Problem 4.16

Discrete time signal is given by:

$x[n] = \cos(0.7\pi n + 0.2\pi)$, $f_s = 2000$ samples/s.

(a) Two different continuous-time signals with frequencies between 7000 and 9000 Hz:

Computing the aliasing frequencies, $\hat{\omega}_1 = \hat{\omega} + 2\pi l$, and

$\hat{\omega}_1 = \hat{\omega} - 2\pi l$, with $\hat{\omega} = 0.7\pi$ and $l = 4$ yields $f_1 = 8700$ Hz and $f_2 = 7300$ Hz, with $\phi_2 = -0.2\pi$ radians.

Hence,

$x_1(t) = \cos(2\pi(8700)t + 0.2\pi)$.

$x_2(t) = \cos(2\pi(7300)t - 0.2\pi)$.

(b) Continuous-time signals whose frequency lies between 7000 and 8000 Hz is:

$x(t) = \cos(2\pi(7300)t - 0.2\pi)$.

(c) The general formula for the frequency f in terms of $\hat{\omega}$ such that the frequency satisfies $f \in [7000, 8000]$ Hz:

$f = 8000 - \frac{f_s \times \hat{\omega}}{2\pi}$, $\phi = -0.2\pi$ radians.