Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Principles of Communication System **Semester: III**

Program: B. Tech Electronics and Computer Engineering **Time : 03 hrs.**

Course Code: ECEG 2049 **Max. Marks: 100**

Instructions: Answer all the questions.
The diagram must be neat and clean.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	A 4-bit input message **(1001)** is fed into a linear block coder. Find the **output** code, if the **H matrix** of linear block code is given as $H = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$	**4**	**CO2**
Q 2	A **convolution** coder is made up of 3 shift registers and has the following condition for the output code. $S_1 = M_1+M_3$, $S_2 = M_2+M_3+M_4$, and $S_3 = M_1+M_2$. Determine the **output** code when the input to this is **1101.**	**4**	**CO2**
Q 3	**Frequency modulation** is employed to transmit a music signal. Illustrate the **block diagram** depicting how the signal can be **received**.	**4**	**CO2**
Q 4	Create a **block diagram** that represents a modem utilizing the **BFSK** (Binary Frequency Shift Keying) technique.	**4**	**CO1**
Q 5	Find the **Fourier** transform of a **pulse signal**. Sketch the two waveforms.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	The generator polynomial of a **cyclic code** is $G(x) = x^3 + x + 1$. Determine the **code** of these input messages using **systematic cyclic code**. (a) 1111 (b) 1001 (c) 0010 (d) 1101	**10**	**CO2**
Q 7	What is the **bandwidth** of the **base** (unmodulated) message of a **TV** signal? Determine the necessary bandwidth required for this signal to be **modulated** under the following three conditions.	**10**	**CO3**

	(a) **Doble Side Band** Amplitude Modulation with a modulation index of 0.5 (b) **Vestige Side Band** Amplitude Modulation with a modulation index of 1. (c) **Frequency Modulation** with a modulation index of **4**.		
Q 8	Discuss the **selection** of **digital modulation** methods for transmitting signals over the **air** between transmitter and receiver. Enumerate the **various categories** of digital modulation techniques and provide a technical comparison between them.	**10**	**CO3**
Q 9	Define **Nyquist** sampling rate. When a message reaches its **maximum frequency** of f_m and is **sampled** at a rate of f_s, analyze the implications under three distinct conditions using a well-defined frequency domain illustration. (a) $f_s = 2 f_m$ (b) $f_s < 2 f_m$ (c) $f_s \geq 2 f_m$	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	A music signal is represented as m(t) = (2 Cos 100πt + 5 Cos 200πt +2 Cos 400πt + 3 Cos 500πt + 2 Cos 600πt). If this signal is converted into a stream of 0 and 1, with the help of an ideal sampling and a quantizer of 2048 levels. The incoming bits are then transmitted using wireless communication to another station. The modulation employed is that class of phase shift keying in which 4 bits are joined together to make a symbol. Then determine the following. (a) Number of bits coming out in 10 mins from a binary coder that follows the quantizer? (b) Bit rate of the Modem (c) Symbol rate of the Modem (d) Minimum bandwidth required to transmit the signal. (e) Capacity of the line between two stations with a SNR of 20 dB.	**20**	**CO4**
Q 11	Determine the code **Shanon-Fano coding** and construct the **code tree** for the symbols x_i (i = 1 to 8) with P = {1/4, 1/8, 1/8, 1/8, 1/8, 1/8, 1/16, 1/16}. A source X has nine symbols represented as x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 and x_9 with $P(x_1) = 0.31$, $P(x_2) = 0.21$, $P(x_3) = 0.11$, $P(x_4) = 0.13$, $P(x_5) = 0.08$, $P(x_6) = 0.05$, $P(x_7) = 0.05$, $P(x_8) = 0.01$ and $P(x_9) = 0.05$. Determine the code using **Huffman coding.**	**20**	**CO2**