

Chapter 8

Root Locus Techniques

Figure 8.1

a. Closed-loop system;
b. equivalent transfer function

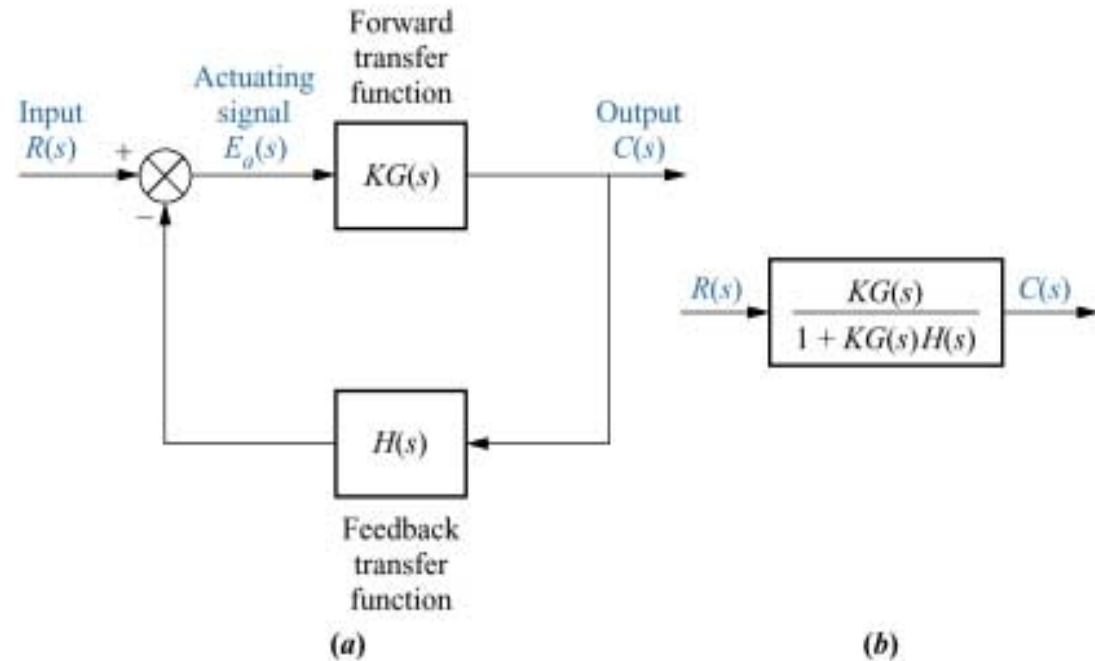


Figure 8.2

Vector representation
of complex numbers:

a. $5 = s + j\omega$;

b. $(s + a)$;

c. alternate
representation
of $(s + a)$;

d. $(s + 7)|_{s \in 5 + j2}$

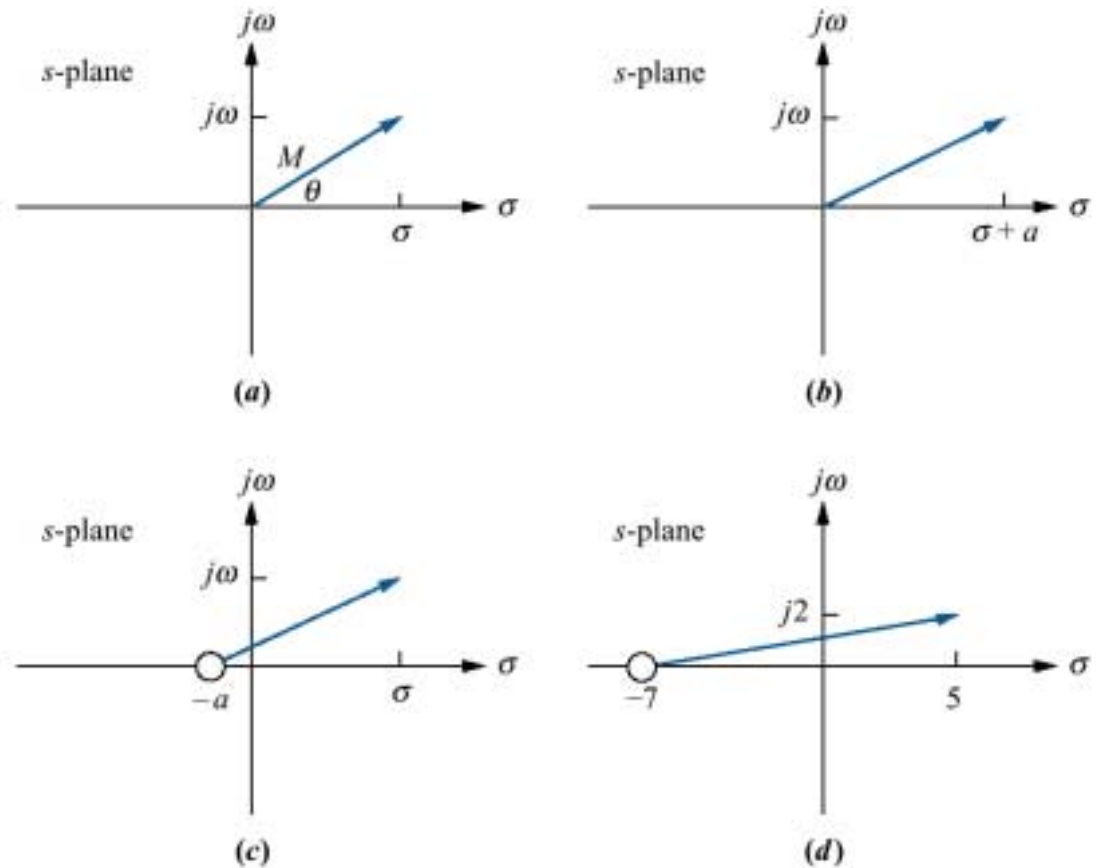


Figure 8.3
Vector representation
of Eq. (8.7)

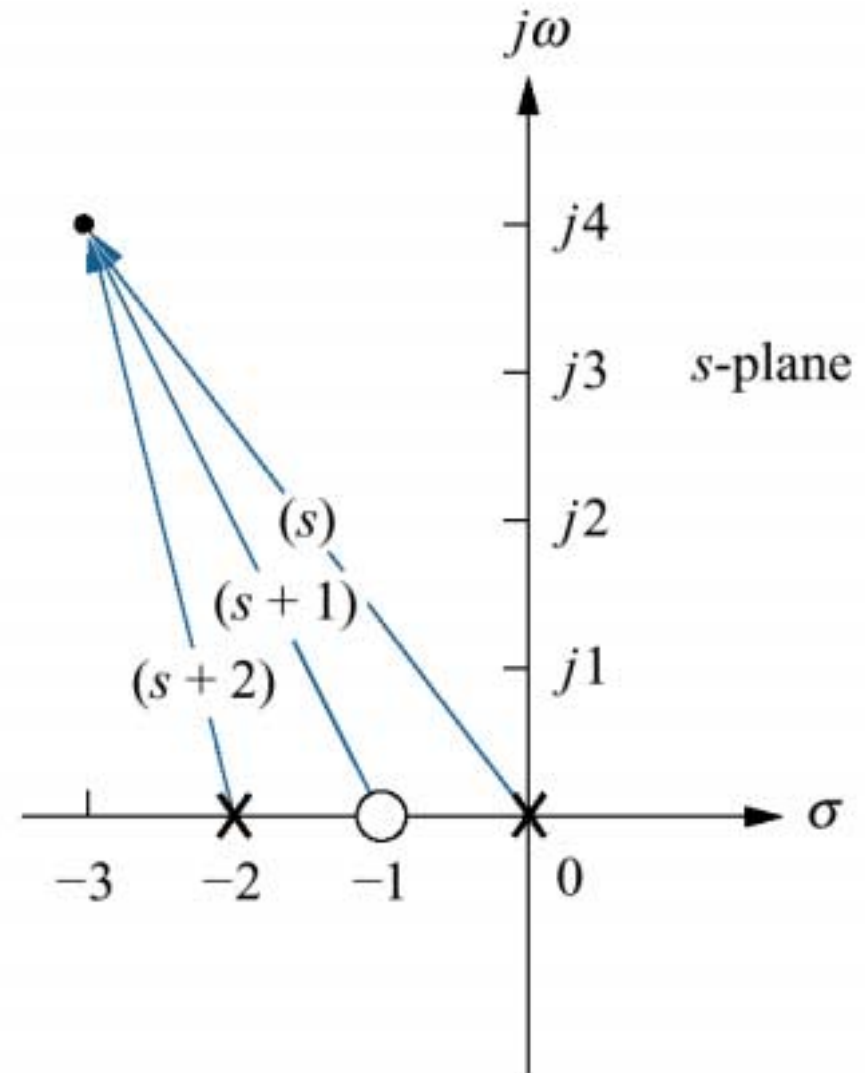


Figure 8.4**a.**

CameraMan® Presenter Camera System automatically follows a subject who wears infrared sensors on their front and back (the front sensor is also a microphone); tracking commands and audio are relayed to CameraMan via a radio frequency link from a unit worn by the subject;

b. block diagram;

c. closed-loop transfer function

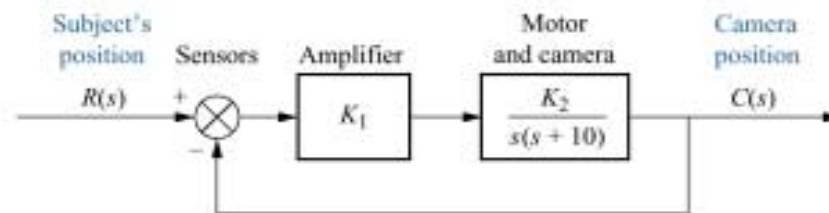
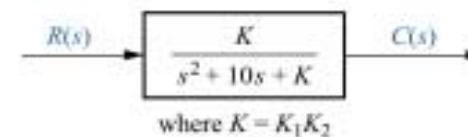
**(a)****(b)****(c)**

Figure 8.5
a. Pole plot from
 Table 8.1;
b. root locus

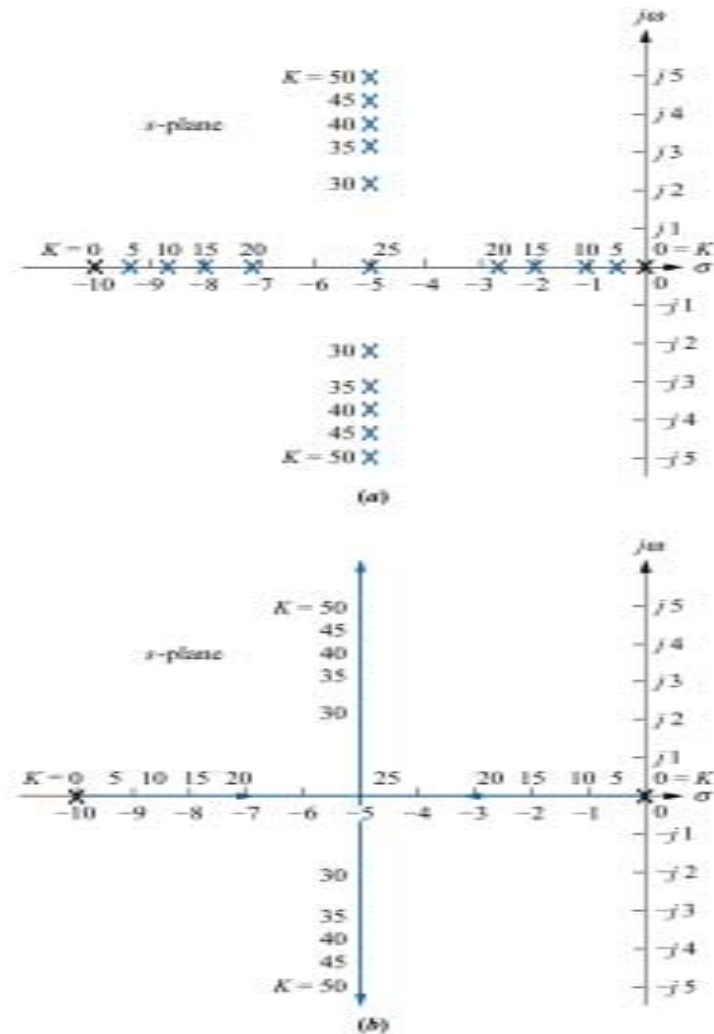


Figure 8.6

- a.** Example system;
b. pole-zero plot of $G(s)$

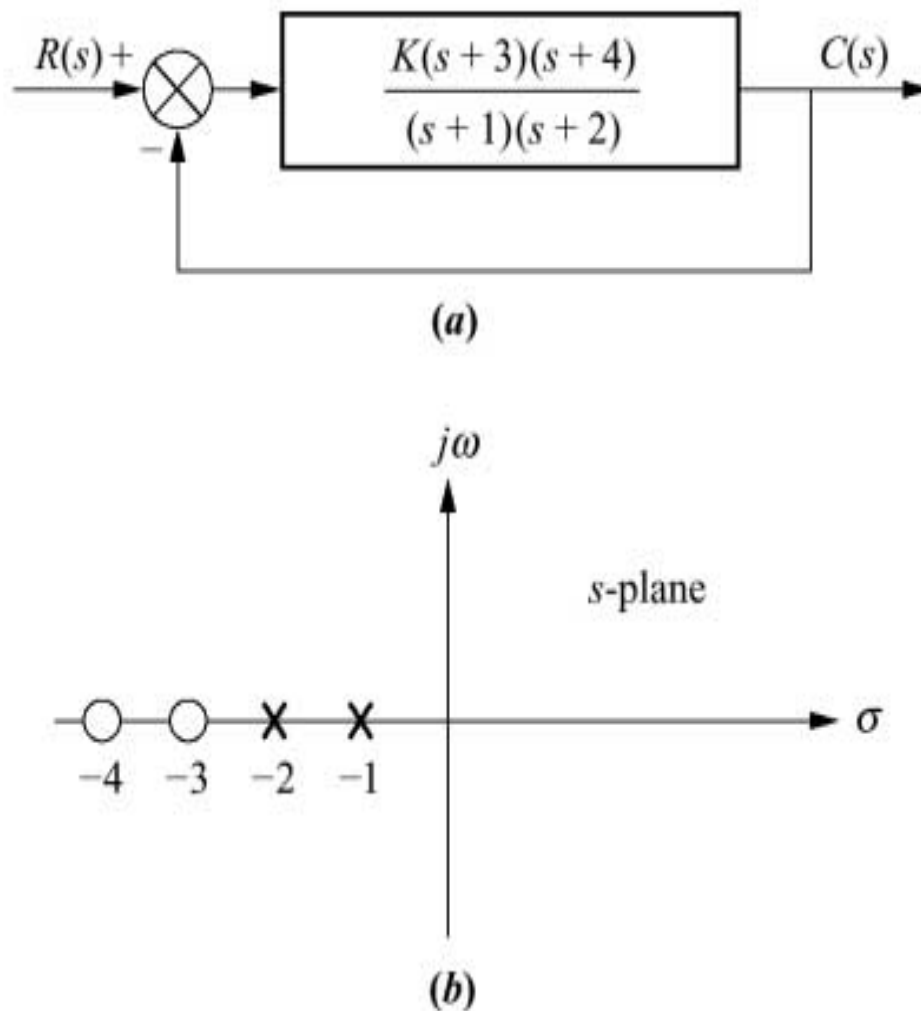


Figure 8.7
Vector representation
of $G(s)$ from Figure
8.6(a) at $-2 + j3$

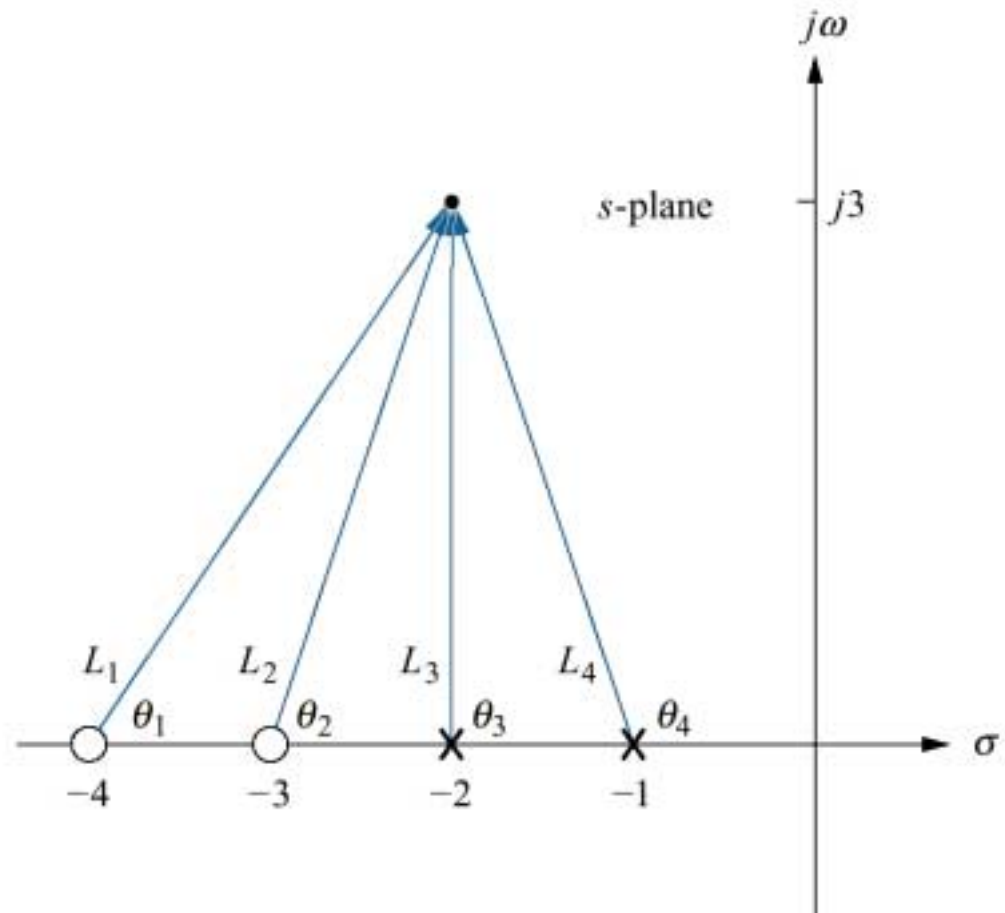


Figure 8.8
Poles and
zeros
of a general
open-loop
system with
test points,
 P_j , on the
real axis

