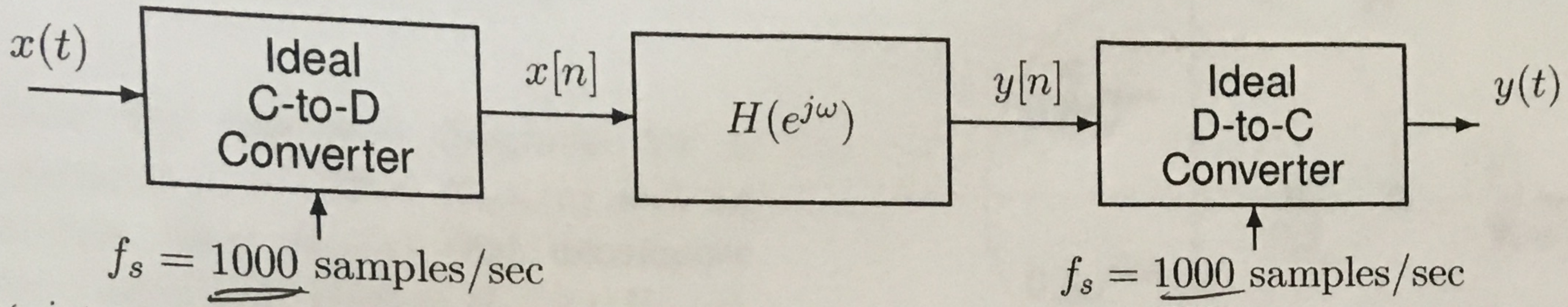
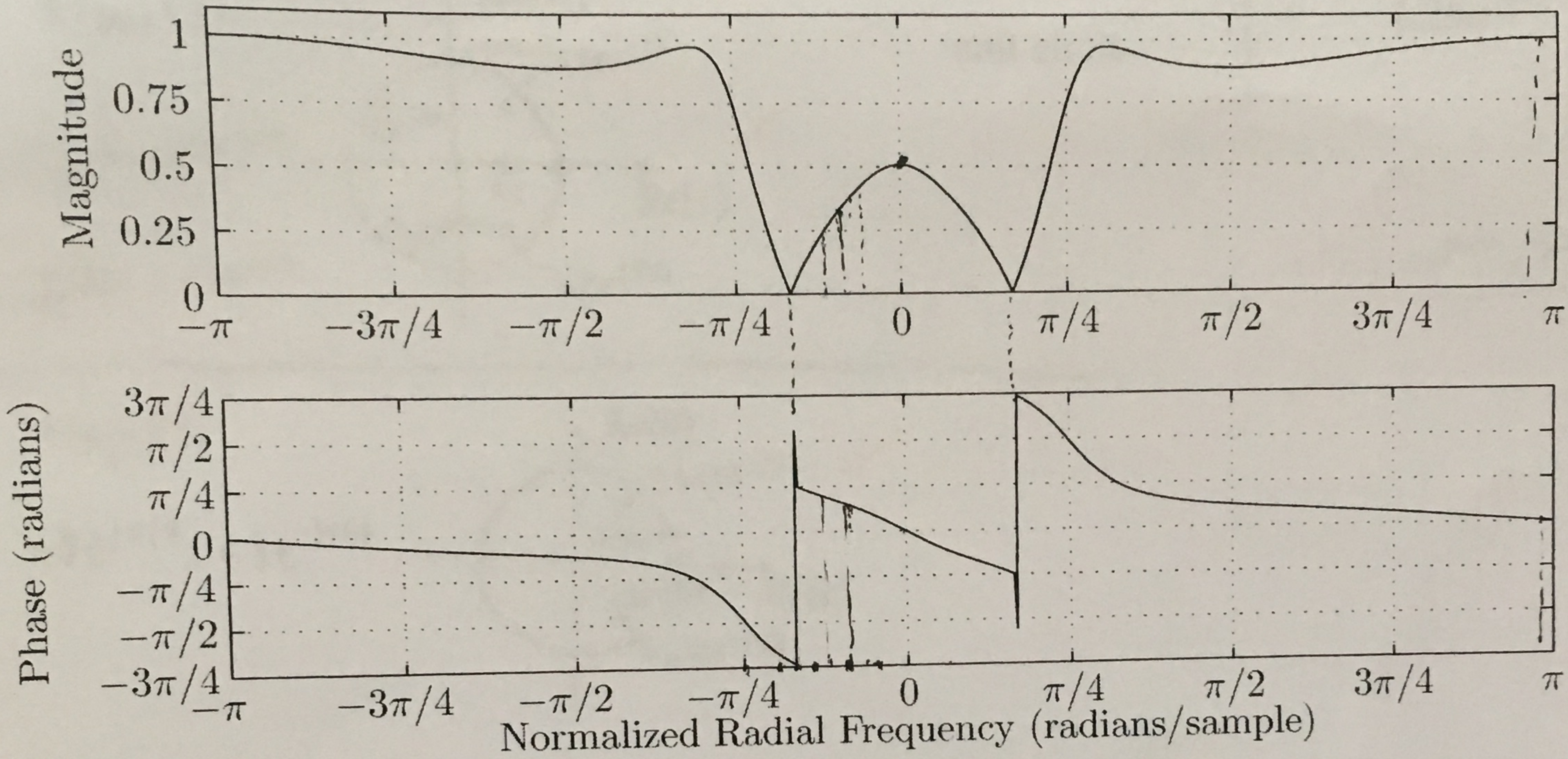


Question #4: (10 points)

Consider the following system for sampling, filtering, and reconstruction of a continuous-time signal



where  $H(e^{j\omega})$  is given in the plots below and the ideal C-to-D converter has no anti-aliasing filter.



Estimate the output  $y(t)$  if the input is  $x(t) = 2 + 4 \cos(2\pi(450)t) - 6 \cos(2\pi(950)t)$ .

$$x(t) = 2 + 4 \cos(2\pi(450)t) - 6 \cos(2\pi(950)t)$$

$$f_s = 1000 \text{ samples/sec}, \quad x[n] = 2 + 4 \cos(0.9\pi n) - 6 \cos(1.9\pi n) = 2 + 4 \cos(0.9\pi n) - 6 \cos(0.1\pi n)$$

$$y[n] = |H(e^{j\omega})| \cos(\omega n + \phi + \angle H(e^{j\omega}))$$

$$\Rightarrow y[n] = 2 |H(e^{j0})| + 4 |H(e^{j0.9\pi})| \cos(0.9\pi n + \angle H(e^{j0.9\pi})) - 6 |H(e^{j0.1\pi})| \cos(0.1\pi n + \angle H(e^{j0.1\pi}))$$

$$= 2 \times 0.5 + 4 \times 1 \times \cos(0.9\pi n + 0) - 6 \times 0.3 \times \cos(0.1\pi n + \pi/8)$$

$$= 1 + 4 \cos(0.9\pi n) - 1.8 \cos(0.1\pi n + \pi/8)$$

(Estimate  $|H(e^{j0.9\pi})| = 1$ ,  $\angle H(e^{j0.9\pi}) = 0$ ,  $|H(e^{j0.1\pi})| = 0.3$ ,  $\angle H(e^{j0.1\pi}) = \pi/8$ )

$$f_s = 1000 \text{ samples/sec}$$

$$\Rightarrow y(t) = 1 + 4 \cos(900\pi t) - 1.8 \cos(100\pi t - \pi/8)$$

$$= 1 + 4 \cos(2\pi(450)t) - 1.8 \cos(2\pi(50)t - \pi/8)$$

✓ ✓ ✓ ✓ ✓ ✓