No more grad. Your best 6 out of 8 will constitute 80% of your final score. We will not cover double-sided Laplace transform. Instead, we will go over the important subjects using the Wiley eBook.

$$H(s) = \frac{N(s)}{P(s)} = \frac{K}{s^n + b_{n-1}s^{n-1} + \ldots + b_1s + b_0}$$

when \( n > m \)

$$H(s)$$ can be written as

$$H(s) = K \frac{(s-z_1)(s-z_2)\ldots(s-z_m)}{(s-p_1)(s-p_2)\ldots(s-p_n)}$$

Examples:

$$H(s) = \frac{5s^2 + 4}{(s+1)(s+4)} = \frac{5s^2 + 4}{s^2 + 5s + 4}$$

$$H(s) = \frac{2s + 3}{(s+2)(s+3)}$$

$$H(s) = \frac{(s+1)(s+2)}{(s-1)(s+3)(s+2)}$$

To derive \( H(s) \), set all \( v_i \) to zero.

Sizing functions do not depend on \( v_i \).
According to Eq. 4.45, for $\omega / \Omega = 1.5$, the sampling rate should be 

$$f_s = 10 x = 10 \times 100 = 1000 \text{ Hz}$$

Per Eq. 6.175, the spectrum of the sampled signal is given by 

$$X(f) = \sum_{k=-n}^{n} X_k(f - k\beta)$$

Spectrum $X_k(f)$ consists of an infinite number of replicas, defined at the right by $X(f)$, for $\beta = 2\pi / \Omega$ or $\beta = 2\pi / (\Omega_1 - \Omega)$. All spectrums are scaled by a multiplication factor of $\frac{1}{2}$. Figure 6.48a displays the spectra for $a = 0$ and $1$. We note that the spectrums do not overlap, which means that the original signal can be reconstructed by passing spectrum $X_k(f)$ through a low-pass filter with a specified response that extends between $-100$ Hz and $+100$ Hz.

6.13.4 Practical Aspects of Sampling

So far, all our discussions of signal sampling assumed the availability of an ideal impulse train composed of impulses.

$$x(t) = \sum_{k=-n}^{n} \delta(t - k\beta)$$

where $\beta = \frac{2\pi}{\Omega}$. To practice the sampling performed by finite-duration signals, the rectangular pulse train is used. The spectrum of a rectangular pulse train is given by 

$$X_{\text{rect}}(f) = \sum_{k=-n}^{n} \delta(f - k\beta)$$

The signal sampled by the pulse train is 

$$x_s(f) = x_n(f) = x(t) \sum_{k=-n}^{n} \delta(f - k\beta)$$

where $X_n(f)$ is the sampling interval and $\Delta f$ is the bandwidth. From Table 6.1, the Fourier series representation of the pulse train is

$$X_{\text{rect}}(f) = \frac{\sin \pi \beta f}{\pi \beta f} X(f) \sum_{k=-n}^{n} \delta(f - k\beta)$$

and the spectrum of the pulse train is 

$$X_{\text{rect}}(f) = 2 \sum_{k=-n}^{n} X(f-k\beta) \sin \frac{\pi \beta f}{\pi \beta}$$

or

$$X_{\text{rect}}(f) = \sum_{k=-n}^{n} (X(f-k\beta) + X(f+k\beta)) \sin \frac{\pi \beta f}{\pi \beta}$$

where $X(f)$ is the spectrum of the original signal.
Another example for finding \(H(s)\) or \(H(z)\)

\[
\begin{align*}
\mathbf{v}(s) &= \mathbf{v}(0) + s\int_0^t \mathbf{v}(\tau) d\tau \\
\mathbf{y}(s) &= (1 - s)\mathbf{y}(0) + 5s\int_0^t \mathbf{u}(\tau) d\tau
\end{align*}
\]