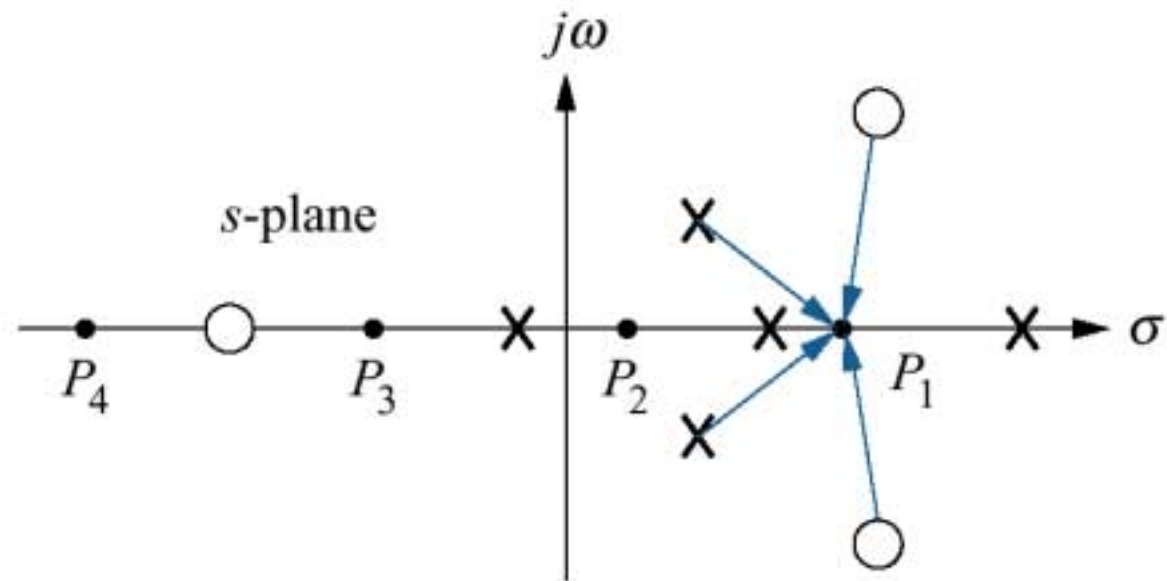


Figure 8.9

Real-axis segments of the root locus for the system of Figure 8.6

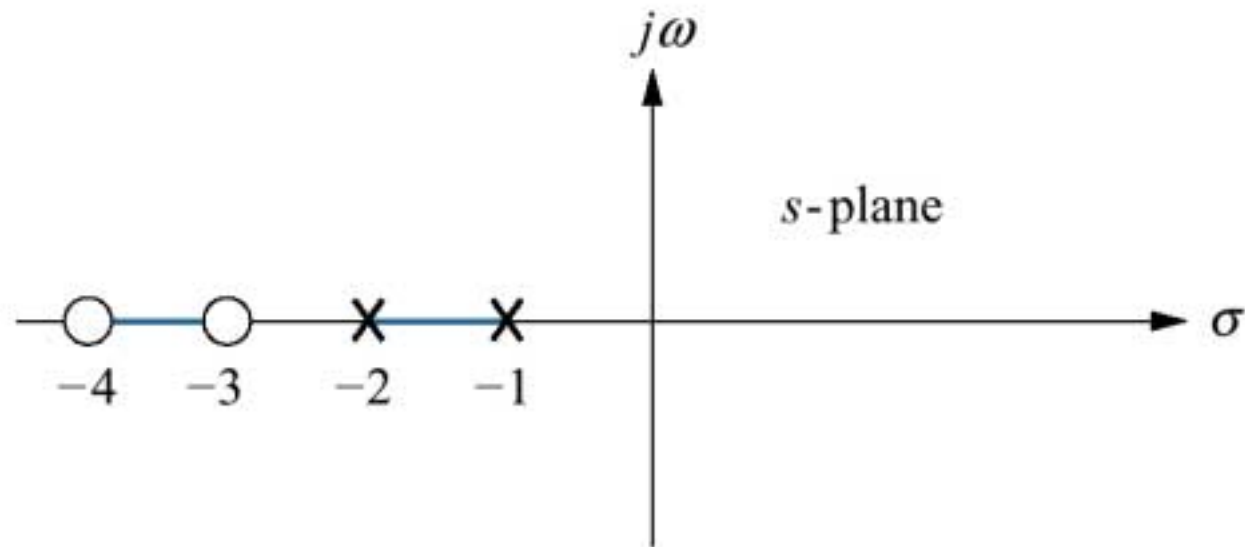


Figure 8.10
Complete root
locus for the
system of
Figure 8.6

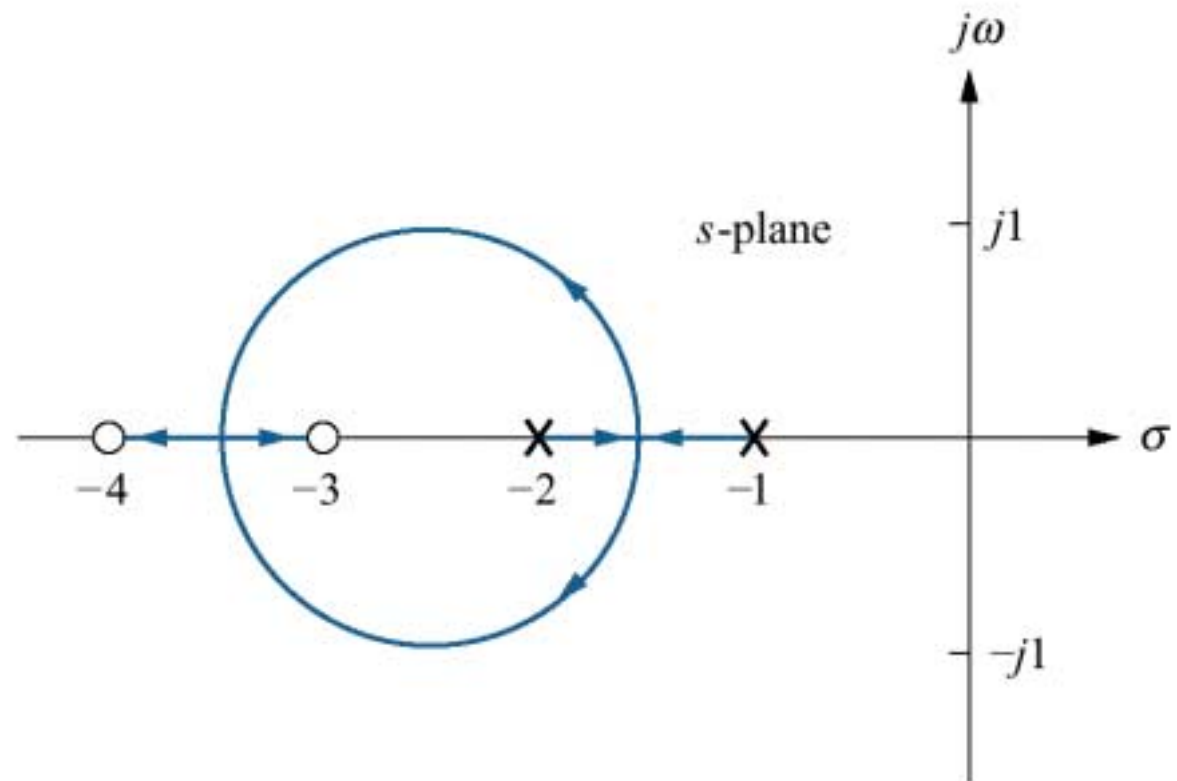


Figure 8.11
System for
Example 8.2

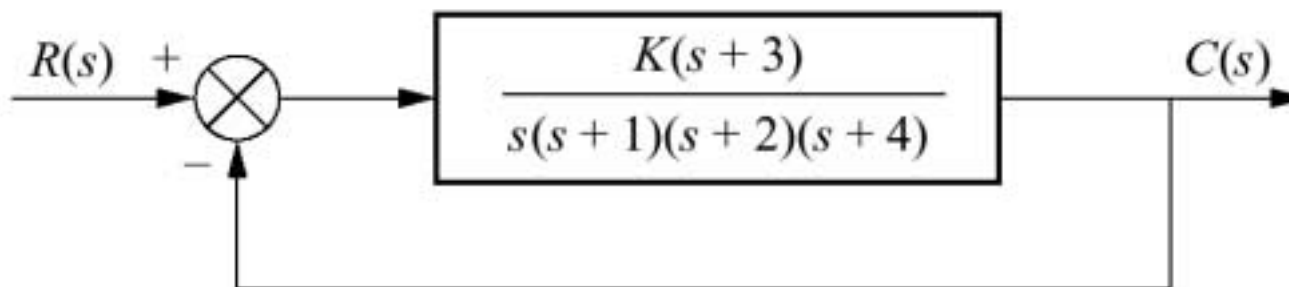


Figure 8.12
Root locus and asymptotes for the system of Figure 8.11

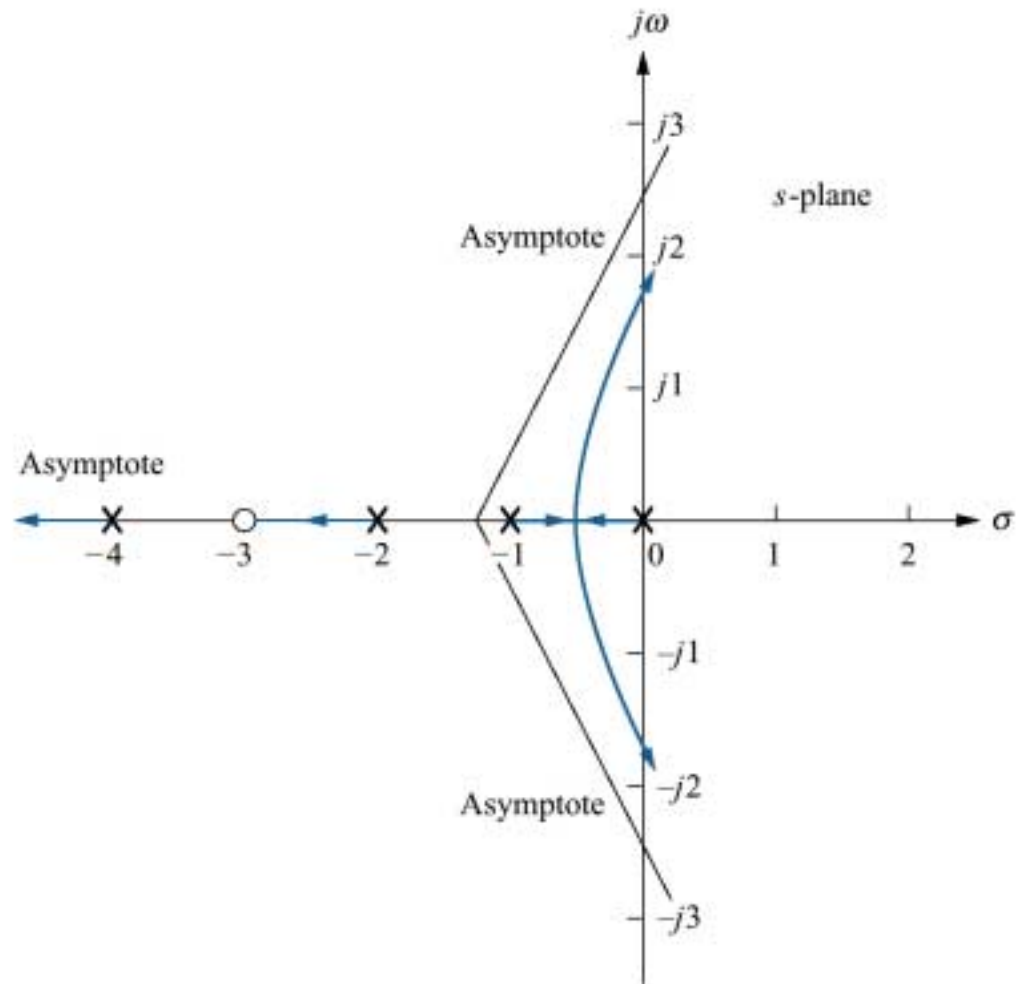


Figure 8.13

Root locus example showing real-axis breakaway ($=s_1$) and break-in points (s_2)

