



AUTUMN END SEMESTER EXAMINATION-2024

3rd Semester B.Tech

COMMUNICATION ENGINEERING

EC20008

(For 2024 (L.E), 2023 & Previous Admitted Batches)

Time: 2 Hours 30 Minutes

Full Marks: 50

Answer any SIX questions.

Question paper consists of four SECTIONS i.e. A, B, C and D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

- (a) Define the signal $\text{Sinc}(x)$ and draw its waveform.
- (b) Write the expression of Gaussian PDF and draw its diagram.
- (c) If the Fourier transform of a rectangular function, $A \text{ rect}(t/T) \leftrightarrow AT \text{ sinc}(f t)$, then write the Fourier Transform of $A \text{ rect}(t-T)/T$.
- (d) Define modulation and mention the types of modulation.
- (e) State the relationship between in FM and PM.
- (f) Consider a signal $x(t) = 4\cos(350\pi t) + 10\cos(600\pi t)$ is uniformly sampled for digital transmission. What should be the maximum allowable time interval between sample values that will ensure perfect signal reproduction?

- (g) Represent the data stream 11010 in the following line coding format
 - (i) Unipolar NRZ (ii) Bipolar RZ(AMI- RZ)
- (h) State the functions of source encoder and channel encoder in a digital communication system.
- (i) What is a Modem? State its application.
- (j) State the principle of optical fiber communication.

SECTION-B

2. (a) Draw and explain the block diagram of communication system. [4]

What is modulation? Discuss any two needs of modulation.

- (b) A message signal $m(t)$ and carrier signal $c(t) = A_c \cos 2\pi f_c t$ are applied to a square law modulator to generate an AM signal. Draw a diagram and evaluate an expression for the AM signal using this method. [4]

3. (a) For DSBSC modulation, explain the following with neat diagrams: [4]

- (i) Phase Error in coherent detection
- (ii) Balanced Modulator.

- (b) The probability density function of a random variable Y is $f_Y(y) = y / 9, 3 \leq y \leq 4$. Determine the values of $P(Y \leq 4)$, mean, mean square and variance of the random variable Y . [4]

SECTION-C

4. (a) Draw and explain the block diagram of AM superheterodyne receiver. [4]

A superheterodyne receiver has radio frequency(RF) tuned to 560 kHz . The intermediate frequency is 455

kHz. Find the local oscillator frequency and Image frequency.

- (b) Discuss the generation and detection of PAM signal with proper diagrams and waveforms. Mention types of PAM. [4]

5. (a) (i) Derive the time domain equations of a NBFM signal. [4]
(ii) Sketch the frequency spectrum and compare with AM spectrum.
(iii) Draw a modulator diagram for NBFM.

- (b) An NBFM signal is expressed as [4]

$$S_{FM}(t) = 4\cos[2\pi 10^5 t + 0.004 \sin 2\pi 10^2 t]$$

- (i) Find the instantaneous frequency.
(ii) The above NBFM signal is used in an Armstrong FM transmitter to generate a WBFM signal having a carrier frequency of 85 MHz and a peak frequency deviation of 75kHz. The frequency provided to the mixer is 5MHz.

Draw the block diagram and find the required values of frequency multipliers.

6. (a) State and prove sampling theorem for low pass signals with proper equations and diagrams. [4]

When does aliasing effect occur?

- (b) (i) What is uniform quantisation in PCM? [4]

(ii) A sinusoidal input signal with amplitude range $-m_p$ to $+m_p$ volts and band limited to 5kHz is transmitted through a PCM channel. Given the sampling rate is five times the Nyquist rate and the maximum quantization error is 0.1% of the peak signal amplitude. Determine

- (i) Code-word length

- (ii) Final bitrate.
- (iii) Output signal to quantization noise ratio.

SECTION-D

7. (a) State the principle of FDM and draw an FDM system. [4]

Three signals each band-limited to 2, 4 and 6 kHz are transmitted through an FDM channel simultaneously. The modulators used are AM, SSB and VSB respectively. Determine the minimum bandwidth of FDM channel assuming a guard band of 0.4 kHz and vestige bandwidth of 0.2 kHz.

- (b) Message bits 0 and 1 are to be transmitted using BPSK modulation technique. [4]

(i) Write the mathematical expressions.

(ii) Sketch the signal space diagram.

(iii) Draw the modulator and demodulator block diagrams.

(iv) Sketch the waveforms for bits 10110.

8. (a) Using Kepler's laws of planetary motion, discuss the principle of Satellite communication. Sketch the block diagram of a satellite communication system. Analyse why uplink frequency is higher than downlink frequency. [4]

- (b) (i) Mention the types of optical fibers. [4]

(ii) A multimode step-index fiber has glass core($n_1 = 1.6$) and fused quartz cladding($n_2 = 1.56$). Compute,

(i) Critical angle

(ii) Acceptance angle

(iii) Numerical aperture
