

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

PAPER ID : 3006

Roll No.

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B.Tech.

FIFTH SEMESTER EXAMINATION, 2005-2006

ANALOG COMMUNICATION SYSTEMS

Time : 2 Hours

Total Marks : 50

- Note :** (i) Answer **ALL** questions.
(ii) All questions carry equal marks.
(iii) Be precise in your answer.

1. Attempt **any four** of the following questions : **4x3=12**
- What are the main elements of the communication system? Explain function of each element and sketch the block diagram of the communication system.
 - Explain the Information capacity theorem in communication process.
 - Write the definition of :
 - Frequency division multiplexing (FDM)
 - Band limited and power limited channels
 - Deterministic and Random signals.
 - Explain the difference between white noise and color noise. Sketch the autocorrelation function and power density spectrum for white noise. If white noise is passed through a filter having transfer function $H(w)$ then what type of noise will be at the output of this filter ?

- (e) Derive the expression for noise band width and establish the relation between noise bandwidth and 3-dB band-width.
- (f) Explain thermal noise and shot noise. State the central limit theorem for thermal noise.

2. Attempt *any four* of the following questions : $4 \times 3 = 12$

- (a) Explain the working of balanced modulator for generating AM wave, with circuit diagram.
- (b) Explain the concept of 'Hetrodyming'. What is the advantage of Hetrodyming ? Draw the block diagram of super hetrodyne AM receiver.
- (c) Derive the relation between output power of an AM transmitter and the depth of the modulation. A 500-Watt carrier is modulated to a depth of 75 percent. Calculate the total power in the modulated wave.
- (d) If base band signal $m(t) = \cos 1000t$. then (i) Sketch the spectrum of $m(t)$ (ii) Sketch the spectrum of DSB-SC signal $m(t) \cos 10,000 t$ (iii) Identify the upper side band (USB) and the lower side band (LSB) spectra.
- (e) An amplitude modulated amplifier has a radio frequency output of 50 watts at 100% modulation. The internal loss in modulator is 10 watt.
 - (i) What is the un modulated carrier power ?
 - (ii) What power is required from the modulator (base band signal) ?
 - (iii) If the percentage modulation is reduced to 75%, how much power output is needed from the modulator (base band signal) ?
- (f) In a radio receiver used in AM system, the mixer translates the carrier frequency f_c to a fixed IF of 455 KHz using a local oscillator of frequency f_{LO} . The

broad cast-band frequencies range from 540 to 1600 KHz. Determine the range of tuning that must be provided in the local oscillator.

- (i) When $f_{LO} > f_C$ and
- (ii) When $f_{LO} < f_C$.

3. Attempt *any two* of the following questions : **6x2=12**

- (a) An FM signal with a frequency deviation of 10KHz at a modulation frequency of 5KHz is applied to two frequency multipliers connected in cascade. The first multiplier doubles the frequency and the second triples the frequency. Determine the frequency deviation and the modulation index of the FM signal obtained at the second multiplier output. What is the frequency separation of the adjacent side frequencies of this FM signal.

Explain the Carson's rule for bandwidth.

- (b) The FM signal $S(t) = A_c \cos[2\pi f_{ct} + 2\pi k_f \int_0^t m(\tau) d\tau]$

is input to the following circuit which consists of a high-pass RC filter and an envelope detector. Assume that R is small compared with the reactance of C for all significant frequency components of s(t) and the envelope detector doesnot load the filter. Determine the resulting signal at the envelope detector output assuming that $K_f |m(t)| < f_c$ for all t. What is the function of Band pass limiter ?

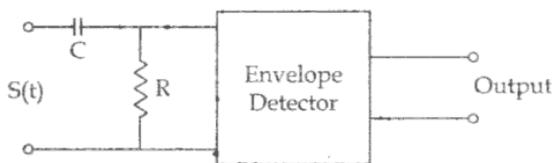


figure 3 (b)

- (c) An angle - modulated signal with carrier frequency $W_c = 2\pi \times 10^5$ is described by the equation $\phi_{EM}(t) = 10 \cdot \cos (w_c t + 5 \sin 3000\pi t + 10 \sin 2000\pi t)$
- Find the power of modulated signal
 - Find the frequency deviation
 - Find the deviation ratio
 - Find the phase deviation
 - Estimate the band width of $\phi_{EM}(t)$.

4. Attempt *any two* of the following questions : $7 \times 2 = 14$

- Explain the necessity of preemphasis and deemphasis in FM transmission.
 - Explain capture and threshold effect in FM
- Consider an analog base band communication system with additive white noise. The transmission channel is assumed to be distortionless and the power spectral density of white noise is 10^{-9} watts per hertz. The signal to be transmitted is an audio signal with 4KHz band width. At the receiver end, an RC low pass filter with 3-dB band width of 8KHz is used to limit the noise power at the output. Calculate the output noise power.
- A single-tone modulating signal $E_m \cos w_m t$, frequency modulates a carrier $A \cos w_c t$. Show that
 - The Figure of merit γ is given by

$$\gamma_{FM} = \left(\frac{3}{2}\right) m_f^2,$$

Where m_f is the modulation index.

- Show that FM behaves as AM for $m_f \leq 0.5$

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