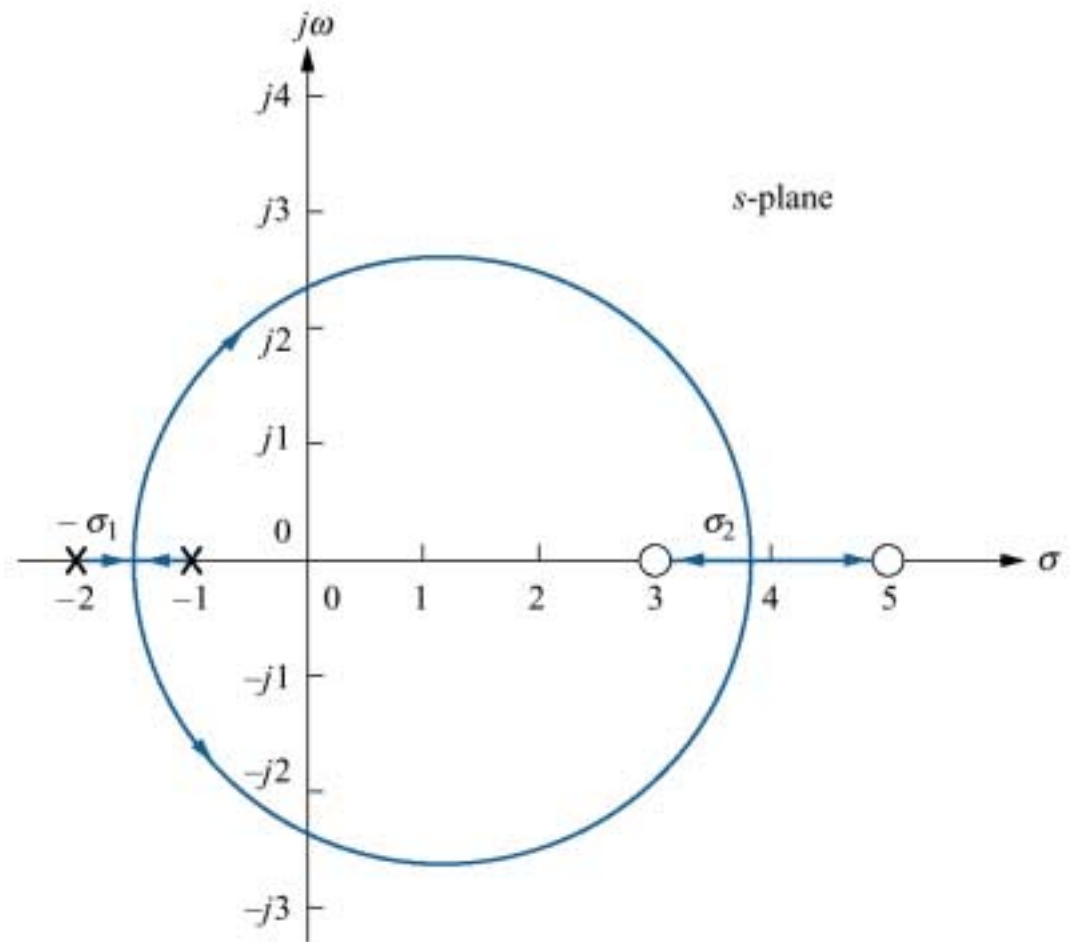


Figure 8.14

Variation of gain
along the real axis for
the root locus of
Figure 8.13

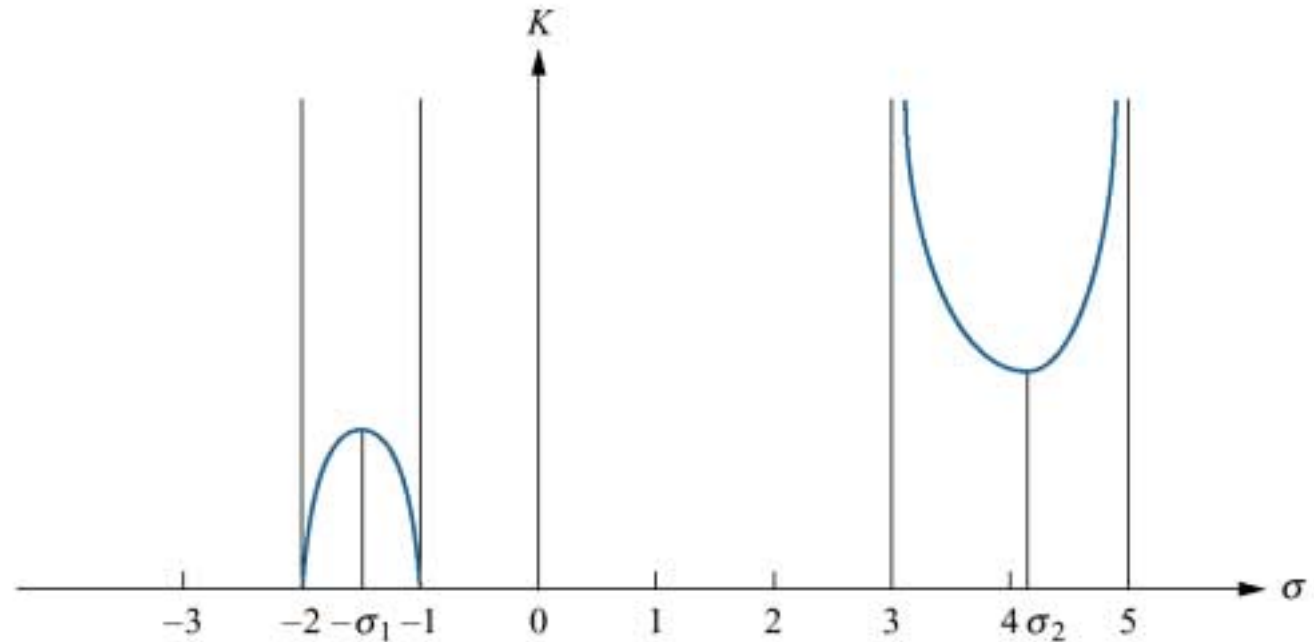


Figure 8.15

Open-loop poles and zeros and calculation of:

