Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Communication System **Semester: IV**

Program: B. Tech ECE **Time : 03 hrs.**

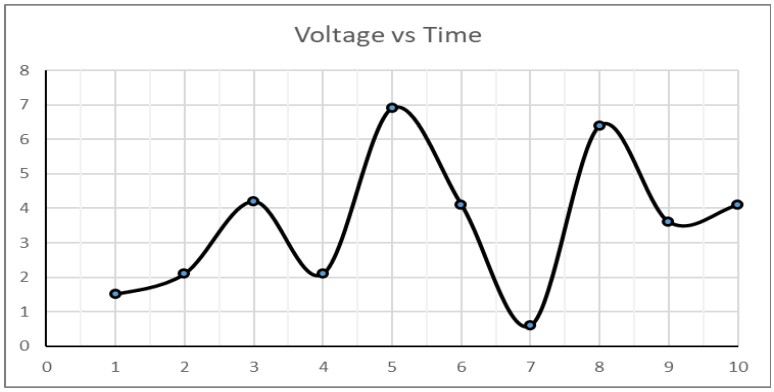
Course Code: ECEG 2042 **Max. Marks: 100**

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 $H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$	**4**	**CO2**
Q 2	A song is recorded digitally and stored on a CD using PCM technique. The highest frequency present in the song is 20 kHz and number of quantisation level is 2048. If the song occupies a space of 60 MB then what is the duration of the song.	**4**	**CO2**
Q 3	**SSB** modulation is utilized for the transmission of an audio signal. Provide a visual representation of the **block diagram** that illustrates the **reception** process of this signal.	**4**	**CO2**
Q 4	Generate a **block diagram** illustrating a **modem** that depicts the **BFSK** (Binary Frequency Shift Keying) technique.	**4**	**CO1**
Q 5	5 stations have applied for broadcasting FM service. These are FM1, FM2, FM3, FM4 and FM5. **95.3 MHz of frequency is given to FM2**. What frequencies will be provided to others? If instead of FM service, they start **AM** transmission, then what will be the broadcasting frequencies of these stations consider that **FM1** will be transmitting at **950 kHz**.	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	A signal is represented as m(t) = 2 Sin $4\pi\times6280$ t +4 Cos 3140 t + 6 Cos $2\pi\times500$ t. It modulates a carrier, 5 Cos $2\pi\times10^3$ t, in amplitude. i. Determine the resultant modulation index. ii. State whether the DSB wave is under-modulated or over-modulated. iii. Calculate the power of the unmodulated signal. iv. Determine the efficiency of the wave.	**10**	**CO2**

	v. Determine the minimum sampling frequency. vi. Draw the spectrum of the resultant SSB. vii. Determine the transmission rate if it is quantized with 1024 levels. viii. Determine the bandwidth of SSB. ix. Draw the spectrum of VSB (taken only one band in LSB) x. Determine the bandwidth of VSB (taken only one band in LSB) **OR** Convert the following signal into string of 0 and 1, then code the resultant binary codes into AMI line coding and determine the transmission rate. The quantization step size is 1volt. The circular spots are the sampling points. 		
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. (a) **Doble Side Band** Amplitude Modulation with a modulation index of 0.8 (b) **Vestige Side Band** Amplitude Modulation with a modulation index of 1. (c) **Frequency Modulation** with a modulation index of **4**.	**10**	**CO3**
Q 8	The generator polynomial of a **cyclic code** is $G(x) = x^3 + x^2 + 1$. Determine the **code** of these input messages using both **systematic** and **nonsystematic cyclic code**. (a) 1001 (b) 1101 (c) 0001	**10**	**CO3**
Q 9	(a) Consider a message signal with the **maximum frequency** of f_m, and it undergoes **sampling** at a rate of f_s. Explore the following three scenarios using a well-defined frequency domain diagram. i. $f_s = 2 f_m$ ii. $f_s < 2 f_m$ iii. $f_s \geq 2 f_m$ (b) If 4 T1 lines are multiplexed and in between each line 20 synchronization bits are used, this multiplexed line is needed to	**6+4**	**CO2**

	transmit using AMI line coding. Then find the minimum transmission rate and bandwidth required.		
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	(a) Determine the code **Shanon-Fano coding** and construct the **code tree** for the symbols x_i (i = 1 to 7) with P = {1/4, 1/4, 1/8, 1/8, 1/8, 1/16, 1/16}. **(b)** 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 $P(x_1) = 0.2$, $P(x_2) = 0.1$, $P(x_3) = 0.1$, $P(x_4) = 0.1$, $P(x_5) = 0.2$, $P(x_6) = 0.05$, $P(x_7) = 0.07$, $P(x_8) = 0.08$ and $P(x_9) = 0.1$. Determine the code using **Huffman coding.** (c) A student designed a DPSK modulator and demodulator separately for the transmission and reception of a sequence of bits over a small distance in laboratory. The modulator was perfect without any error and shows a noise free waveform at its output display unit. The received signal at the demodulator also shows a good result on the eye diagram display unit and waveform display unit, but the received bits are not in sequence with the transmitting bits. What went wrong with the demodulation?	**5+10+5**	**CO3**
Q 11	(a) A music signal is represented as $m(t) = (10 \cos 100\pi t + 5 \cos 200\pi t + 2 \cos 400\pi t + 2 \cos 500\pi t)$. After converting this signal into a sequence of 0s and 1s using optimal sampling and a quantizer with 512 levels, the resulting bits are transmitted wirelessly to another station. The chosen modulation method involves grouping 4 bits to form a symbol under phase shift modulation. Then determine the following. i. Number of **bits** coming out in 5 mins from a binary coder that follows the quantizer? ii. **Bit rate** of the Modem iii. **Symbol rate** of the Modem iv. Minimum **bandwidth** required to transmit the signal. v. **Capacity** of the line between two stations with a SNR of 30 dB. (b) An engineer **designed** a **digital link** between two stations. The stations are 1000 km apart and there is direct line of communication radio link between the two stations. The maximum allowable bandwidth supported by the link is 40 kHz. The engineer recorded a speech signal for 4 minutes. The maximum allowable frequency of this speech signal was limited to 10 kHz. It was converted into streams of 0s and 1s using PCM technique. The number of bits required to encode one sampled signal is 5. The PCM signal is fed into a modulator operating at 5000 MHz of carrier frequency. Which type of digital modulation scheme the engineer has to choose for an uninterrupted transmission? Also determine the range of frequencies over the wireless link in which the transmission happens.	**10+10**	**CO4**