4.1 → $x(t) = 11\cos(7\pi t - \pi/3)$

$x[n] = x\left(\frac{n}{f_s}\right) = \frac{7\pi n}{f_s} - \frac{\pi}{3}$

→ a) $f_s = 9$, $x[n] = 11\cos\left(\frac{7\pi}{9}n - \frac{\pi}{3}\right)$ $A = 11$ $\varphi = -\frac{\pi}{3}$ $\omega_1 = \frac{7\pi}{9}$

→ b) $f_s = 6$, $x[n] = 11\cos\left(\frac{7\pi}{6}n - \frac{\pi}{3}\right)$

$= 11\cos\left(\left(\frac{7\pi}{6} - 2\pi\right)n - \frac{\pi}{3}\right)$

$= 11\cos\left(-\frac{5\pi}{6}n - \frac{\pi}{3}\right)$

$= 11\cos\left(\frac{5\pi}{6}n + \frac{\pi}{3}\right)$ $A = 11$ $\varphi = +\frac{\pi}{3}$ $\omega_2 = \frac{5\pi}{6}$

→ c) $f_s = 3$ $x[n] = 11\cos\left(\frac{7\pi}{3}n - \frac{\pi}{3}\right)$

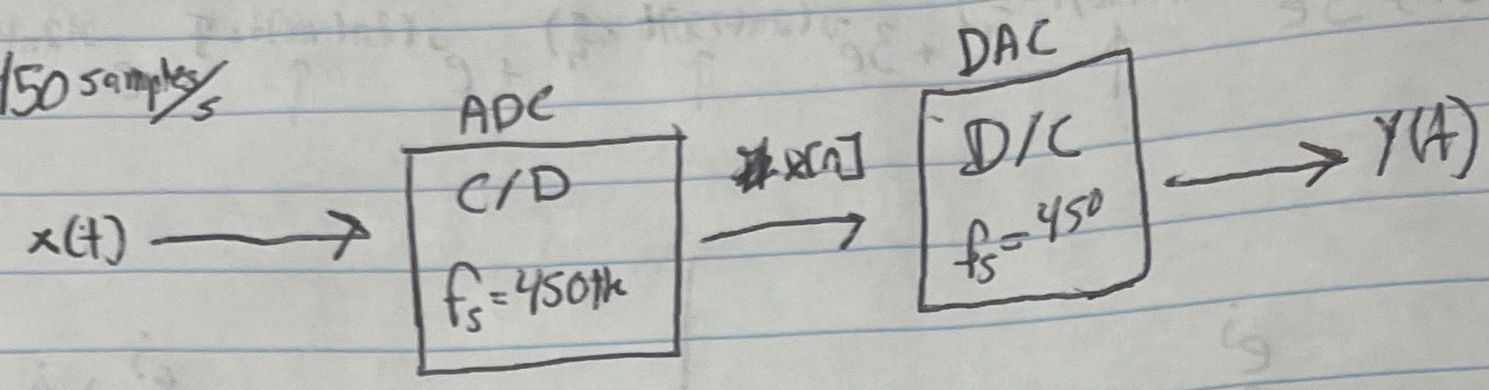
$11\cos\left(\left(\frac{7\pi}{3} - 2\pi\right)n - \frac{\pi}{3}\right) = 11\cos\left(\frac{\pi}{3}n - \frac{\pi}{3}\right)$ $A = 11$ $\varphi = -\frac{\pi}{3}$ $\omega_1 = \frac{\pi}{3}$

4.5 a) Oversample to guarantee no alasy → 50 Hz

b) $r(t) = x(t)\cos(22\pi t) \rightarrow 72$ Hz

c) $v(t) = r(t) + r(t - 0.02) \rightarrow 72$ Hz

4.7 $f_s = 450$ samples/s



a) No, we will not be able to reconstruct the sample

b) $x(t) = 26\cos(400\pi t + 0.7\pi) + 14\cos(1000\pi t - 0.3\pi)$

$x[n] = x(n/450) = 26\cos\left(\frac{400\pi n}{450} + 0.7\pi\right) + 14\cos\left(\frac{1000\pi n}{450} - 0.3\pi\right)$

$= 26\cos\left(\frac{8}{9}\pi n + 0.7\pi\right) + 14\cos\left(\frac{20}{9}\pi n - 0.3\pi\right)$

$\frac{20}{9}\pi - 2\pi = \frac{2\pi}{9}$

40 $\frac{2\pi}{9}\left(\frac{1}{2\pi}\right)(360) = 80$Hz

$\frac{3\pi}{\pi}(360)$

c) $y(t) = 26\cos\left(\frac{8}{9}\pi(450t) + 0.7\pi\right) + 14\cos\left(\frac{2\pi}{9}(450t) - 0.3\pi\right)$

$= 26\cos(400t + 0.7\pi) + 14\cos(1000t - 0.3\pi)$