- a. angle of departure;
- b. angle of arrival

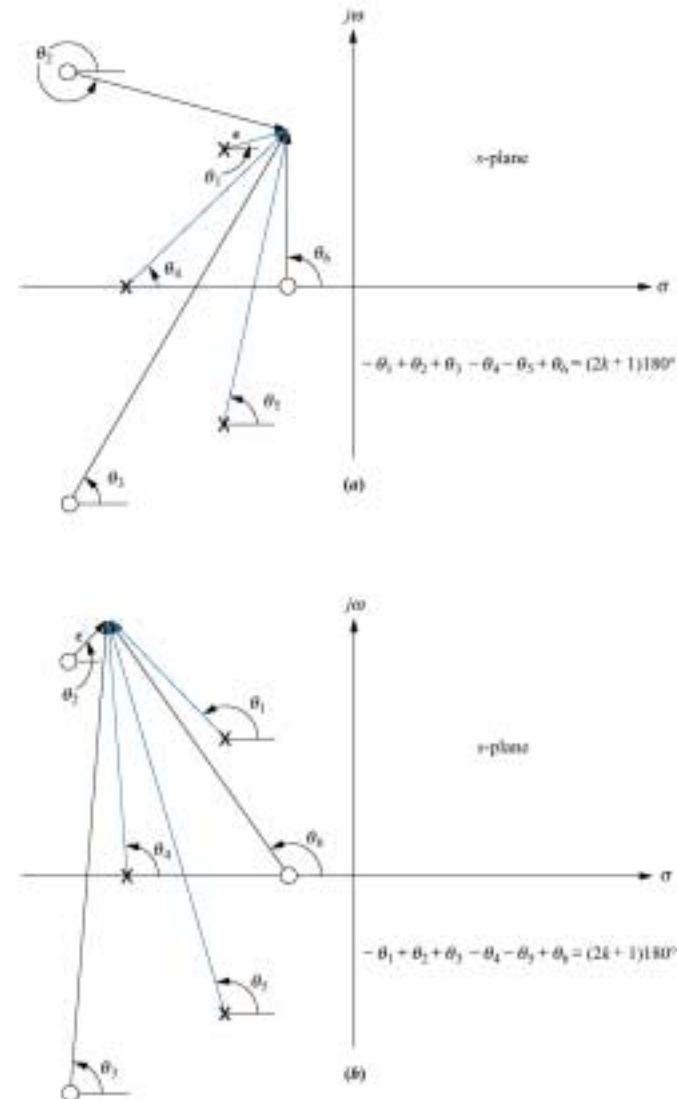


Figure 8.16
Unity feedback
system
with complex poles

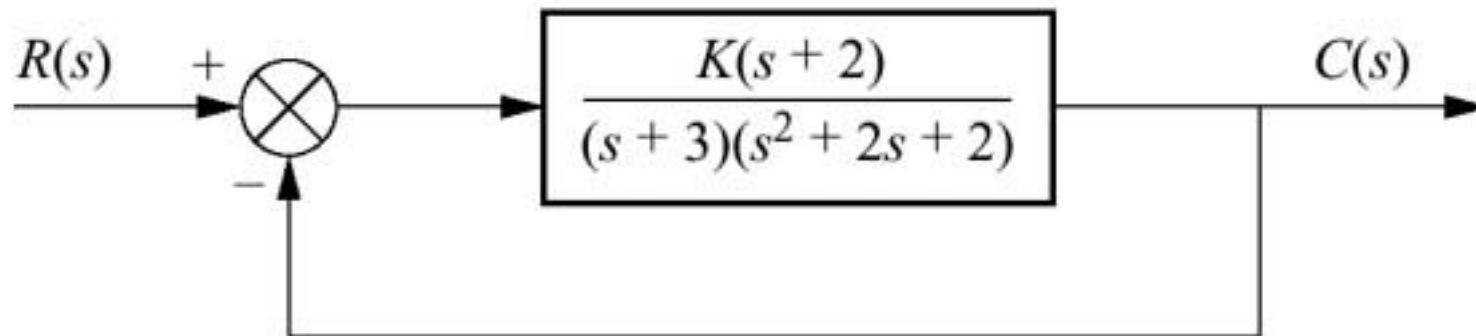


Figure 8.17
Root locus for system
of Figure 8.16
showing angle of
departure

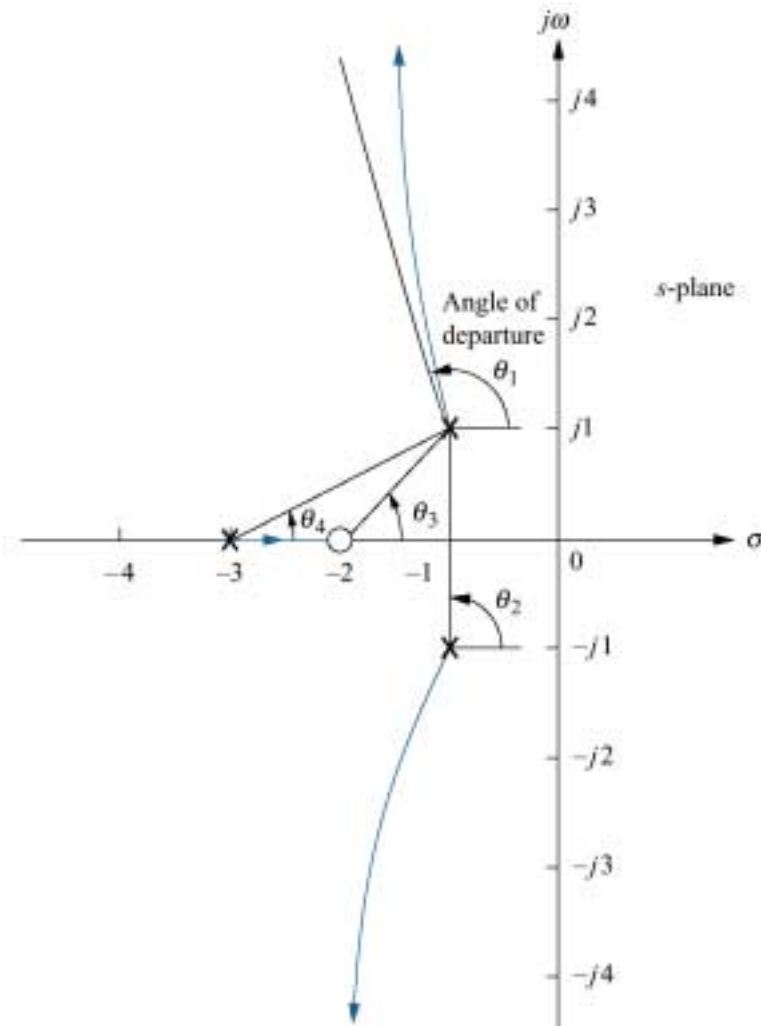


Figure 8.18

Finding and calibrating
exact points on
the root locus of
Figure 8.12

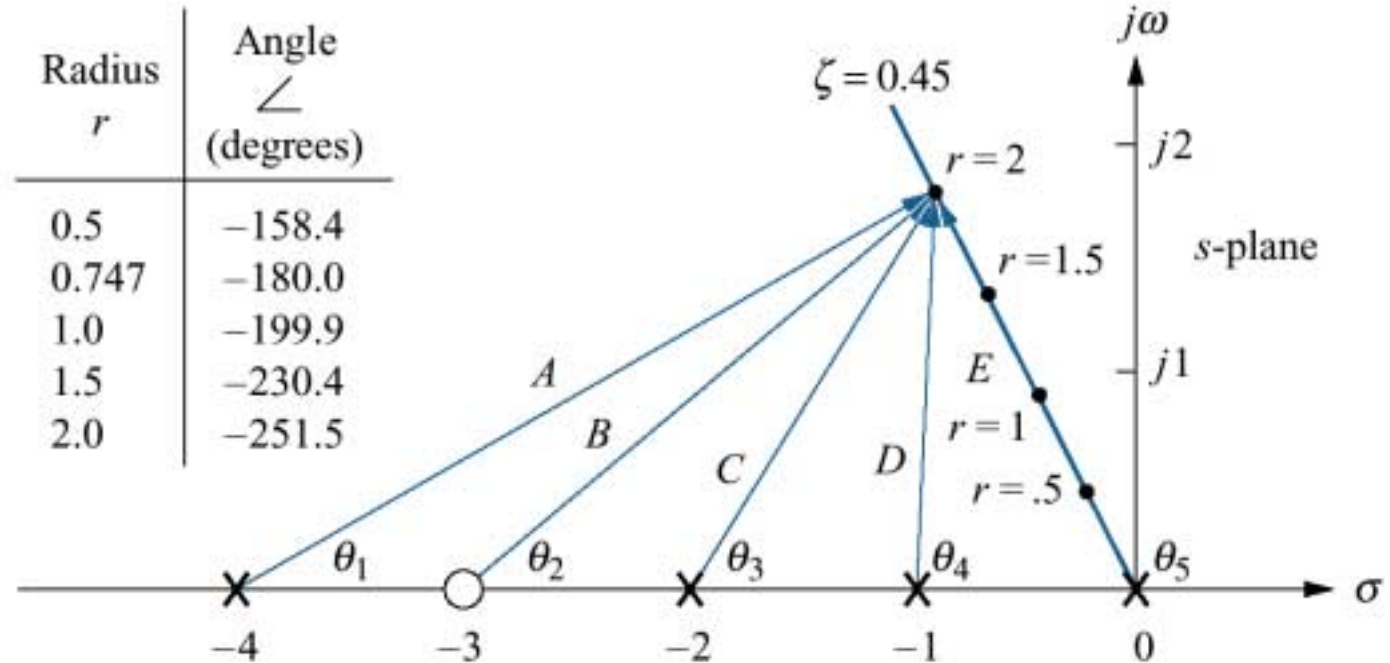


Figure 8.19

- a. System for
Example 8.7;
b. root locus sketch

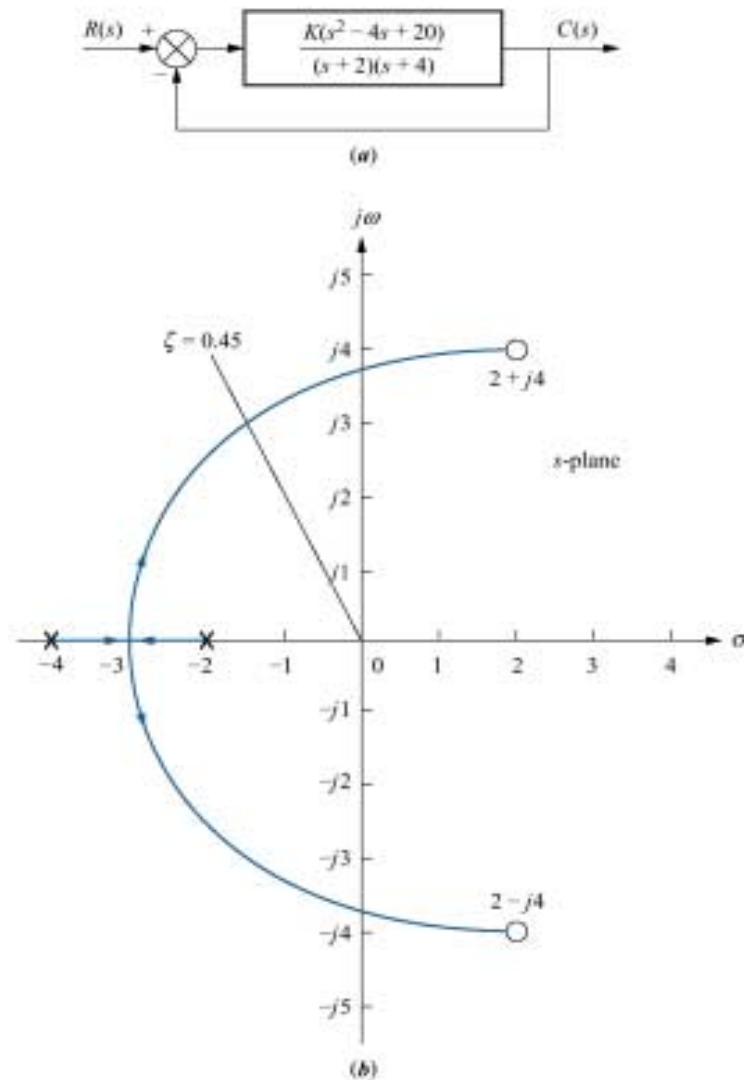


Figure 8.20
Making second- order approximations

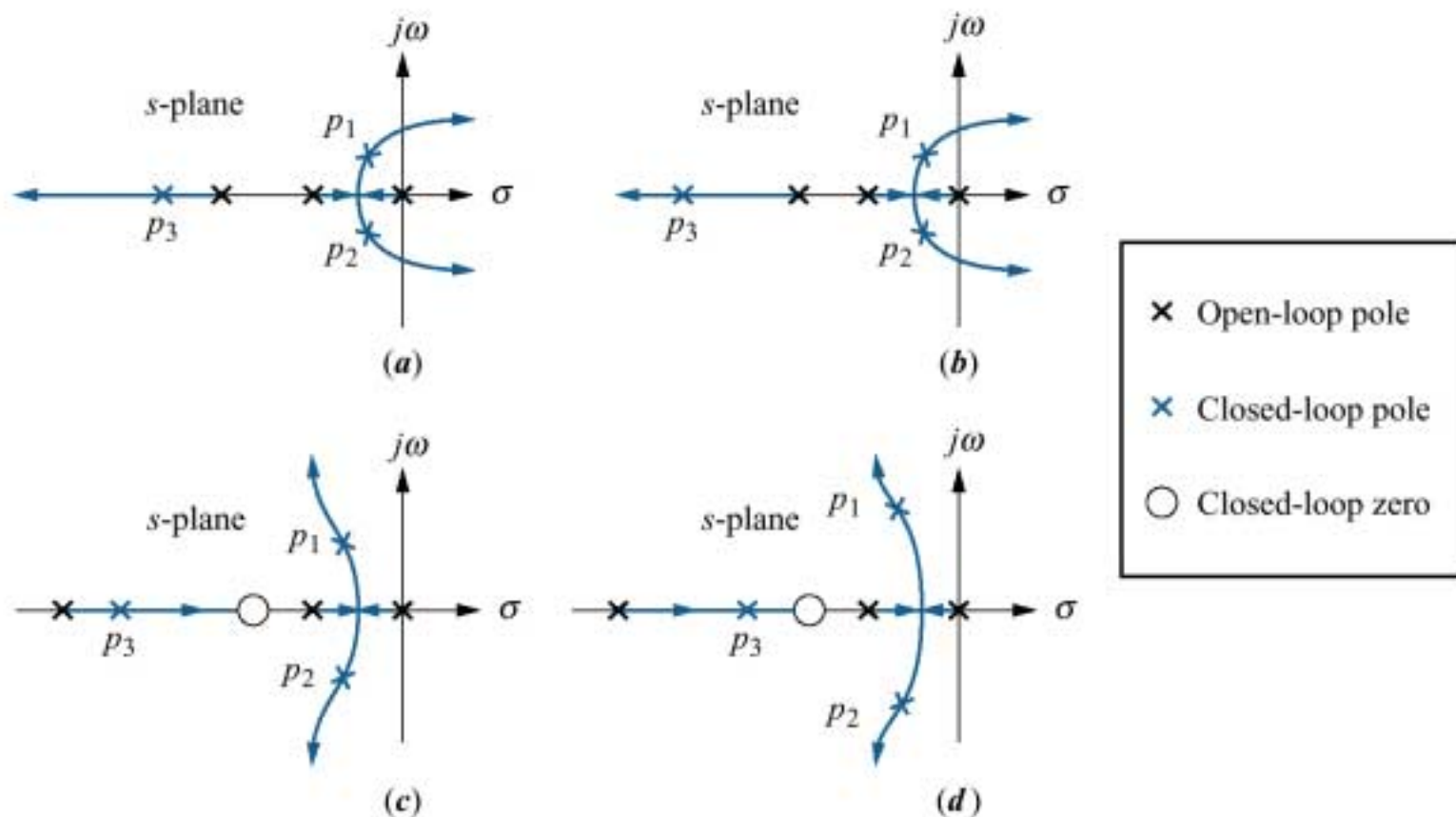


Figure 8.21
System for
Example 8.8

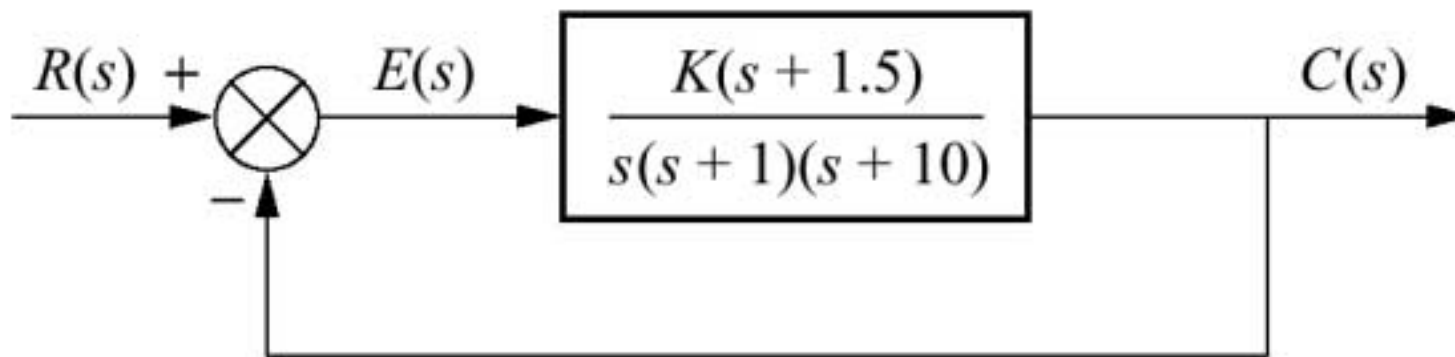


Figure 8.22
Root locus for
Example 8.8

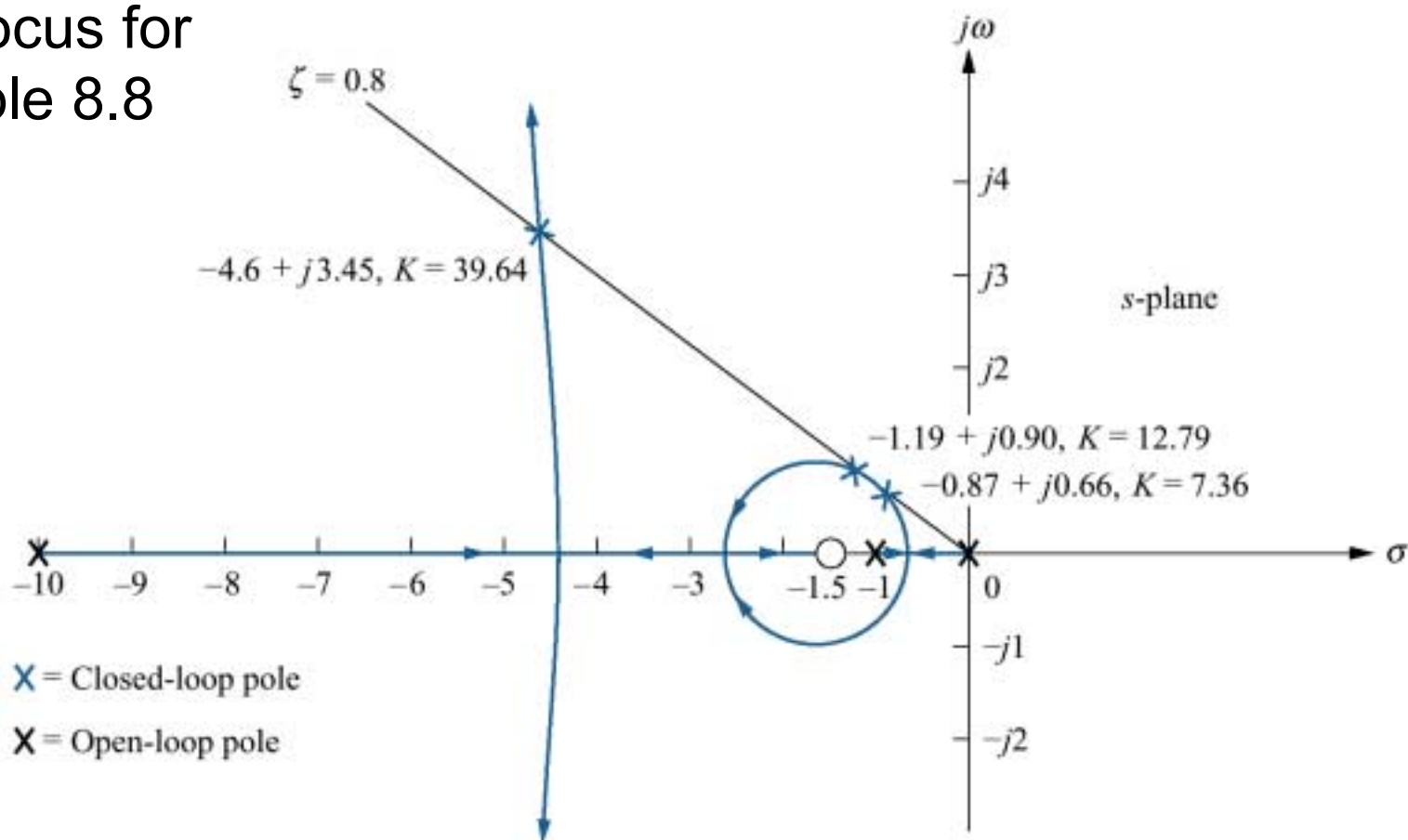


Figure 8.23
Second- and third-order
responses for
Example 8.8:
a. Case 2;
b. Case 3

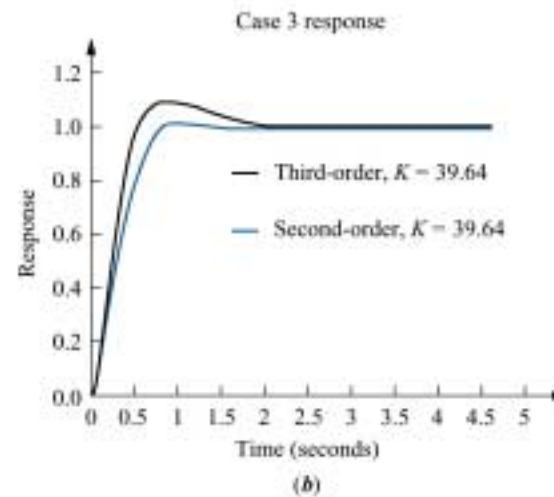
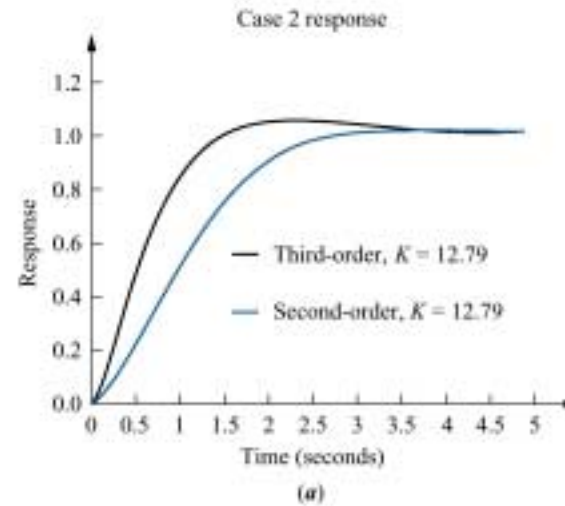


