Assignment -3
Total Marks: 30

1. Why is PSK considered more robust than ASK in noisy environments? [1]
2. Design a **multi-level Amplitude Shift Keying (ASK)** system to transmit the binary data stream **11010011** using 4 amplitude levels, where each signal element represents 2 bits. The system parameters are as follows:
   The carrier signal completes 3 cycles within each signal element and the phase is 0°. [3]

Bit Pattern	Amplitude
00	1V
01	3V
10	5V
11	7V

3. Design a **Frequency Shift Keying (FSK)** system to transmit the binary data stream 1011 with the following conditions:
   The base carrier frequency is **fc**=12Hz for this entire data stream and it takes 1s. The system uses a frequency shift of **Δf**= 4 Hz. with a peak amplitude of 5V and a phase of 0°. Based on these parameters:
   (a) Calculate the frequencies **f1** and **f0** for binary representations 1 and 0, respectively. [2]
   (b) Determine the duration of each signal element. [*Hint: Assume each signal element has an equal duration and the total transmission time is 1s*.] [1]
   (c) Draw the FSK modulated signal for the given data stream **1011**. [2]
   (d) Determine whether the modulated signal is **coherent** or **non-coherent**, providing reasoning for your conclusion. [2]
4. Design a **QPSK (Quadrature Phase Shift Keying)** system to transmit the binary data stream 11010100 where each signal element represents 2 bits. The carrier signal has 3 full-cycles in each signal element and peak amplitude is 5V. Draw the modulated signal waveform for the given data stream. [3]
5. Draw the constellation diagram for the following cases. Also, find the peak amplitude value for each case and define the modulation type (ASK, FSK, PSK, or

QAM). The numbers in parentheses define the values of I and Q respectively. Here, I represents the in-phase component and Q represents the quadrature component. [8]

a. Two points at (2, 0) and (3, 0)
b. Two points at (3, 0) and (−3, 0)
c. Four points at (2, 2), (−2, 2), (−2, −2), and (2, −2)
d. Two points at (0, 2) and (0, −2)

6. A low-pass signal has a maximum frequency of 15 kHz.
   a) What is the minimum sampling rate required for accurate digitization of the signal? [1]
   b) If the signal is sampled at 45 kHz, is this considered oversampling? Explain. [1]
7. A voltage signal ranges from -10V to +10V. If the signal is quantized into 16 levels:
   a) Calculate the width of each quantization zone (Δ). [1]
   b) How many bits are required to represent each sample? [1]
8. The following table represents a sampled analog signal for digital signal representation. By applying the concept of **Pulse Code Modulation**, assume there will be **3-bit code words** for each sampled amplitude. Show the **normalized quantized value** and **quantization code** for the given analog signal values at different time stamps. Assume that the sampling amplitudes are between -24V to +24V. [4]

Time (ms)	Analog Signal Value (V)
0	8.6
1	-12.3
2	15.7
3	-19.8
4	5.4