1. (a) Consider a time function \( g_1(t) \) that has a Fourier transform \( G_1(f) \) given by

\[
G_1(f) = \begin{cases} 
8 - 0.01f & \text{for } 0 \leq f \leq 400 \text{ Hz} \\
4 & \text{for } f > 400 \text{ Hz} \\
G_1(-f) & \text{for } f < 0.
\end{cases}
\]

Can \( g_1(t) \) be recovered from appropriately placed samples of \( g_1(t) \)? If so, what is the required sampling rate?

(b) Repeat part (a) for \( g_2(t) \) that has a Fourier transform \( G_2(f) \) given by

\[
G_2(f) = \begin{cases} 
4 - 0.01f & \text{for } 0 \leq f \leq 400 \text{ Hz} \\
0 & \text{for } f > 400 \text{ Hz} \\
G_1(-f) & \text{for } f < 0.
\end{cases}
\]

2. A voice signal \( m(t) \) which is bandlimited to 3200 Hz, multiplies the function \( \cos(20000 \pi t) \). Assuming ideal sampling, specify a sampling rate such that \( m(t) \cos(20000 \pi t) \) can be uniquely recovered using an ideal BPF (bandpass filter). What are the ideal BPF cutoff frequencies?

3. Design a 15-level uniform midtread quantizer for an input signal with a dynamic range of \( \pm 10 \text{ V} \). Find the quantizer output value and the quantization error for an input signal amplitude of 1.2 V.

4. Consider the periodic signal \( x(t) \) with period \( T \) (i.e. \( x(t) = x(t + nT) \) for any integer \( n \)), given by

\[
x(t) = \frac{V}{T} t, \quad \text{for } -\frac{T}{2} \leq t \leq \frac{T}{2}.
\]

This signal is input to a uniform quantizer whose quantization noise is uniformly distributed in \([-\Delta/2, \Delta/2]\). Find the SQNR at the quantizer output when the input is \( x(t) \).

5. Specify the natural binary code, the folded binary code, and a Gray code for a 16-level quantizer.

6. Given the binary sequence 1 1 0 1 1 1 0, sketch the transmitted pulse sequence for:

(a) Unipolar NRZ line coding.
(b) Polar RZ coding.
(c) Bipolar NRZ coding.