Figure 8.24

System requiring a
root locus calibrated
with p_1 as a
parameter

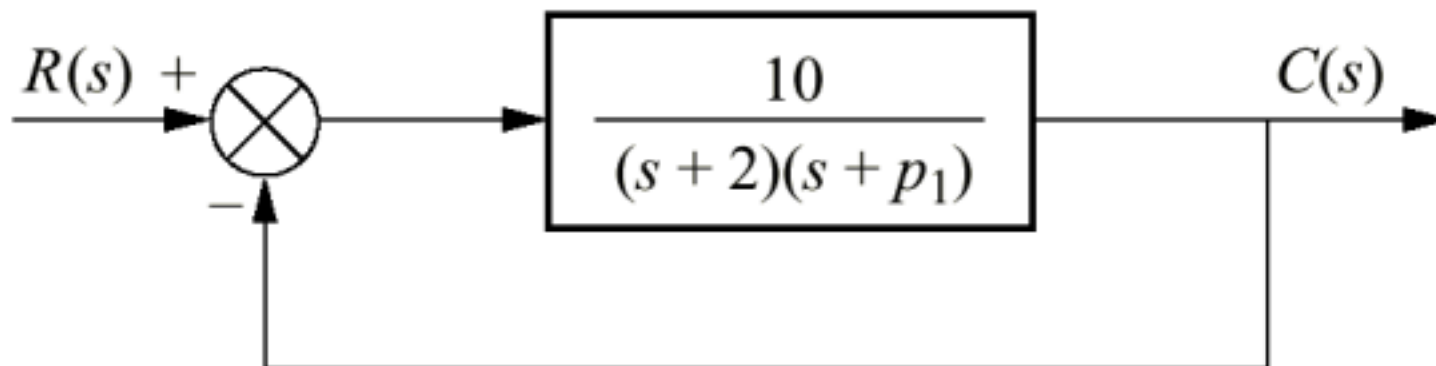


Figure 8.25

Root locus for the system of Figure 8.24, with p_1 as a parameter

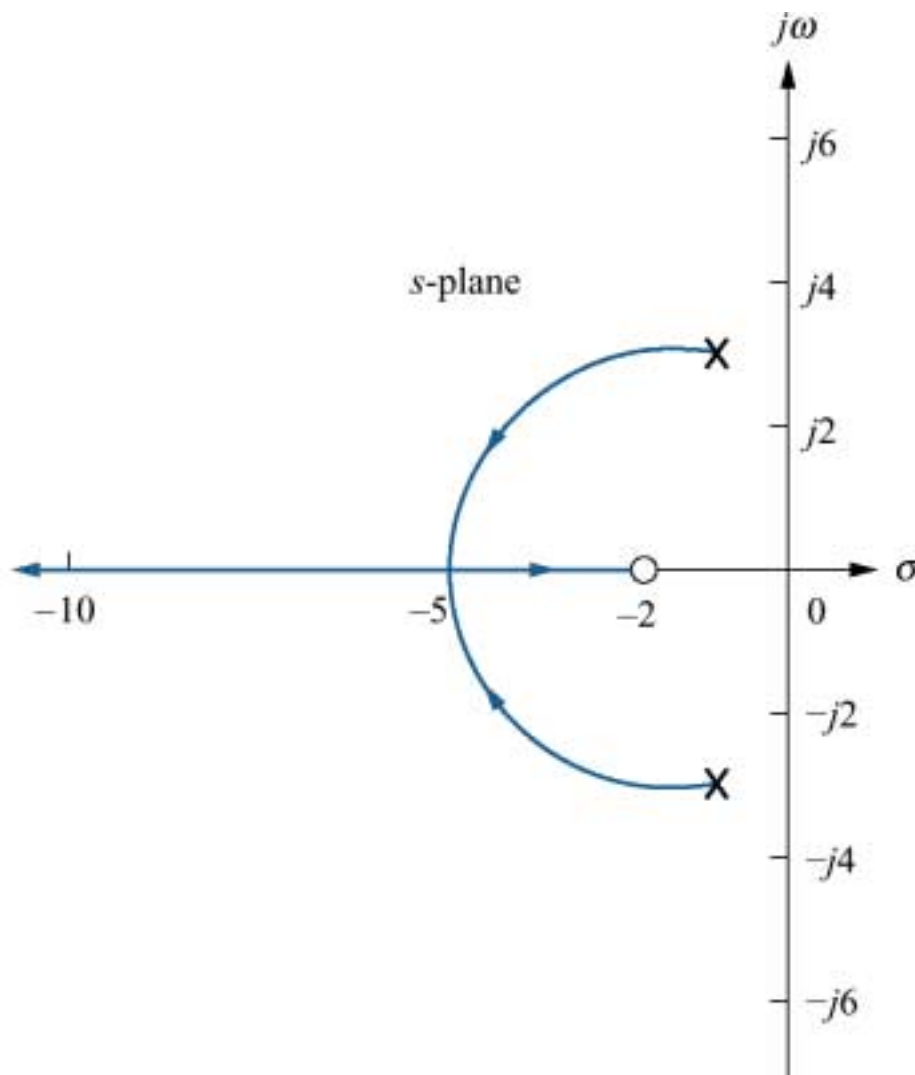


Figure 8.26
Positive-feedback
system

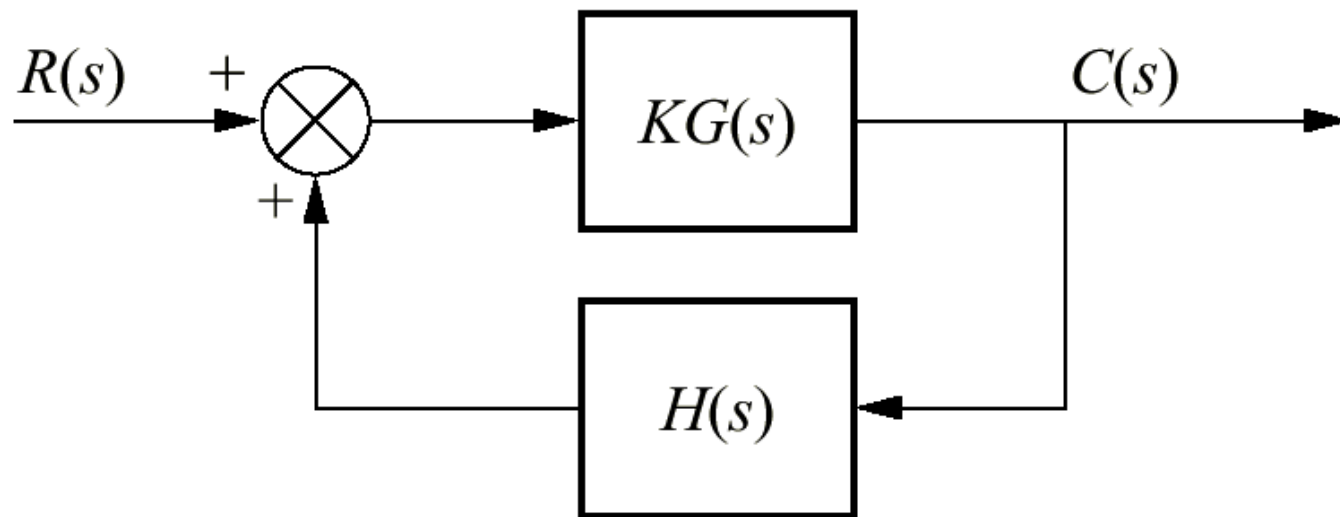


Figure 8.27

- a.** Equivalent positive-feedback system for Example 8.9;
b. root locus

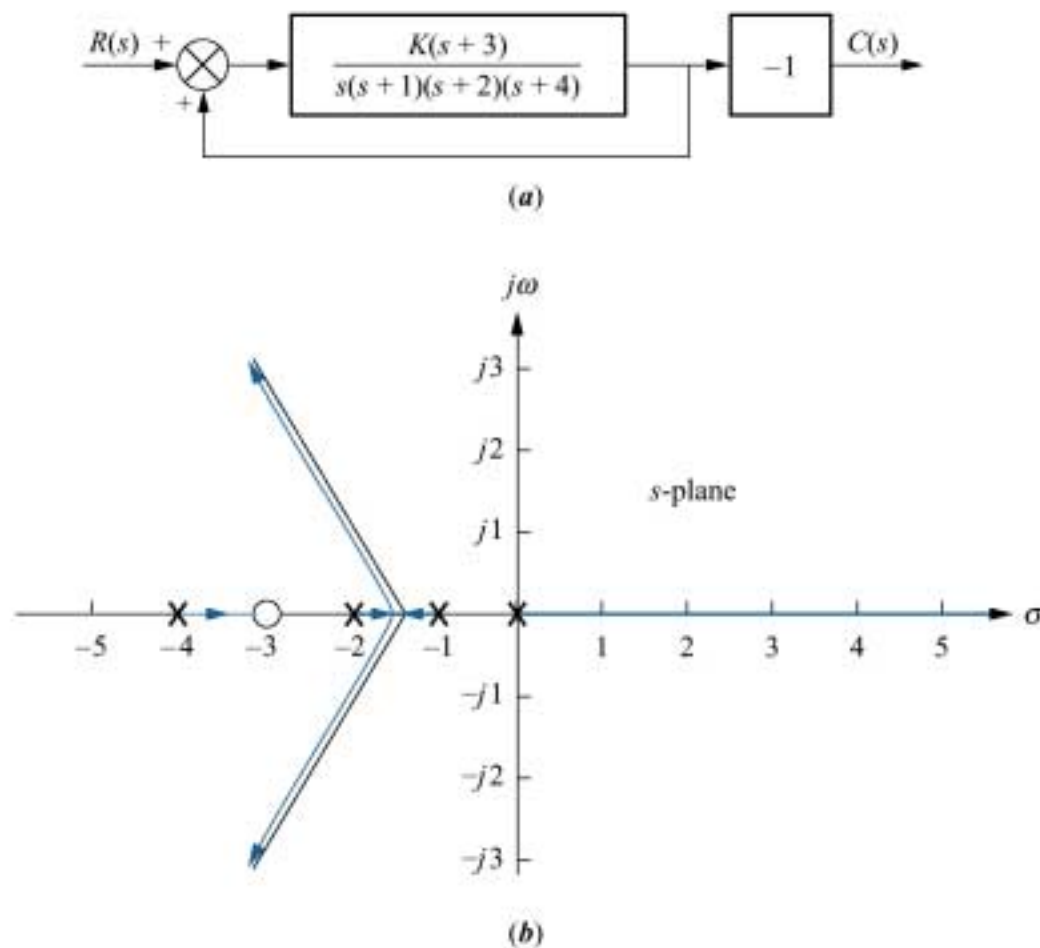


Figure 8.28

Portion of the root locus for the antenna control system

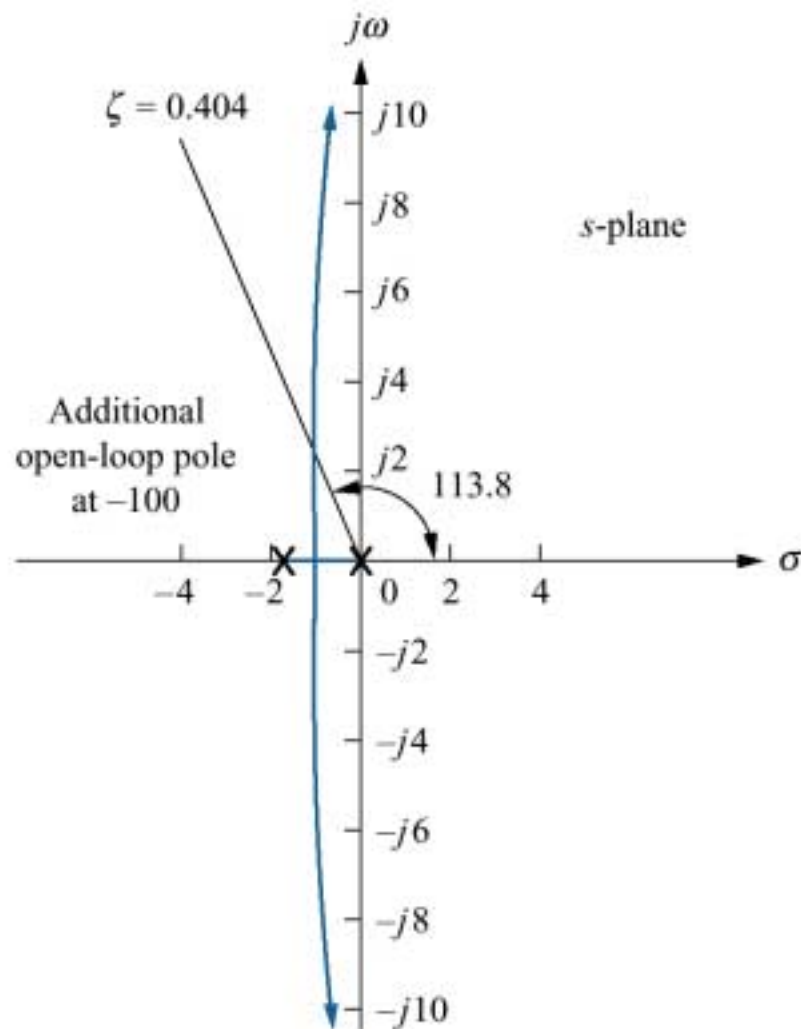


Figure 8.29

Step response of the
gain-adjusted antenna
control system

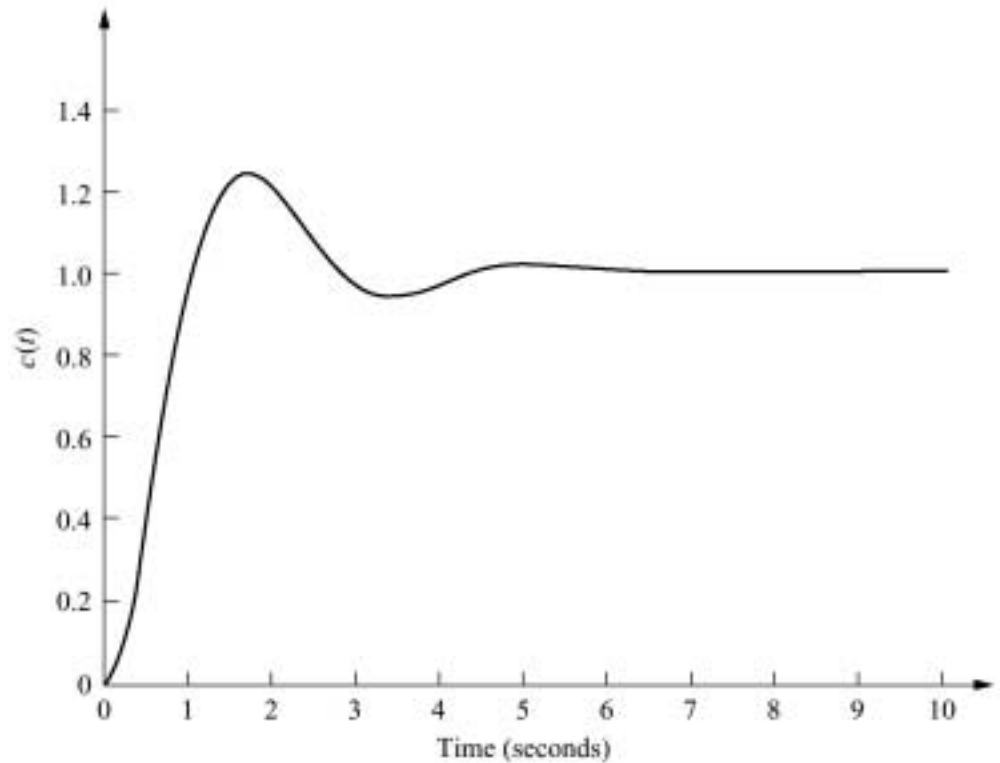


Figure 8.30

Root locus of pitch control loop without rate feedback, UFSS vehicle

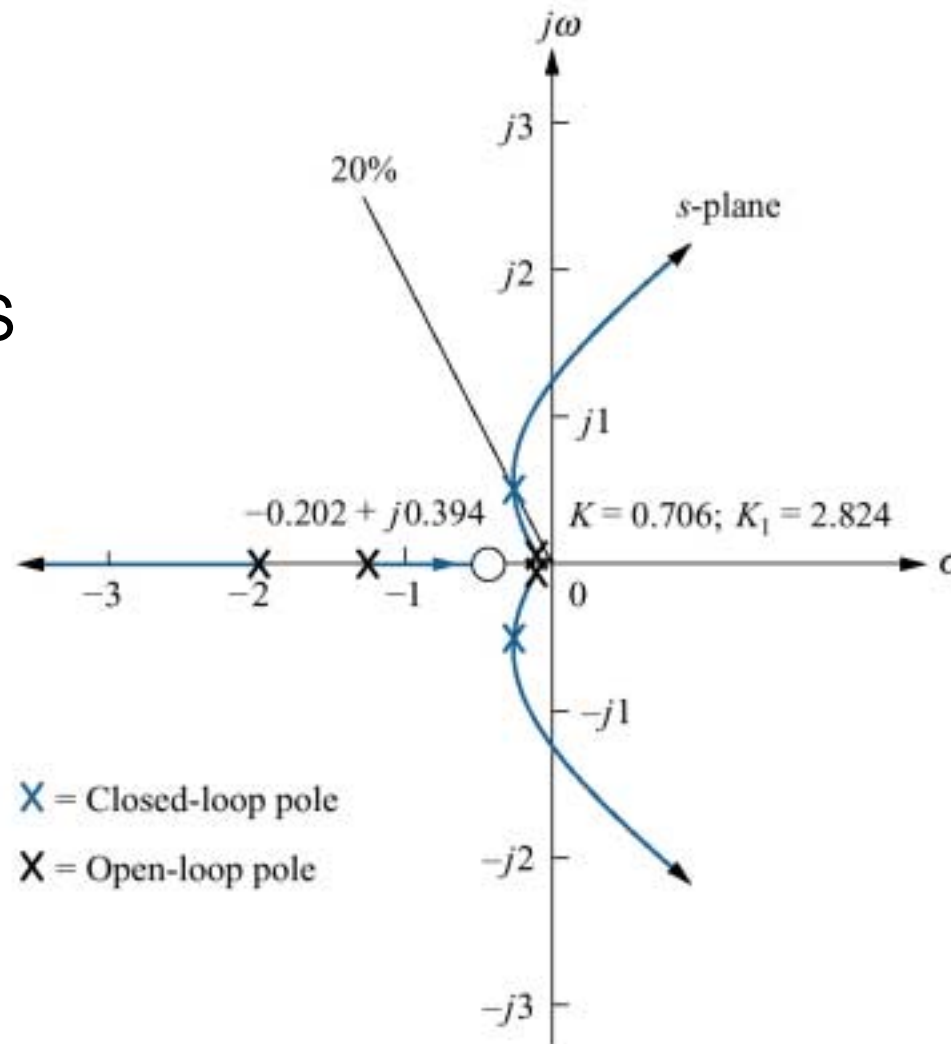


Figure 8.31
Computer simulation of step response of pitch control loop without rate feedback, UFSS vehicle

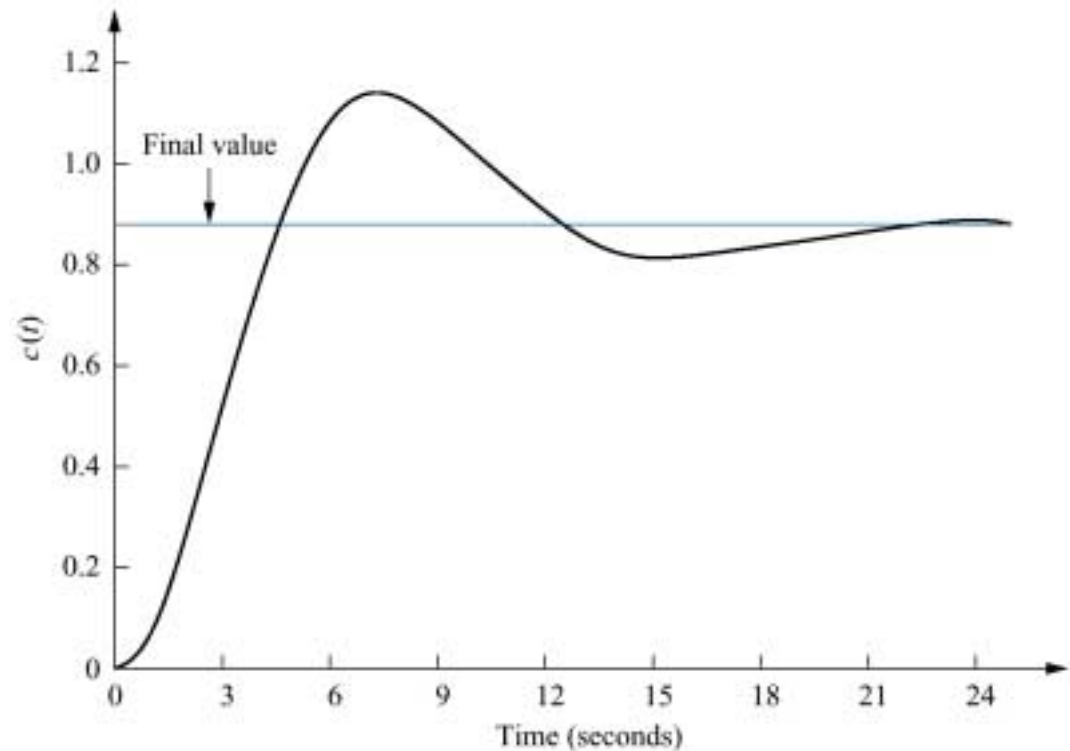


Figure 8.32
 Root locus of pitch control loop with rate feedback, UFSS vehicle

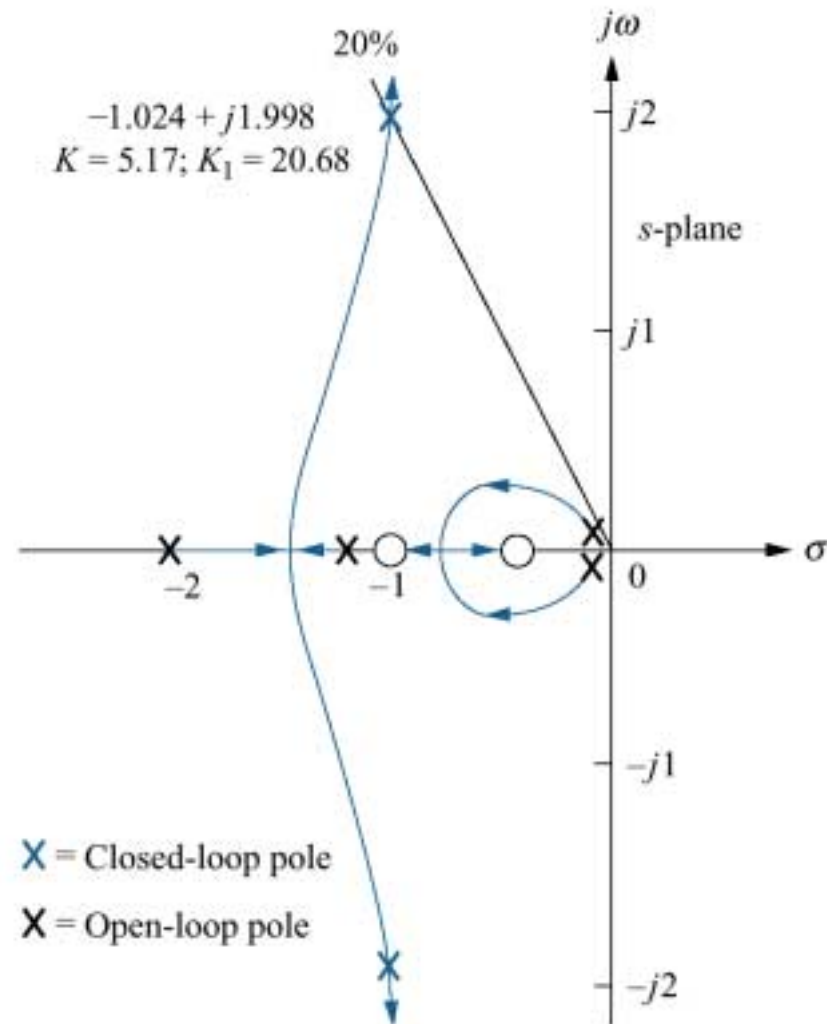


Figure 8.33

Computer simulation of step response of pitch control loop with rate feedback, UFSS vehicle

