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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2025 - 2026)

Subject: Analog and Digital Communication

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

(1.1) Frequency range of voice signal is(CO1,K2)

1

(a) 0 - 4.5MHz

(b) 20Hz - 20kHz

(c) 300Hz - 3.5kHz

(d) Either 'a' or 'b'

(1.2) Guard bands are provided in FM signal to:(CO1,K2)

1

(a) to increase the noise

(b) to increase bandwidth

(c) prevent interference from adjacent signals

(d) none of the above

(1.3) Which of the following has least noise immunity?(CO2,K2)

1

(a) QAM

(b) ASK

(c) FSK

(d) PSK

(1.4) is mostly preferred for telegraphy(CO2,K2)

1

(a) single tone modulation

(b) On-off keying

(c) Frequency shift keying

(d) pulse code modulation

(1.5) DSSS system spreads the baseband signal by _____ the baseband pulses with a

1

pseudo noise sequence. (CO3,K2)

- (a) Adding
 - (b) Subtracting
 - (c) Multiplying
 - (d) Dividing
- (1.6) Spread spectrum has immunity from(CO3,K2) 1
- (a) Noise
 - (b) Multi-path distortion
 - (c) Noise & Multi-path distortion
 - (d) None of the mentioned
- (1.7) According to shannon's law, maximum information rate (R) and channel capacity are related as:(CO4,K2) 1
- (a) $R = C$
 - (b) $R \geq C$
 - (c) $R \leq C$
 - (d) $R > C$
- (1.8) What is the maximum entropy possible for a given message?(CO4,K2) 1
- (a) Depends on the message
 - (b) 1
 - (c) Infinity
 - (d) 0
- (1.9) In Viterbi's algorithm, the selected paths are regarded as _____ (CO5,K2) 1
- (a) Survivors
 - (b) Defenders
 - (c) Destroyers
 - (d) Carriers
- (1.10) The divisor in a cyclic code is normally called the (CO5,K2) 1
- (a) degree
 - (b) generator
 - (c) redundancy
 - (d) None of the mentioned

2. Attempt all parts:-

- (2.1) Define Figure of Merit.(CO1,K1) 2
- (2.2) What do you mean by differential Phase shift Keying?(CO2,K2) 2
- (2.3) What do you mean by BER? (CO3, K2) 2
- (2.4) What is the relation between information and probability? (CO4,K1) 2
- (2.5) What do you mean by generator matrix? (CO5,K2) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) A 107.6 MHz carrier signal is frequency modulated by a 7kHz sine wave . The 6

resultant FM signal has a frequency deviation of 50 kHz. Determine the modulation index and the carrier swing of the FM wave.(CO1,K2)

- (3.2) For the FM signal $m(t) = 10 \cos [2\pi (10^6) t + 5 \sin 2\pi (10^3) t]$. Find the (i) modulation index (ii) modulating frequency (iii) carrier frequency (iv) amplitude of carrier.)(CO1,K2) 6

Answer any one of the following:-

- (3.3) What do you mean by polar and unipolar line coding techniques?(CO2,K2) 6
- (3.4) Explain the generation of a FSK with the help of waveform and block diagram. (CO2,K2) 6

Answer any one of the following:-

- (3.5) Define processing gain or spreading factor and write down the difference between fast hopping and slow hopping.(CO3,K1) 6
- (3.6) Elaborate spread spectrum techniques and its type in details.(CO3,K2) 6

Answer any one of the following:-

- (3.7) Given an AWGN channel with 8 kHz bandwidth and the noise power spectral density is 10^{-12} W/Hz. The signal power required at the receiver is 0.1mW. Calculate the capacity of this channel. (CO4,K3) 6
- (3.8) A discrete memory less source X has four symbols x_1, x_2, x_3 and x_4 , with probabilities $P(x_1) = 0.4, P(x_2) = 0.2, P(x_3) = 0.2, P(x_4) = 0.2$. Calculate entropy.(CO4,K3) 6

Answer any one of the following:-

- (3.9) For a (6, 3) block code, the generator matrix G is given by: 6

$$G = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

- i. Realize an encoder for this code
- ii. Verify that this code is a single-error correcting code
- iii. If the received codeword is 100011, find the syndrome(CO5,K2)

- (3.10) Explain syndrome decoding for linear block codes in detail. (CO5,K2) 6

SECTION-C 50

4. Answer any one of the following:-

- (4.1) Explain Frequency Division Multiplexing using block diagram. (CO1, K2) 10
- (4.2) An AM signal in which the carrier is modulated upto 70%, contains 1500W at the carrier frequency. Determine the power content of the upper and lower sidebands for this percentage of modulation. Calculate the power at the carrier and the power content of each of the sidebands when the percentage modulation drops to 50%. (CO1,K3) 10

5. Answer any one of the following:-

- (5.1) How QPSK is better than BPSK system? Explain the block diagram of QPSK generator.(CO2,K2) 10
- (5.2) Find the Nyquist rate and the Nyquist interval for the signal $x(t) = \frac{1}{2} \pi \cos(4000 \pi t) \cos(1000 \pi t)$. (CO2,K2) 10

6. Answer any one of the following:-

- (6.1) What is the concept of Matched Filter ? Calculate the probability of error for the matched filter. (CO3,K1) 10
- (6.2) What is Frequency Hopping? Explain the different types of frequency hopping with necessary diagrams. (CO3,K1) 10
7. Answer any one of the following:-
- (7.1) Write note on following: a) Kraft's inequality, b) Code efficiency, c) Codeword d) Shannon's code. (CO4, K2) 10
- (7.2) A discrete memoryless source has five symbols x_1, x_2, x_3, x_4 and x_5 with probabilities $p(x_1) = 0.4, p(x_2)=0.19, p(x_3)=0.16, p(x_4)=0.15$ and $p(x_5)=0.1$. Construct the Shannon-Fano code and calculate the coding efficiency.(CO4,K3) 10
8. Answer any one of the following:-
- (8.1) For the message 10110, design convolutional code tree. (CO5,K3) 10
- (8.2) For a (6, 3) systematic linear block code, the three parity-check bits C_4, C_5 , and C_6 are formed from the following equations:
 $C_4 = d_1 \oplus d_3$
 $C_5 = d_1 \oplus d_2 \oplus d_3$
 $C_6 = d_1 \oplus d_2$
 (i) Write down the Generator matrix. , (ii) Construct all possible code words.
 (iii) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits.(CO5,K6) 10