Printed Page:- 04 **Subject Code:- AEC0401**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2023- 20.24

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-a. The function of multiplexing is (CO1) 1

(a) to reduce the bandwidth of the signal to be transmitted

(b) to combine multiple data streams over a single data channel

(c) to allow multiple data streams over multiple channels in a prescribed format

(d) to match the frequencies of the signal at the transmitter as well as the receiver

1-b. The Bandwidth of Amplitude Modulation is ___ (CO1) 1

(a) f_m

(b) $f_m/2$

(c) $f_m/4$

(d) $2f_m$

1-c. Phase shift in QPSK is (CO2) 1

(a) 90^0

(b) 180^0

(c) 45^0

(d) 0^0

1-d. Aliasing error occur when: (CO2) 1

(a) $f_s > 2f_m$

(b) $fs < 2f_m$

(c) $f_s = 2f_m$

(d) none

1-e. Which of the following gives the least probability of error? (CO3) 1

(a) In Amplitude Shift Keying
(b) In Frequency Shift Keying
(c) In Phase Shift Keying
(d) In Differential Phase Shift Keying

1-f. DSSS system spreads the baseband signal by _____ the baseband pulses with a pseudo noise sequence. (CO3) 1

(a) Adding
(b) Subtracting
(c) Multiplying
(d) Dividing

1-g. The units of entropy is ..... (CO4) 1

(a) bits/second
(b) bits/message
(c) message/second
(d) symbol/second

1-h. A source produces three symbols A, B and C with probabilities, P(A) = ½, P(B) = ¼ and P(C) = ¼. The source entropy is (CO4) 1

(a) ½ bit/symbol
(b) 1 ¼ bits/symbol
(c) 1 bit/symbol
(d) 1 ½ bits/symbol

1-i. The…….of errors is more difficult than the…….. (CO5) 1

(a) correction, detection
(b) detection,correction
(c) creation, correction
(d) creation, detection

1-j. The……..between two words is the number of differences between corresponding bits. (CO5) 1

(a) Hamming code
(b) Hamming distance
(c) Hamming rule
(d) None of the mentioned

2. Attempt all parts:-

2.a. How can we generate FM from PM and vice-versa? (CO1) 2

2.b. What is Amplitude Shift Keying? (CO2) 2

2.c. Define Noise. (CO3) 2

2.d.	What is Entropy? (CO4)	2
2.e.	Calculate Hamming Weight of codeword C = 0110000. (CO5)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	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)	6
3-b.	Derive an expression of single -tone AM signal, sketch the spectrum, define Modulation Index and derive expression for BW. (CO1)	6
3-c.	What is Pulse Code Modulation technique? Explain the Bandwidth requirements in PCM. (CO2)	6
3-d.	What is NRZ and RZ encoding techniques? Explain by drawing the waveforms. (CO2)	6
3.e.	Explain the concept of Direct Sequence Spread Spectrum. (CO3)	6
3.f.	Explain Shannon – Hartley theorem of channel capacity. Show that the channel capacity of an ideal AWGN channel with infinite bandwidth is given by $C_\infty = 1.44S/No$ b/s. (CO4)	6
3.g.	Explain syndrome decoding for linear block codes in detail. (CO5)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	What do you understand by AM? Explain with proper diagram, waveform and expressions. (CO1)	10
4-b.	A sinusoidal carrier of 20V, 2 MHz is frequency modulated by a sinusoidal message signal of 5V, 25 KHz with kf = 50 KHz/volt. Find; i) Δf, β, BW, and power. ii) Repeat the above if message signal amplitude is doubled. (CO1)	10

5. Answer any one of the following:-

5-a.	Define Time Division Multiplexing, how it is different from FDM-Frequency Division Multiplexing? (CO2)	10
5-b.	Find the Nyquist rate and the Nyquist interval for the signal x(t) = $1/2\pi$ cos(4000πt) cos(1000πt). (CO2)	10

6. Answer any one of the following:-

6-a.	What is the concept of Matched Filter ? Calculate the probability of error for the matched filter. (CO3)	10
6-b.	What is Frequency Hopping? Explain the different types of frequency hopping with necessary diagrams. (CO3)	10

7. Answer any one of the following:-

7-a.	A discrete memoryless source has five symbols x1, x2, x3, x4 and x5 with probabilities p(x1) = 0.4, p(x2)=0.19, p(x3)=0.16, p(x4)=0.14 and p(x5)=0.11. Construct the Shannon-Fano code for this source. Calculate the average code	10

length and coding efficiency of the source. (CO4)

7-b. Explain AWGN. Given an AWGN channel with 8kHz bandwidth and the noise power spectral density is 10^-24 W/Hz. The signal power required at the receiver is 0.1mW. Calculate the capacity of this channel. (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. The generator matrix for a (6, 3) block code is given below. Find all the code vectors of this code. (CO5) 10

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

8-b. For the message 10110, design convolutional code tree.(CO5) 10