7.3 Specify the Nyquist rate and the Nyquist interval for each of the following signals:

(a) \( g(t) = \text{sinc}(200t) \)
(b) \( g(t) = \text{sinc}^2(200t) \)
(c) \( g(t) = \text{sinc}(200t) + \text{sinc}^2(200t) \)

7.7 Twenty-four voice signals are sampled uniformly and then time-division multiplexed. The sampling operation uses flat-top samples with 1 \( \mu \)s duration. The multiplexing operation includes provision for synchronization by adding an extra pulse of sufficient amplitude and also 1 \( \mu \)s duration. The highest frequency component of each voice signal is 3.4 kHz.

(a) Assuming a sampling rate of 8 kHz, calculate the spacing between successive pulses of the multiplexed signal.
(b) Repeat your calculation assuming the use of Nyquist rate sampling.

7.17 A PCM system that uses a uniform quantizer is followed by a 7-bit binary encoder. The bit rate of the system is equal to 50 \( \times 10^6 \) b/s.

(a) What is the maximum message bandwidth for which the system operates satisfactorily?
(b) Determine the output signal-to-quantization noise ratio when a full-load sinusoidal modulating wave of frequency 1 MHz is applied to the input.
7.21 Consider a sine wave of frequency $f_m$ and amplitude $A_m$, applied to a delta modulator of step-size $\Lambda$. Show that slope-overload distortion will occur if

$$A_m > \frac{\Lambda}{2\pi f_m T_s}$$

where $T_s$ is the sampling period. What is the maximum power that may be transmitted without slope-overload distortion?

7.22 A linear delta modulator is designed to operate on speech signals limited to 3.4 kHz. The specifications of the modulator are as follows:

- Sampling rate $= 10f_{Nyquist}$, where $f_{Nyquist}$ is the Nyquist rate of the speech signal.
- Step-size $\Lambda = 100$ mV.

The modulator is tested with a 1-kHz sinusoidal signal. Determine the maximum amplitude of this test signal permissible to avoid slope overload.