



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

PAPER ID : 3085

Roll No.

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

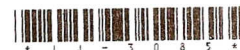
- (i) Is this system linear ?
(ii) Is this system time-invariant ?



- (b) Explain the difference in the following :
- Linear and non-linear systems
 - Time - invariant and time-varying system.
 - 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 :
- $x(t) = A \cos \omega_0 t$
 - $x(t) = a + f(t)$, where a is constant and $f(t)$ is a power signal with zero mean value.
- (e) Explain the following :
- Base - band signal
 - Pass - band signal
 - Modulation and Demodulation
 - 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 $e_C = E_C \cos \omega_C t$
- Derive an expression for AM wave
 - 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 :
- Total modulated power
 - Root mean square value of the modulated signal, and
 - 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 : $2 \times 10 = 20$

- (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) $10 \cos\left(200\pi t + \frac{\pi}{3}\right)$

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

(iii) $\cos 200\pi t \cos(5 \sin 2\pi t)$
 $+ \sin 200 \pi t \cdot \sin(5 \sin 2\pi t)$

(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 : $10 \times 2 = 20$

- (a) Define Noise figure. How to calculate the noise figure for a receiver? A receiver connected to an antenna whose resistance is 50Ω has an equivalent noise resistance of 30Ω . 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 500Ω 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 40Ω .

- (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 : $10 \times 2 = 20$

- (a) (i) Write a short note on the efficiency of PCM systems.
- (ii) An event has six possible outcomes with the probabilities

$$p_1 = \frac{1}{2}, p_2 = \frac{1}{4}, p_3 = \frac{1}{8}, p_4 = \frac{1}{16},$$

$p_5 = \frac{1}{32}, p_6 = \frac{1}{32}$. 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 $\left(\frac{s}{n}\right)$ 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

$\left(\frac{S_0}{N_0}\right)$ of FM and AM, and show that

FM behaves as AM for modulation

index $m_f \leq \frac{1}{2}$.