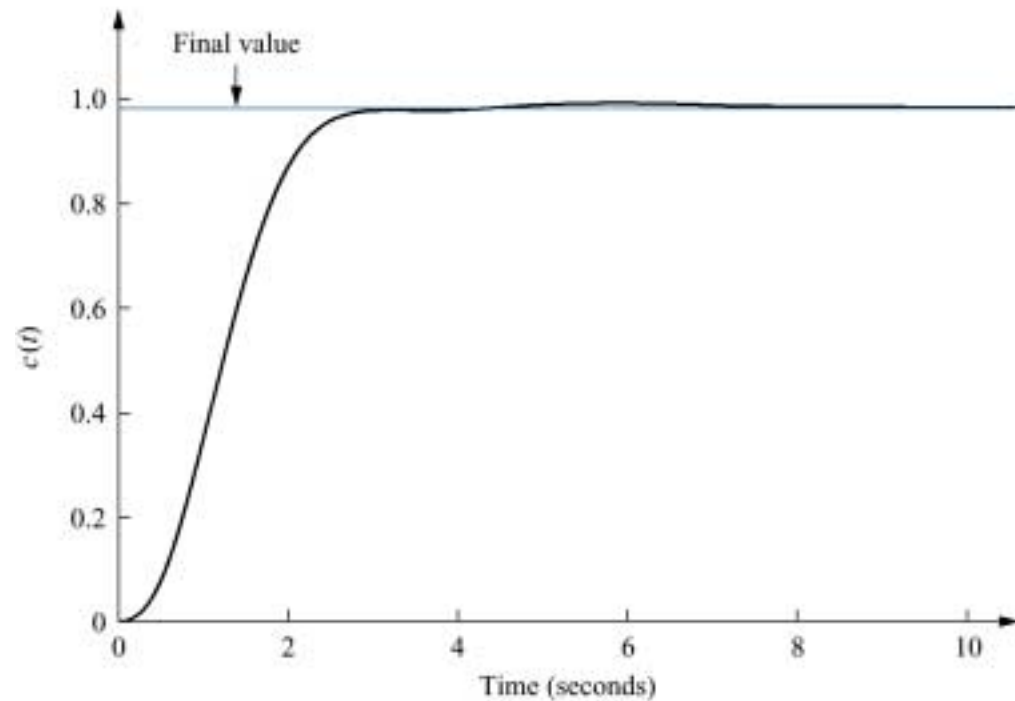


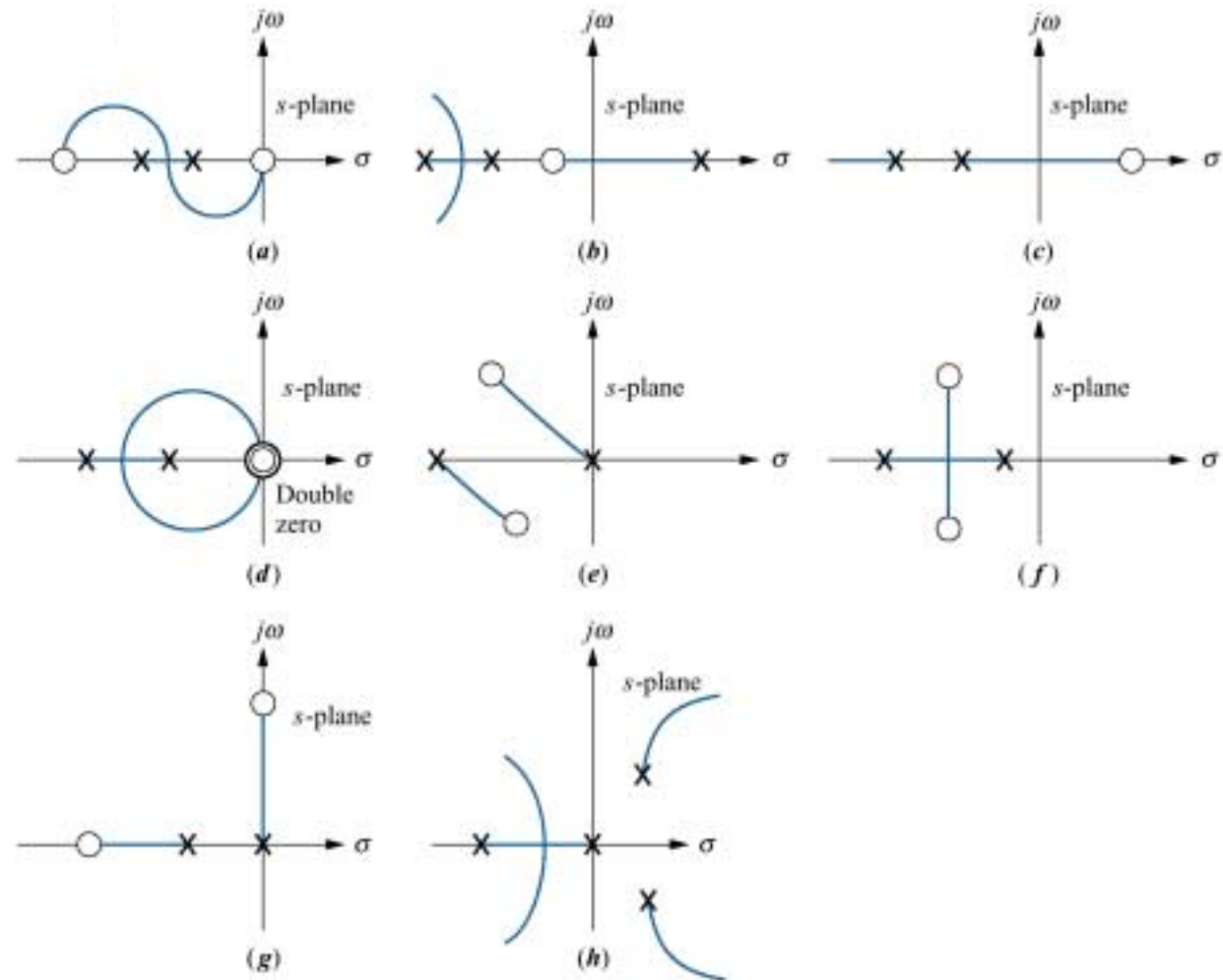
Figure P8.1

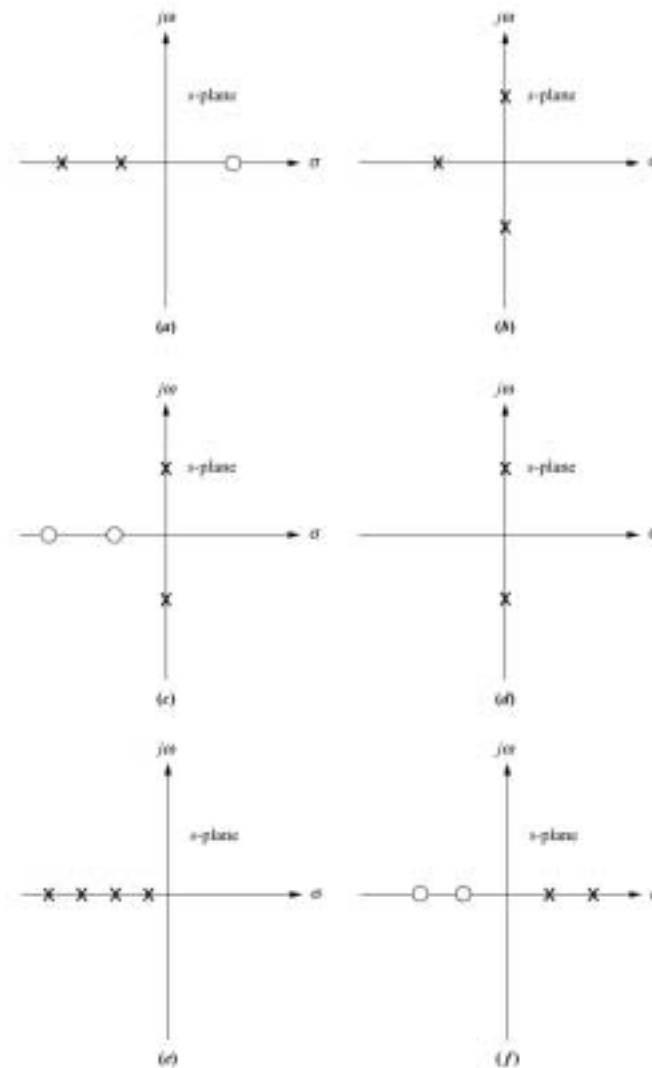
Figure P8.2

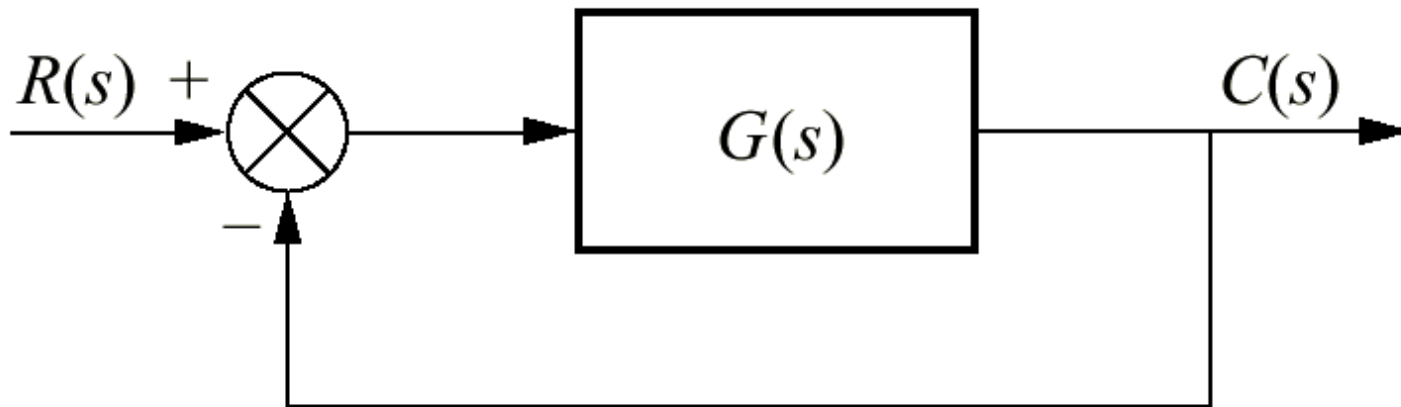
Figure P8.3

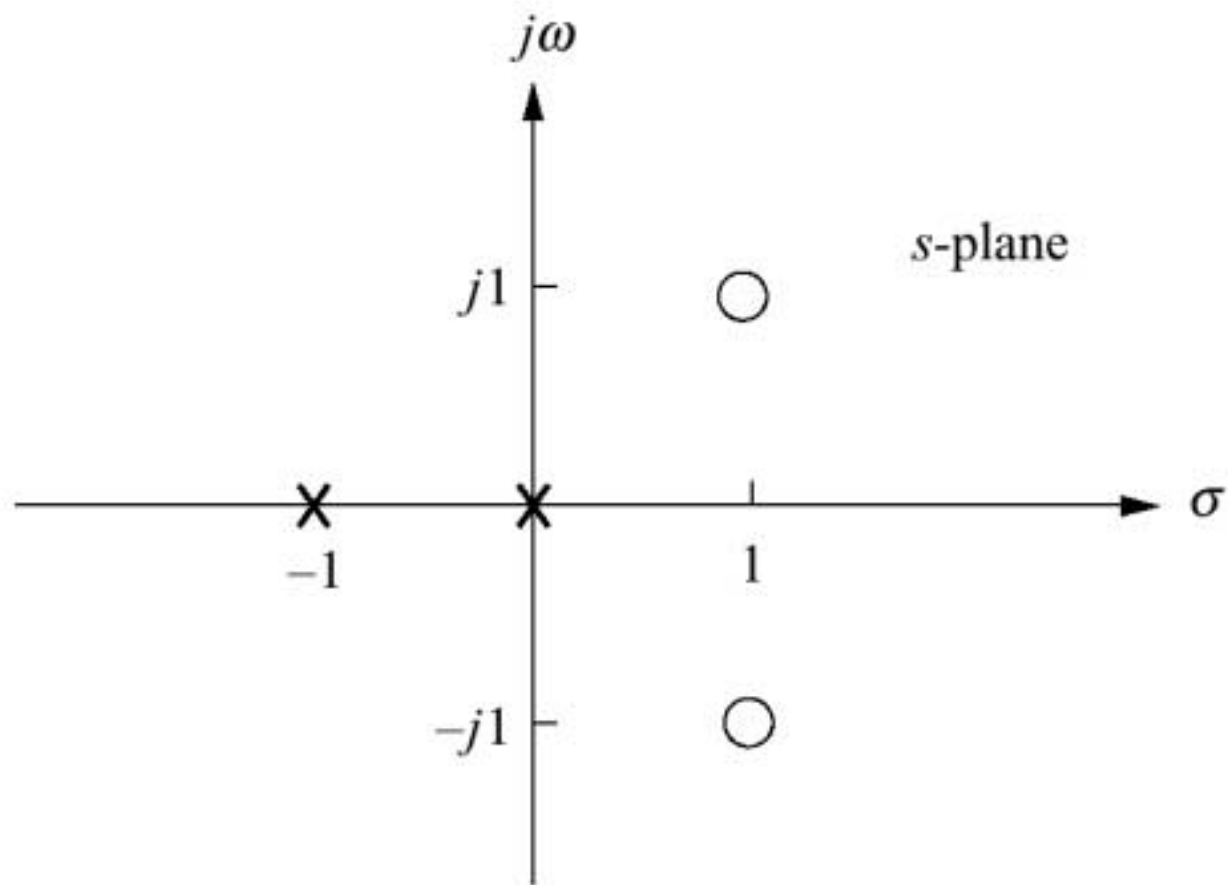
Figure P8.4

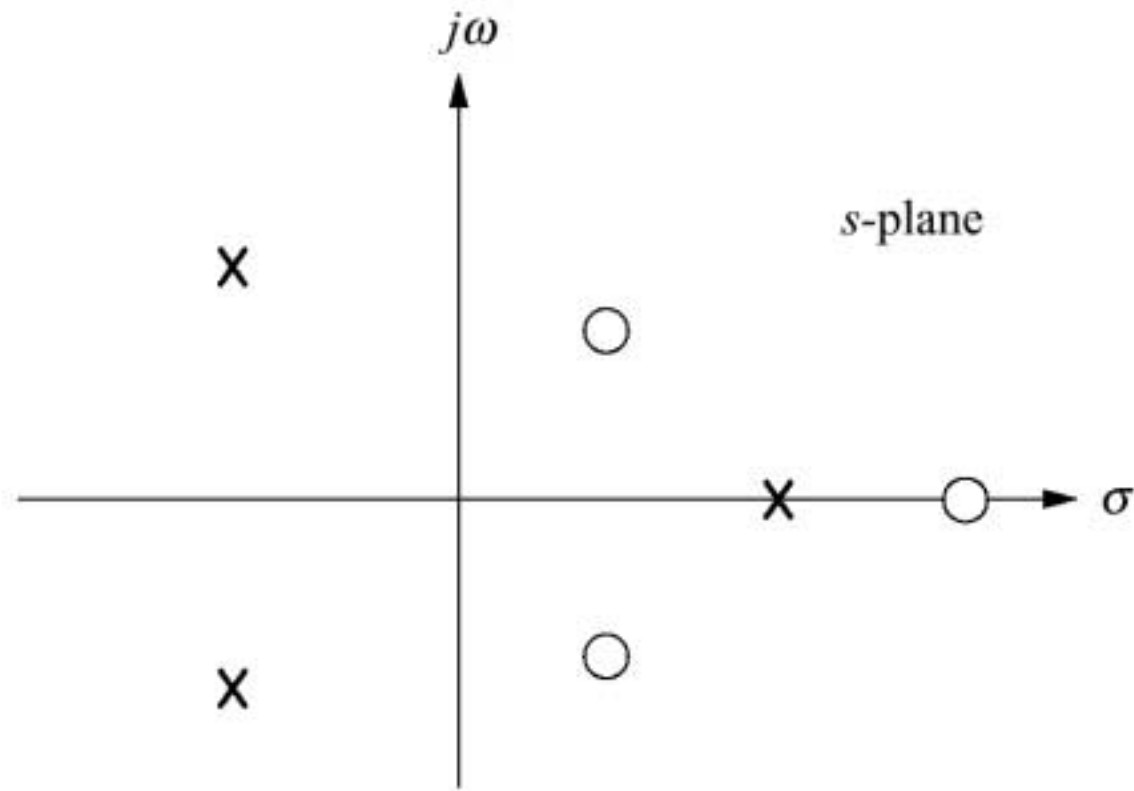
Figure P8.5

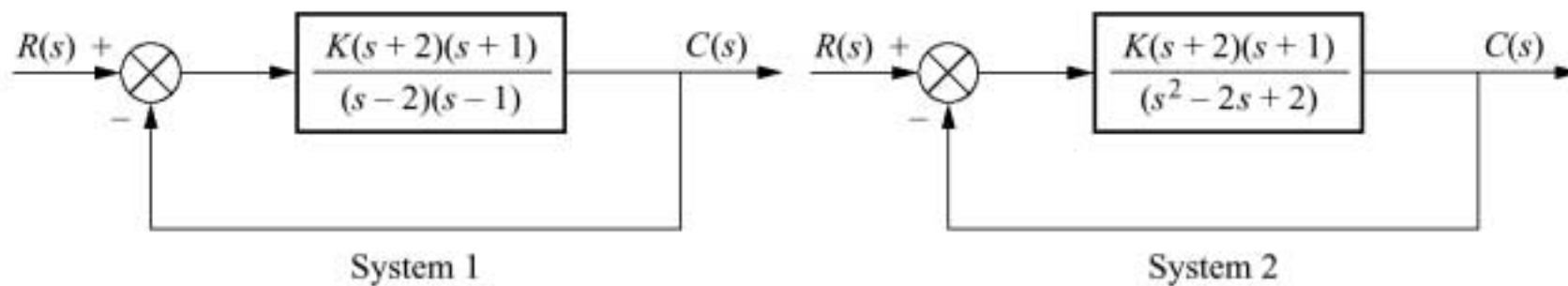
Figure P8.6

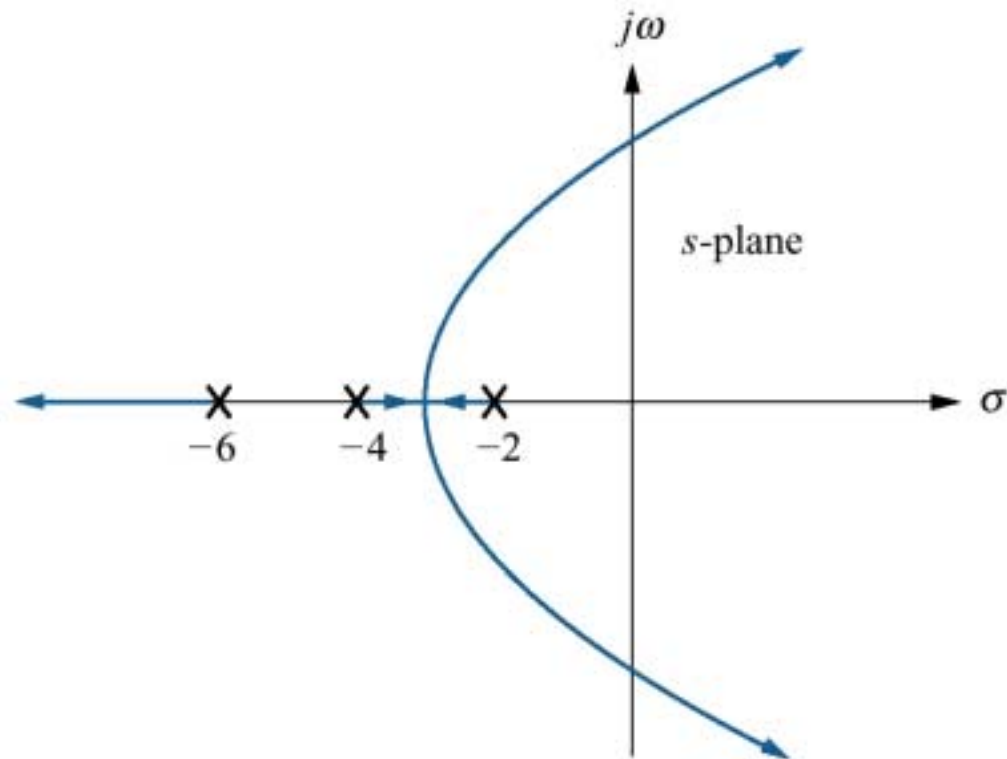
Figure P8.7

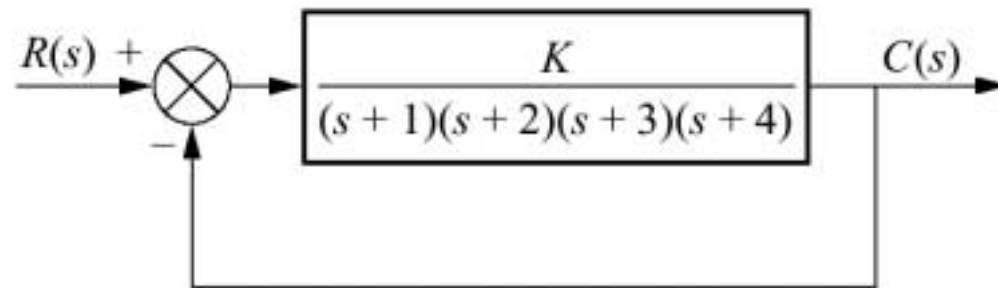
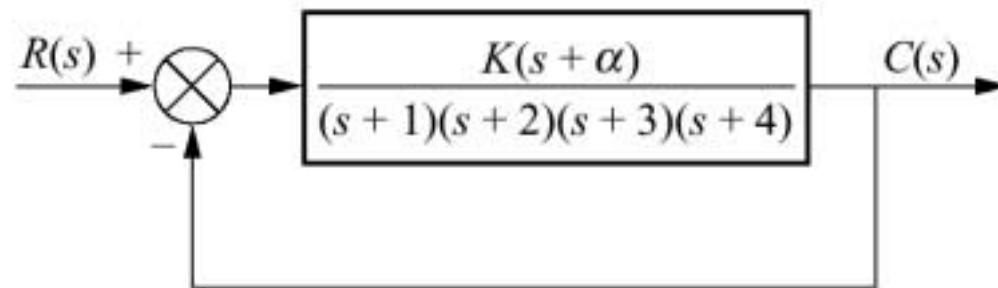
Figure P8.8**(a)****(b)**

