Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Digital Communication — **Semester: VI**
Program: B. Tech - EE and BCT — **Time 03 hrs.**
Course Code: ELEG 333 — **Max. Marks: 100**

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

SECTION A

S. No.		Marks	CO
Q 1	Define **Nyquist theorem** of **sampling**. State the Nyquist condition of sampling for a **band pass signal**.	**5**	**CO1**
Q 2	Draw **AMI, B6ZS** and **HDB3** line coding for the input bit sequence **110000001000001** with proper bit timing.	**5**	**CO2**
Q 3	If the number of quantization level in a PCM system has been increased from **64 to 512**, then calculate by how much the **SQR** will be changed?	**5**	**CO3**
Q 4	Calculate the **bandwidth** required to transmit a signal using **BPSK** technique. The input data rate is **160 kbps** and carrier frequency is **50 kHz**. Draw the **spectrum** also.	**5**	**CO4**

SECTION B

Q 5	Encode the following using **Huffman Coding** technique. [M] = M_1 M_2 M_3 M_4 M_5 M_6 M_7 M_8 [P] = 0.20 0.10 0.12 0.05 0.16 0.15 0.05 0.17	**10**	**CO4**
Q 6	Write down the condition of **error probability** for **both binary** sequences. Find the **probability of error** of **binary phase shift keying modulation** scheme using white noise and matched filter analysis.	**10**	**CO3**
Q 7	Draw the **block diagram** of a **MODEM** using **Binary Phase Shift Keying** modulation scheme. If the rate of incoming bit is 10 kbps and the frequency of the	**10**	**CO4**

	carrier signal, fed to the modulator, is 500 kHz, then find the frequency at each path of the MODEM. **or** Draw the **block diagram** of a **MODEM** using **Binary Frequency Shift Keying** modulation scheme. If the rate of incoming bit is 10 kbps and the frequency of the carrier signal, fed to the modulator, is 500 kHz, then find the frequency at each path of the MODEM.		
Q 8	What are the **advantages** and **disadvantages** of **BPSK** over **DPSK**? Take a bit sequence of **110101100101**. Compute the encoded and decoded DPSK sequence (reference bit is 0) using Ex-OR coder.	**10**	**CO3**
	SECTION-C		
Q 9	A signal is given as: **$m(t) = \cos 628\times10^3 t$**. It has been sampled, and quantized using **512 level** of quantization. The signal is transmitted over radio link using **QPSK** modulation , with the carrier frequency of **1.0 GHz**. Compute (i) **SQR** of the signal after the stage of quantization. (ii) **Minimum bandwidth** of the **transmission line** that connect PCM encoder and Modulator. (iii) **Minimum bandwidth** required to transmit the **spectrum** for **first null point** and **second null point**. (iv) Draw the **two spectrum** showing the first and second null points.	**20**	**CO2**
Q 10	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 25 kHz. The engineer recorded a speech signal for 5 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 6. The PCM signal is fed into a modulator operating at 500 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.	**20**	**CO4**

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SECTION A

S. No.		Marks	CO
Q 1	Draw the **spectrum** of a QPSK modulator. The input data rate is **100 kbps** and carrier frequency is **50 kHz**.	**5**	**CO4**
Q 2	Apply **any two Scrambling** technique of the line coding on for the input bit sequence **11000000001110001** with proper bit timing.	**5**	**CO3**
Q 3	A Delta Modulator is made to operate with a step size of 400 mV. The incoming sinusoidal signal is limited to a bandwidth of 3 kHz. Then calculate the **SQR** of the modulator.	**5**	**CO2**
Q 4	Define **Nyquist theorem** of **sampling**. State the Nyquist condition of sampling for a **band pass signal**.	**5**	**CO1**

SECTION B

Q 5	Draw the **block diagram** of a **MODEM** using **Quadrature Shift Keying.** Demonstrate phasor diagram of the scheme also.	**10**	**CO3**
Q 6	Write down the condition of **error probability** for **both binary** sequences. Find the **probability of error** of **amplitude shift keying modulation** scheme using white noise and matched filter analysis.	**10**	**CO3**
Q 7	Encode the following using **Huffman Coding** technique. [M] = M_1 M_2 M_3 M_4 M_5 M_6 M_7 M_8 [P] = 0.17 0.12 0.10 0.08 0.13 0.15 0.05 0.20	**10**	**CO4**

Q 8	Draw the **transmitter** configuration of **Differential Phase shift keying** technique. Take a bit sequence of **110101100101**. Compute the encoded and decoded DPSK sequence (reference bit is 0) using Ex-NOR coder.	**10**	**CO4**
	SECTION-C		
Q 9	A signal is given as: $\mathbf{m(t) = Cos\ 250\pi \times 10^3 t}$. It has been sampled, and quantized using **32 level** of quantization. The signal is transmitted over radio link using **BFSK** modulation , with the carrier frequency of **1.0 GHz**. Compute (i) **SQR** of the signal after the stage of quantization. (ii) **Minimum bandwidth** of the **transmission line** that connect PCM encoder and Modulator. (iii) **Minimum bandwidth** required to transmit the **spectrum**. (iv) Find the probability of the error with **noise spectral power** of **0.6** unit. The **energy of the bit** is **4** unit.	**20**	**CO2**
Q 10	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 25 kHz. The engineer recorded a speech signal for 5 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 6. The PCM signal is fed into a modulator operating at 500 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.	**20**	**CO4**