency components, is given by

$$f(t) = E_1\cos\omega_1 t + E_2\cos\omega_2 t + E_3\cos\omega_3 t$$

where $\omega_3 > \omega_2 > \omega_1$ and $E_1 > E_2 > E_3$ the signal $f(t)$ modulates a carrier $e_C = E_C\cos\omega_C t$

(i) Derive an expression for AM wave

(ii) Draw a single - sided spectrum, and find the bandwidth of the AM wave.

(b) A carrier $A\cos\omega_C t$ is modulated by a single–tone modulating signal

$$f(t) = E_m\cos\omega_m t.$$

Find :

(i) Total modulated power

(ii) Root mean square value of the modulated signal, and

(iii) Transmission efficiency for a 100% modulation.

(c) Prove that the balanced modulator produces an output consisting of side bands only, with the carrier removed. What applications can this circuit have ?

3 Attempt any **two** parts of the following : 2×10=20

(a) (i) Explain spike generation and threshold effect in FM.

(ii) The maximum deviation allowed in an FM broadcast system is 75 kHz. If the modulating signal is a single–tone sinusoid of 10 kHz, find the bandwidth of the FM signal. What will be the change in the bandwidth, if modulating frequency is doubled ? Determine the bandwidth when modulating signals amplitude is also doubled.

(b) What is frequency division multiplexing system ? Determine the instantaneous frequency in hertz of the following single :

(i) $10\cos\left(200\pi t + \pi/3\right)$

(ii) $10\cos\left(20\pi t + \pi t^2\right)$

(iii) $\cos 200\pi t \cos\left(5\sin 2\pi t\right)$

$+\sin 200\,\pi t \cdot \sin\left(5\sin 2\pi t\right)$

(c) Write short notes on the following :

(i) Multiple frequency and square wave modulation

(ii) Linear and non linear modulation

(iii) Narrow band and wide band FM

(iv) Demodulation of FM signals.

4 Attempt any **two** parts the following : 10×2=20

(a) Define Noise figure. How to calculate the noise figure for a receiver ? A receiver connected to an antenna whose resistance is $50\,\Omega$ has an equivalent noise resistance of $30\,\Omega$. Calculate the receiver's noise figure in decibels and its equivalent noise temperature.

(b) (i) Explain narrow band noise in communication system

(ii) The first stage of a two-stage r.f. amplifier has an output resistance of $20\,k\Omega$ and a voltage gain of 10. The input resistance, and the noise resistance is $500\,\Omega$ and $2\,k\Omega$, respectively. The second stage has an output resistance of $400\,k\Omega$, a voltage gain of 20, an input resistance of $80\,k\Omega$ and noise resistance of $10\,k\Omega$. Compute equivalent noise resistance of the two-stage amplifier and its noise-figure. The amplifier is driven by a generator whose output impedance is $40\,\Omega$.

(c) Show that, for an RC low pass filter the noise band width B_N and system bandwidth B_{3dB} are related as

$$B_N = \frac{\pi}{2} B_{3dB}$$

5 Attempt any **two** parts of the following : **10×2=20**

(a) (i) Write a short note on the efficiency of PCM systems.

(ii) An event has six possible outcomes with the probabilities

$p_1 = 1/2$, $p_2 = 1/4$, $p_3 = 1/8$, $p_4 = 1/16$,

$p_5 = 1/32$, $p_6 = 1/32$. Find the entropy of the system. Also find the rate of information if there are 16 outcomes per second.

(b) Explain Shannon-Hartley theorem for the capacity of a Gaussian channel. A Gaussian channel has 1 MHz bandwidth. Calculate the channel capacity if the signal power to noise spectral density ratio $\left(s/n\right)$ is 10^5 *Hz*. Also find the maximum information rate.

(c) (i) What do you mean by coded and un-coded systems ?

(ii) Evaluate output signal to noise ratio $\left(S_0/N_0\right)$ of FM and AM, and show that FM behaves as AM for modulation index $m_f \leq 1/2$.