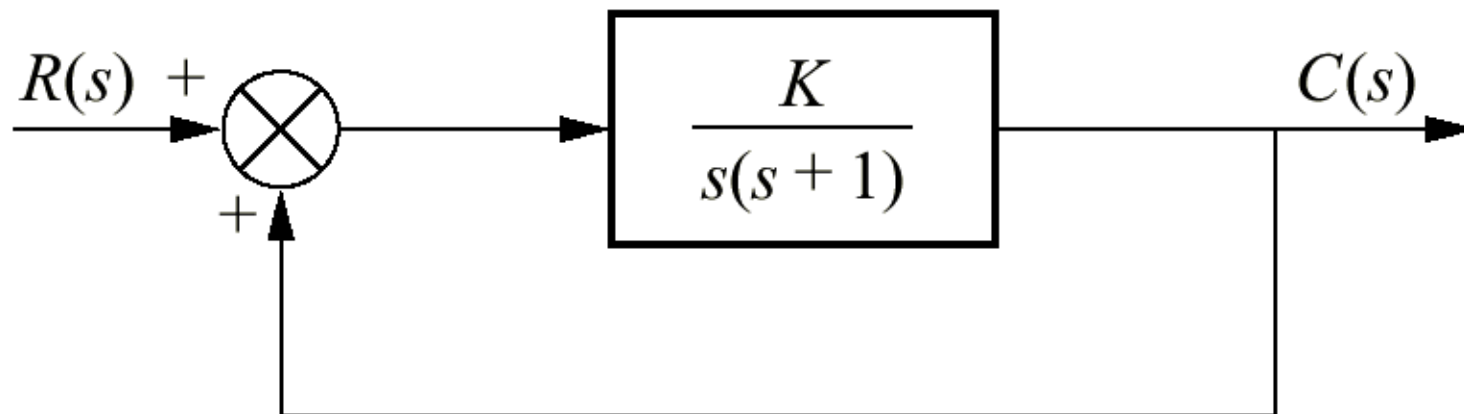
Figure P8.9

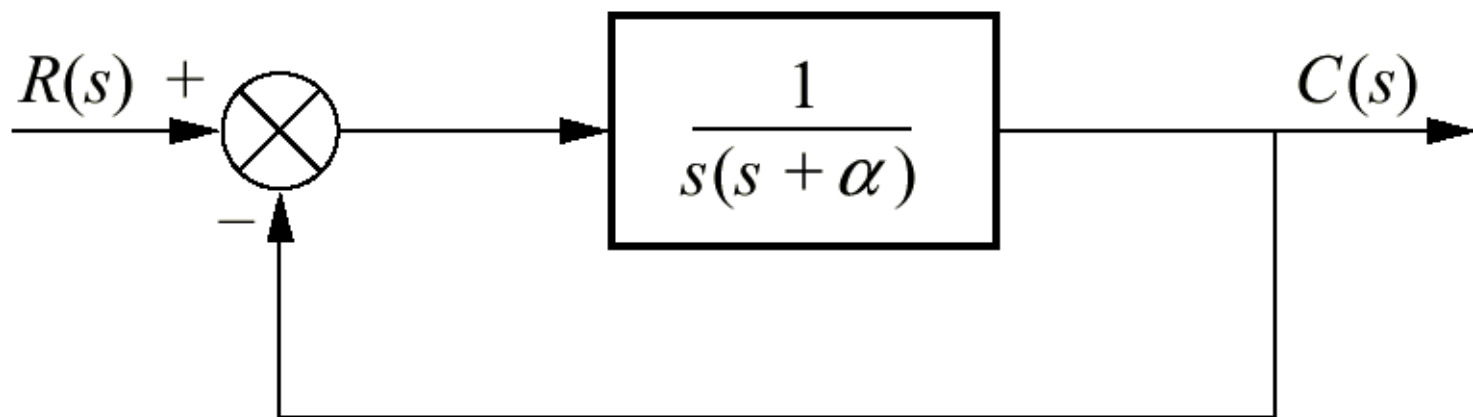
Figure P8.10

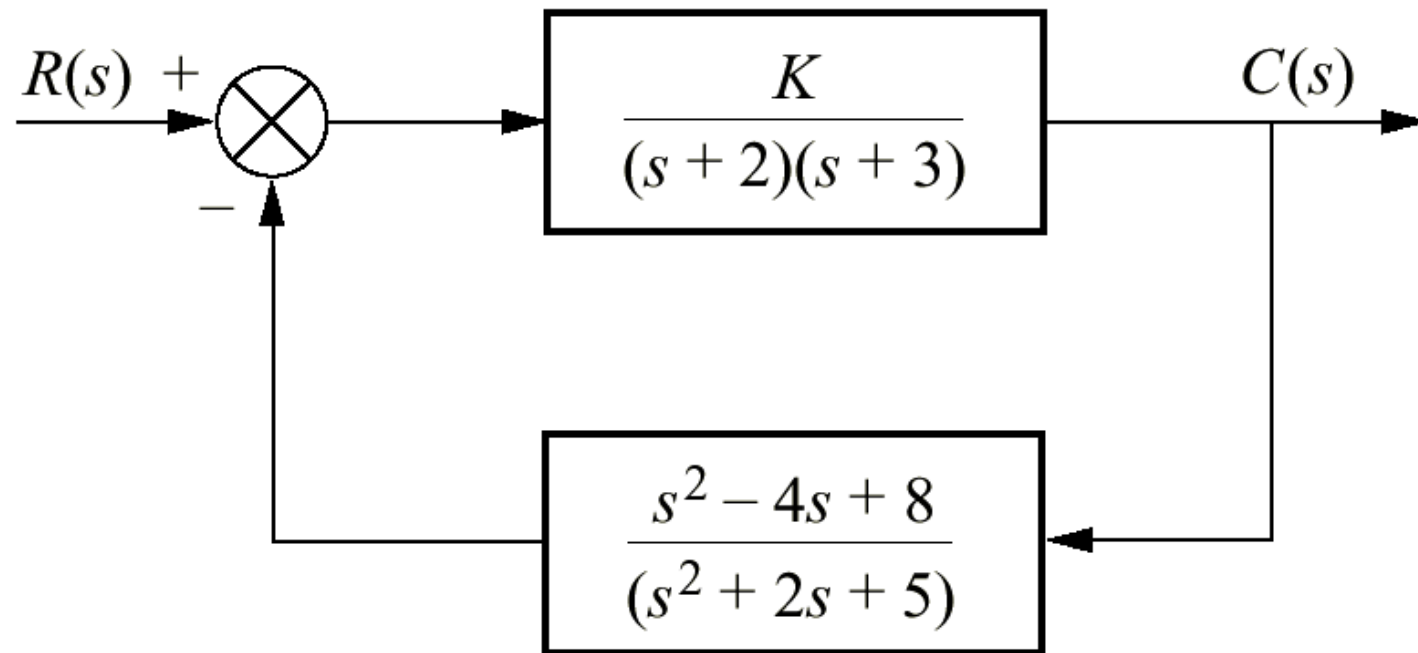
Figure P8.11

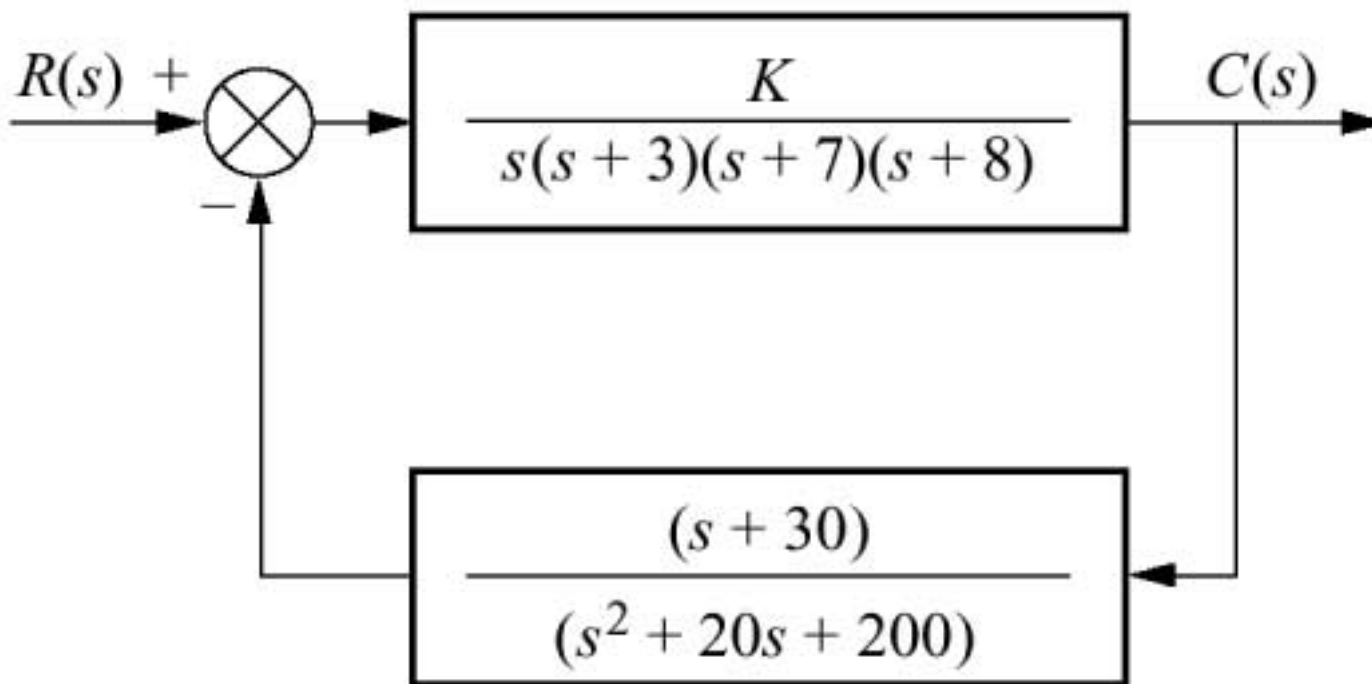
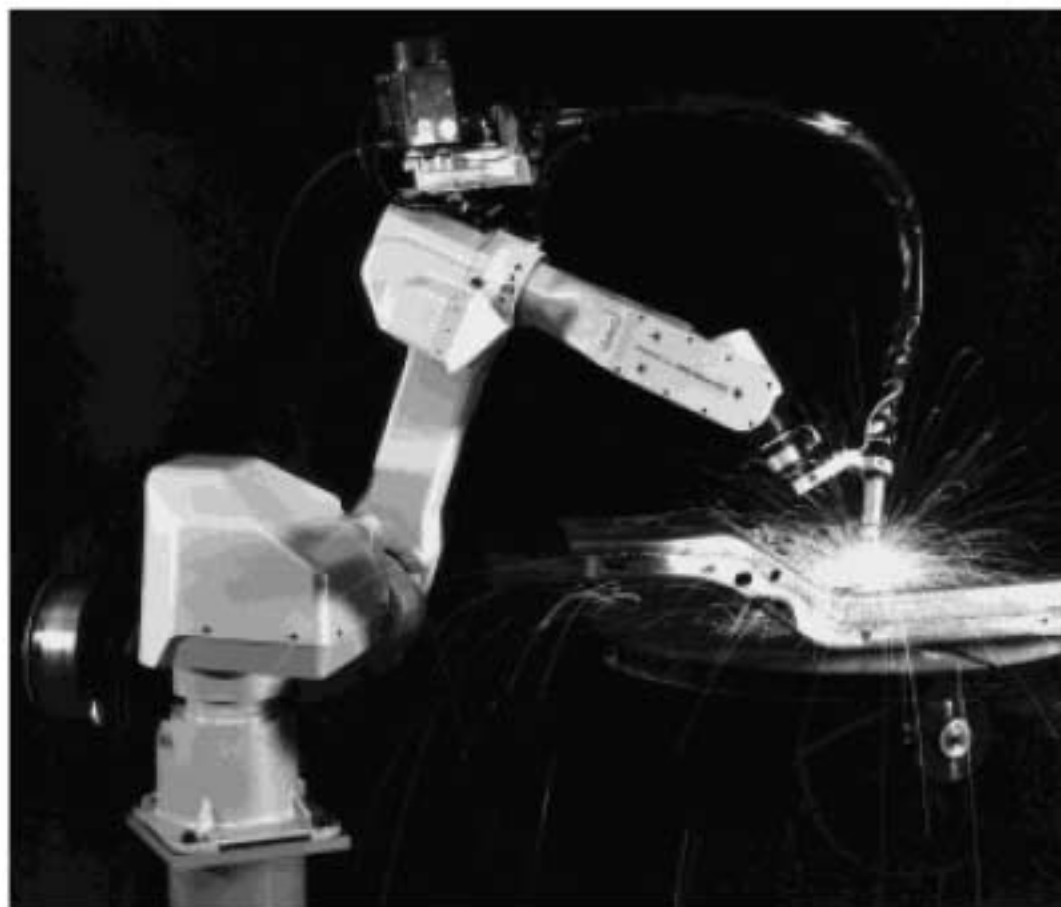
Figure P8.12

Figure P8.13

a. Robot equipped to perform arc welding;
(*figure continues*)



(a)

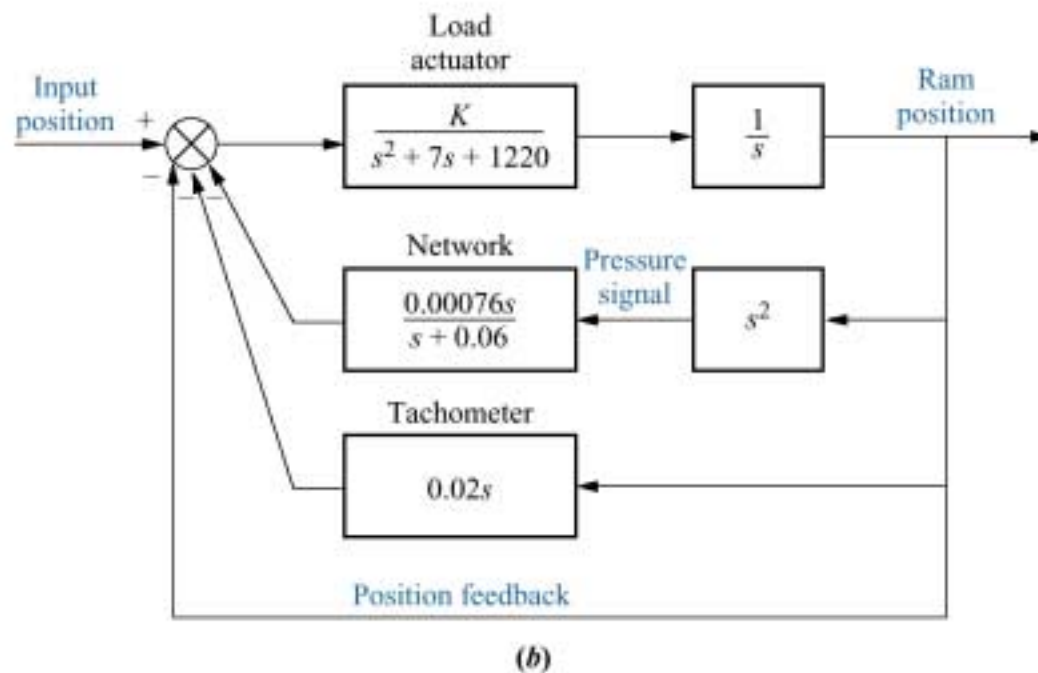
Figure P8.13*(continued)***b.** block diagram for swing motion system

Figure P8.14
Block diagram of
