

## Problem 2.2.

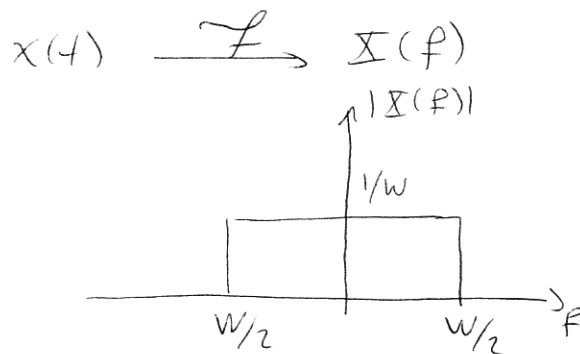
$$(a) \quad 800 \text{ char/s} \times 8 \text{ bits/char} = 6400 \text{ bits/s}$$

$$(b) \quad \frac{6400 \text{ bits/s}}{4 \text{ bits/sym}} = 1600 \text{ sym/sec.}$$

## Problem 2.7

$$x(t) = \frac{\sin 6280t}{6280t} = \frac{\sin 2\pi W_2 t}{2W_2 t/2}$$

$$\Rightarrow \frac{W}{2} = 1000$$



msg. freq.  $f_m = 1000 \text{ Hz}$

$$f_s = 2 f_m = 2000 \text{ samples/s at least.}$$

# Problem 2.8

$$(a) \left(\frac{S}{N}\right)_q = 3L^2 \geq 30 \text{ dB}$$

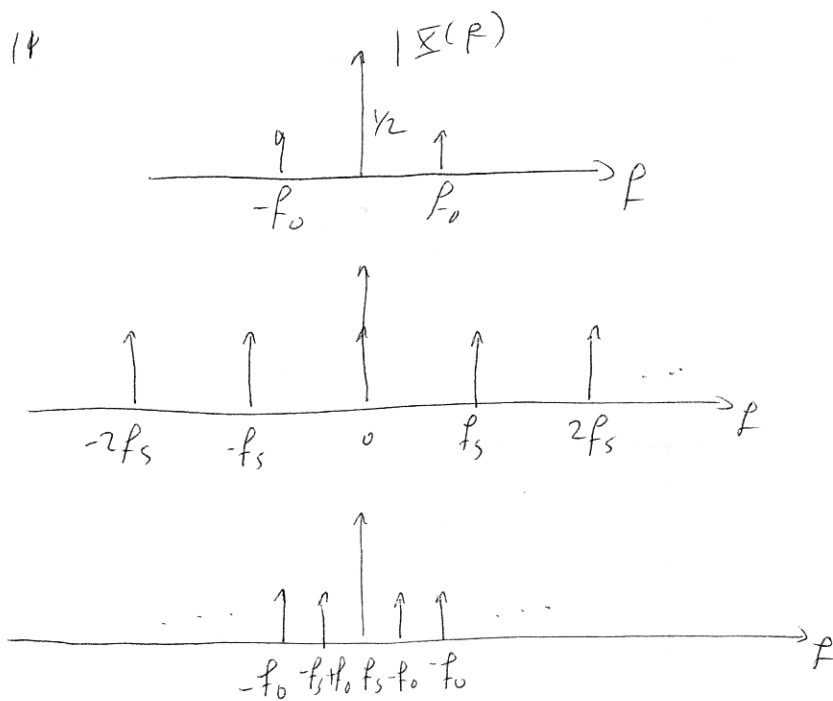
$$\Rightarrow L = 18.26 \quad \text{round up to } 2^n = 32$$

$$l = \log_2 32 = 5 \text{ bits/sample.}$$

$$(b) T_b = \frac{T_s}{l} = \frac{1}{l F_s} = \frac{1}{5(8000)} = 25 \mu\text{s}$$

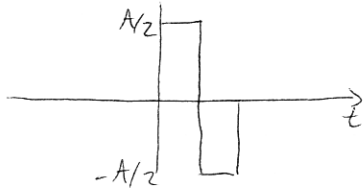
$$W = \frac{1}{T_b} = \frac{1}{25 \mu\text{s}} = 40 \text{ kHz}$$

# Problem 2.14



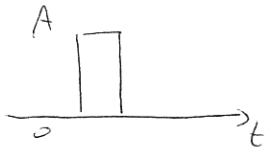
## Problem 2.17

Bipolar



$$\begin{aligned} \text{Avg. power} &= \frac{1}{2} \left(\frac{A}{2}\right)^2 + \frac{1}{2} \left(\frac{A}{2}\right)^2 \\ &= \frac{A^2}{4} \end{aligned}$$

Unipolar



$$\begin{aligned} \text{Avg power} &= \frac{1}{2} (A^2) + \frac{1}{2} (0)^2 \\ &= \frac{A^2}{2} \end{aligned}$$

## Problem 2.18

$$\begin{aligned} R_{Ti} &= 24 \text{ samples/frame} \times 8 \text{ bits/sample} \times 8000 \text{ frames/s} \\ &+ 1 \text{ alignment bit/frame} = 1.544 \times 10^6 \text{ bits/s} \end{aligned}$$

$$BW_{\text{eff}} = \frac{R_{Ti}}{W} = \frac{1.544 \times 10^6}{386 \times 10^3} = 4 \text{ bits/s/Hz}$$