Problem 6.9 Y5 As part of the control of a process, an analog signal is to be digitized at uniform intervals.

- The continuous signal is band-limited (narrow frequency spectrum), with no significant frequency components greater than 15 kHz.
- The dynamic range of the signal is ±5 V.
- ADCs are available with resolutions of 4, 6, 8, 10, 12, … bits.
- The accuracy of the ADC precision voltage reference (referred to the input) is ±0.0002 V.
- The maximum allowable total error is ±0.002 V.

Suggest appropriate values for:

a. The ADC resolution
b. The minimum sampling rate
c. The maximum aperture (or conversion response) time

2. Find the closed-loop transfer function, $T(s) = C(s)/R(s)$ for the system shown in Figure P5.2, using block diagram reduction. [Section: 5.2]

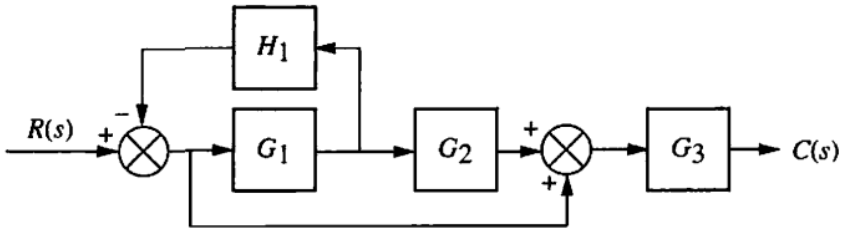

FIGURE P5.2

1. For the unity feedback system shown in Figure P7.1, where

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$$G(s) = \frac{450(s+8)(s+12)(s+15)}{s(s+38)(s^2+2s+28)}$$

find the steady-state errors for the following test inputs: $25u(t)$, $37tu(t)$, $47t^2u(t)$. [Section: 7.2]

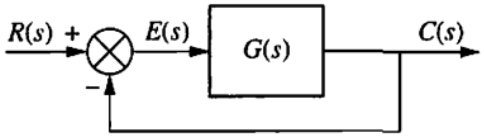
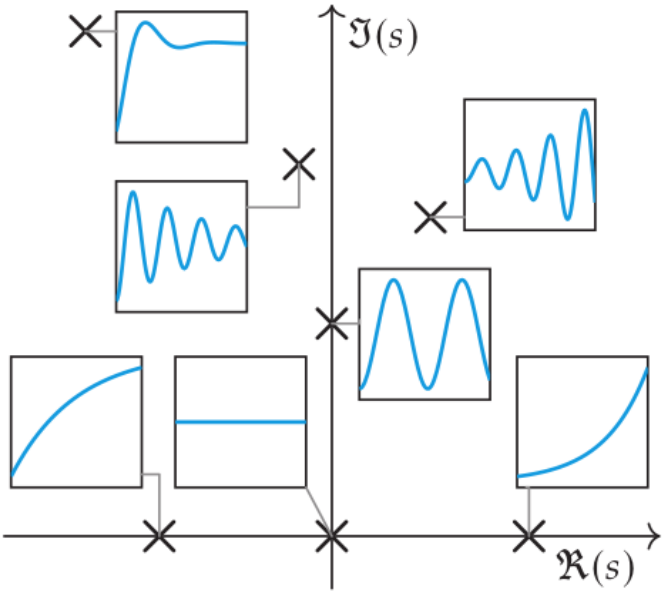
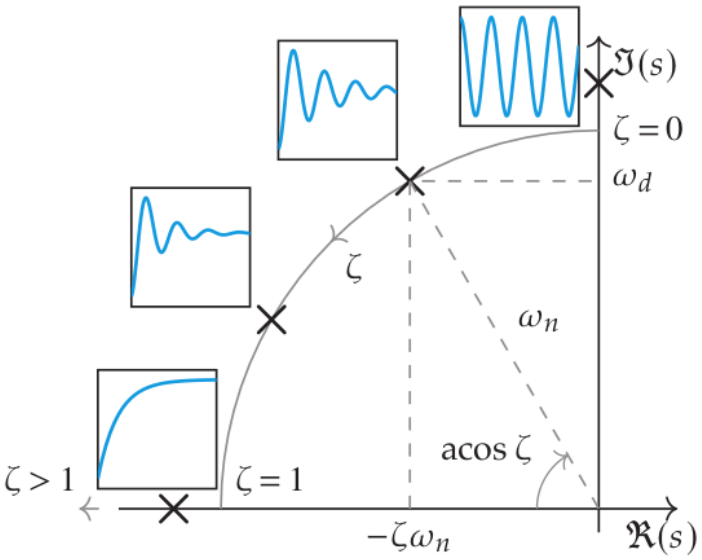
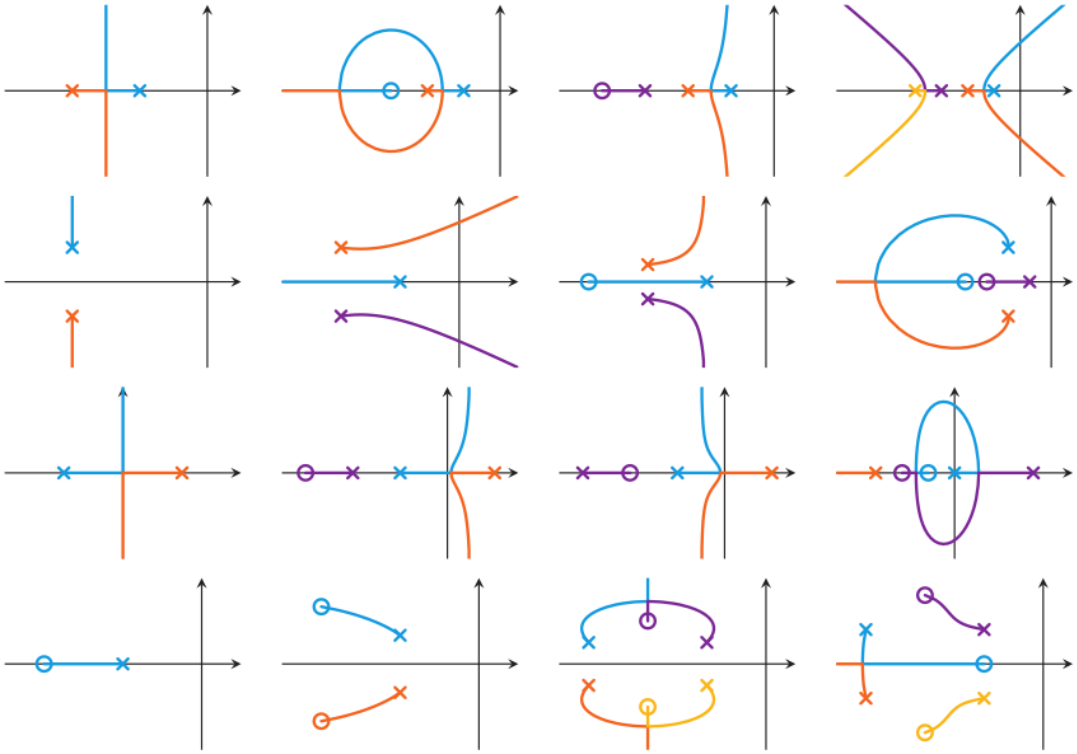


