Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Communication System **Semester: IV**

Program: B. Tech ELE **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)

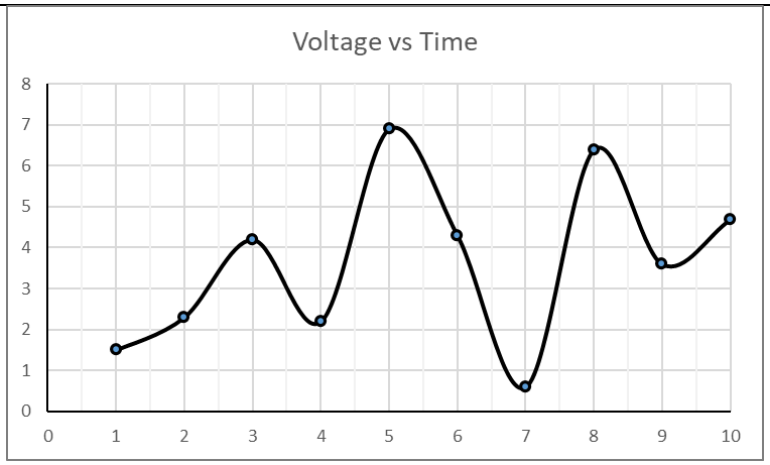
S. No.		Marks	CO
Q 1	Calculate the entropy of a system for an event that has six possible outcomes with probabilities 1/2,1/4,1/8,1/16,1/32.	**4**	**CO4**
Q 2	A song is recorded digitally and stored on a CD using PCM technique. The highest frequency present in the song is 15 kHz and number of quantisation level is 2048. If the song occupies a space of 60 MB then what is the duration of the song.	**4**	**CO2**
Q 3	A super heterodyne receiver is utilized to receive the AM radio. Provide a visual representation of the block diagram that illustrates the reception process.	**4**	**CO1**
Q 4	Illustrate a block diagram depicting a modem that works on the BFSK (Binary Frequency Shift Keying) technique.	**4**	**CO3**
Q 5	Draw the spectrum of a TV transmission by Doordarshan in India. The carrier frequency is 730 MHz.	**4**	**CO1**

SECTION B

(4Qx10M= 40 Marks)

Q 6	(a) Why is single-sideband (SSB) modulation preferred over conventional AM in many communication systems? (b) Two FM systems operate with the same carrier frequency and modulation index, but one uses a message signal with twice the frequency of the other. How does this affect the bandwidth of the FM signal? (c) A speech signal, band limited to 4 kHz and peak voltage varying between +5V and -5V is sampled at the 1.5 times the Nyquist rate.	**3+3+4**	**CO2**

	Each sample is quantized and represented by 0 to 127 levels. Assuming the signal to be uniformly distributed between its peak values, find the signal to noise ratio at the quantizer output. What would be the bandwidth required to fed this signal into a MSK Modem.		
Q 7	(a) A 400W carrier is amplitude modulated to a depth of 100%. Calculate the total power in case of the standard AM and DSBSC techniques. Formulate how much power saving in watts is achieved for DSBSC? If the depth of modulation is changed to 75%, then how much power in W is required for transmitting the DSBSC wave? (b) A message signal is given as: $m(t) = 3 \cos 500\pi t$. Determine the signal to quantization noise ratio when this is quantized with 512 levels. How many bits of quantization is required to achieve a SQR of at least 40 dB. (c) 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. i. 1001 ii. 1101	**10**	**CO3**
Q 8	(a) If 4 T1 lines are multiplexed and in between each line 20 synchronization bits are used, this multiplexed line is needed to transmit using AMI line coding. Then find the minimum transmission rate and bandwidth required. **OR** (b) 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 (x axis is in ms). The quantization step size is 1 volt. The circular spots are the sampling points.	**10**	**CO3**

			
Q 9	(a) Determine the probability of error of a BPSK system using white noise and matched filter analysis. (b) Draw the signal space diagram of transmitting a QPSK modulated wave.	**6+4**	**CO2**
Q 10	(a) Determine the efficiency using Shanon-Fano coding for the symbols x_i (i = 1 to 6) with P = {1/4, 1/4, 1/4, 1/8, 1/16, 1/16}. (b) Find out the capacity of a 10 kHz line, having a signal and noise power of 278.6 W and 16 dB respectively.	**5+5**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 11	(a) 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 Shanon fano and Huffman coding. (b) 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 12	(a) A music signal is represented as $m(t) = (10 \cos 100\pi t + 5 \cos 200\pi t + 2 \cos 400\pi t + 2 \cos 500\pi t)$. The resulting bits are transmitted wirelessly to another station after converting this signal into a sequence of 0s and 1s using optimal sampling and a quantizer with 512 levels. The chosen modulation method involves grouping 4 bits to form a symbol under phase shift modulation. Then determine:		

	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 a 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 carrier frequency of. Which type of digital modulation scheme must the engineer choose for uninterrupted transmission? Also determine the range of frequencies over the wireless link in which the transmission happens.	**10+10**	**CO4**