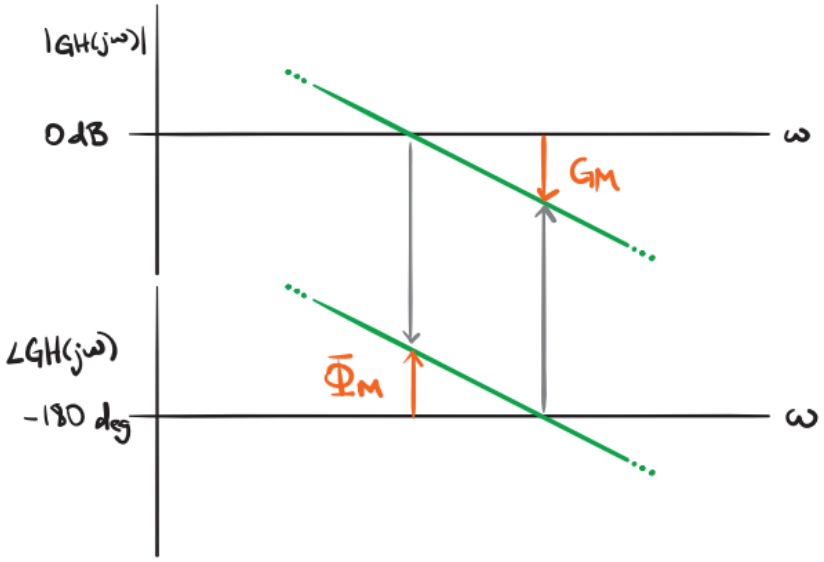
FIGURE P7.1


$\Im(s)$
$\Re(s)$


$\Im(s)$
$\zeta = 0$
ω_d
ζ
ω_n
acos ζ
$\zeta > 1$
$\zeta = 1$
$-\zeta\omega_n$
$\Re(s)$

Problem 7.1 7X If a closed-loop system has a set of complex conjugate poles at $p = -2.5 \pm j4.33$ and no zeros, what is the system's natural frequency, damping ratio, overshoot, and settling time?




|GH(jω)|
0dB
ω
GM
∠GH(jω)
-180 deg
ΦM
ω

1. Tell how many roots of the following polynomial are in the right half-plane, in the left half-plane, and on the $j\omega$-axis: [Section: 6.2]

$$P(s) = s^5 + 3s^4 + 5s^3 + 4s^2 + s + 3$$