smoother

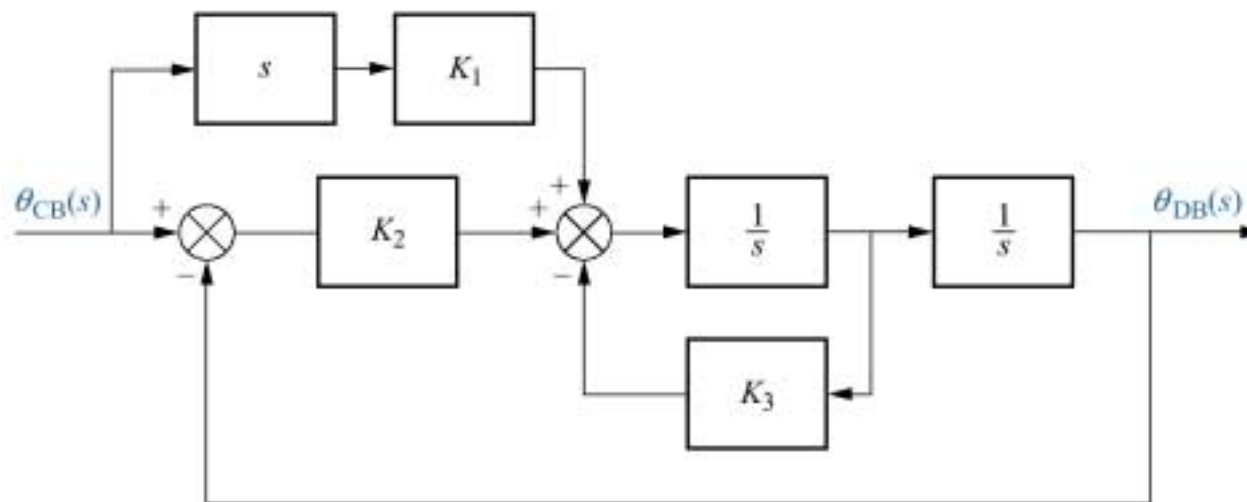


Figure P8.15
a. Active vibration absorber
b. (1992 AIAA);
 control system
 block diagram

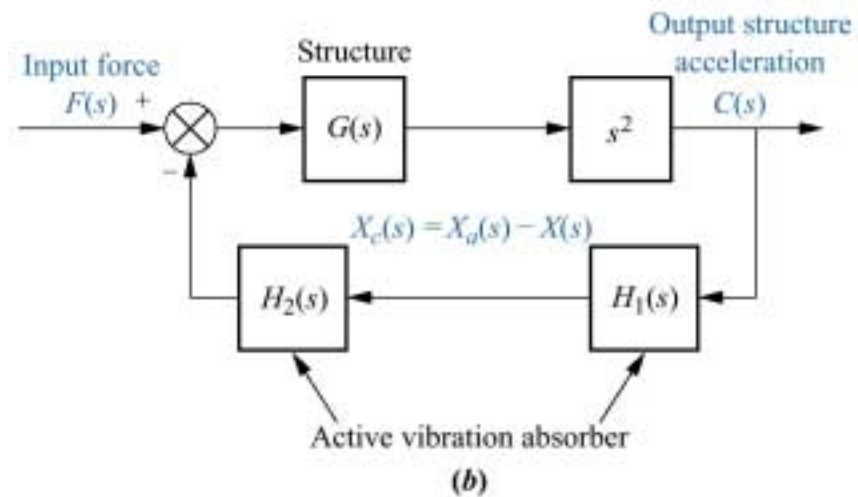
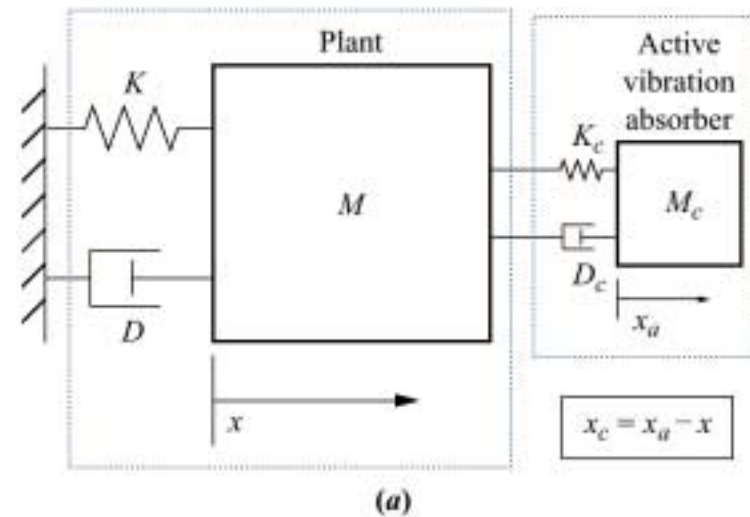


Figure P8.16

Floppy disk drive:
a. physical representation;
b. block diagram

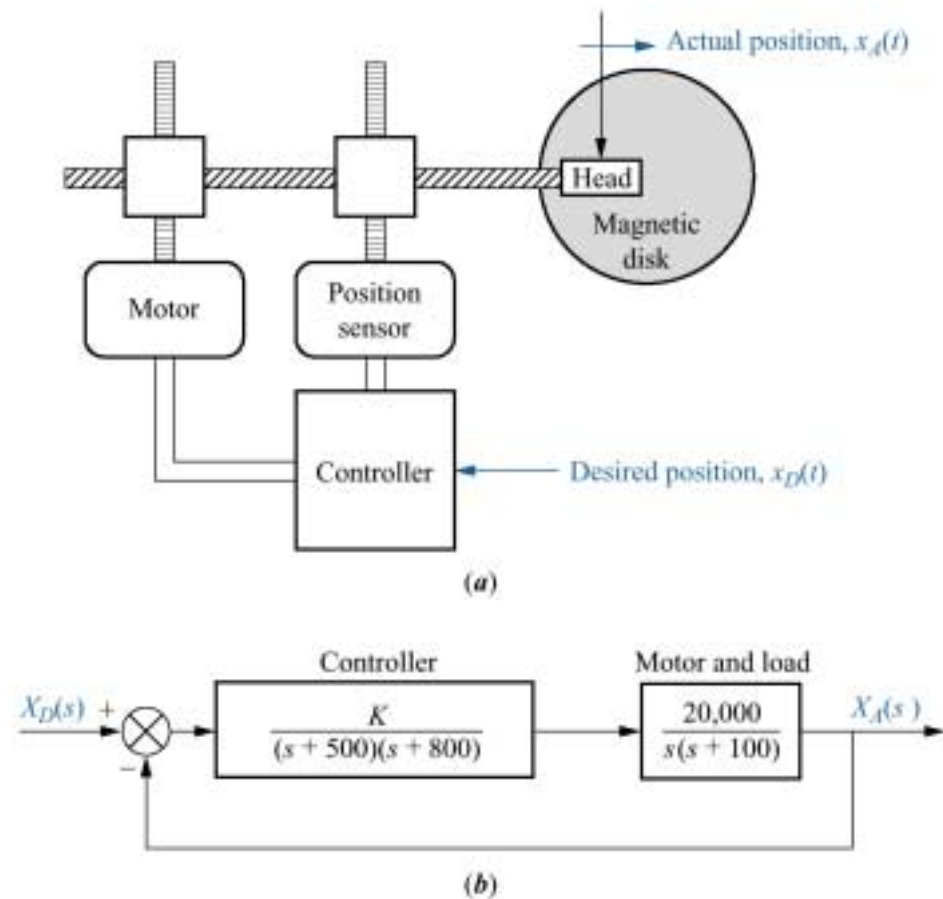


Figure P8.17
Simplified block
diagram of pupil
servomechanism

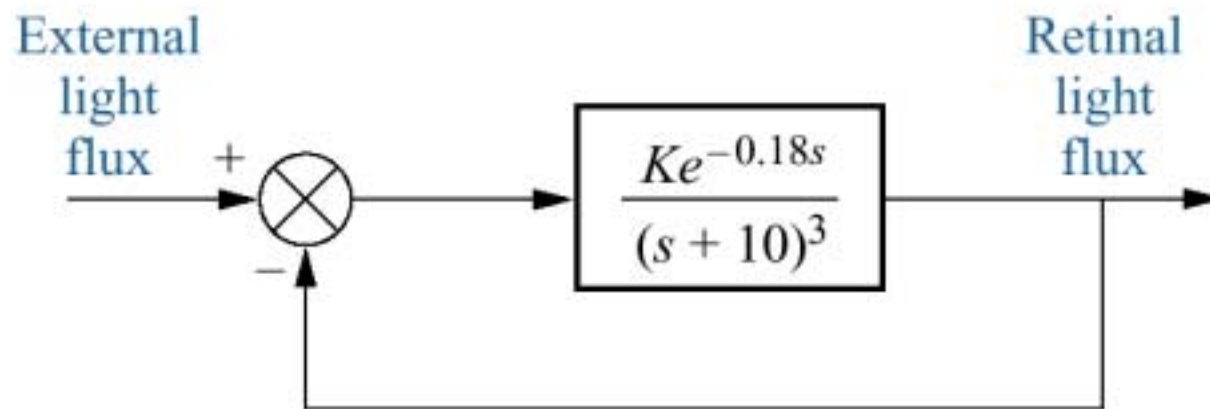


Figure P8.18
Active suspension system

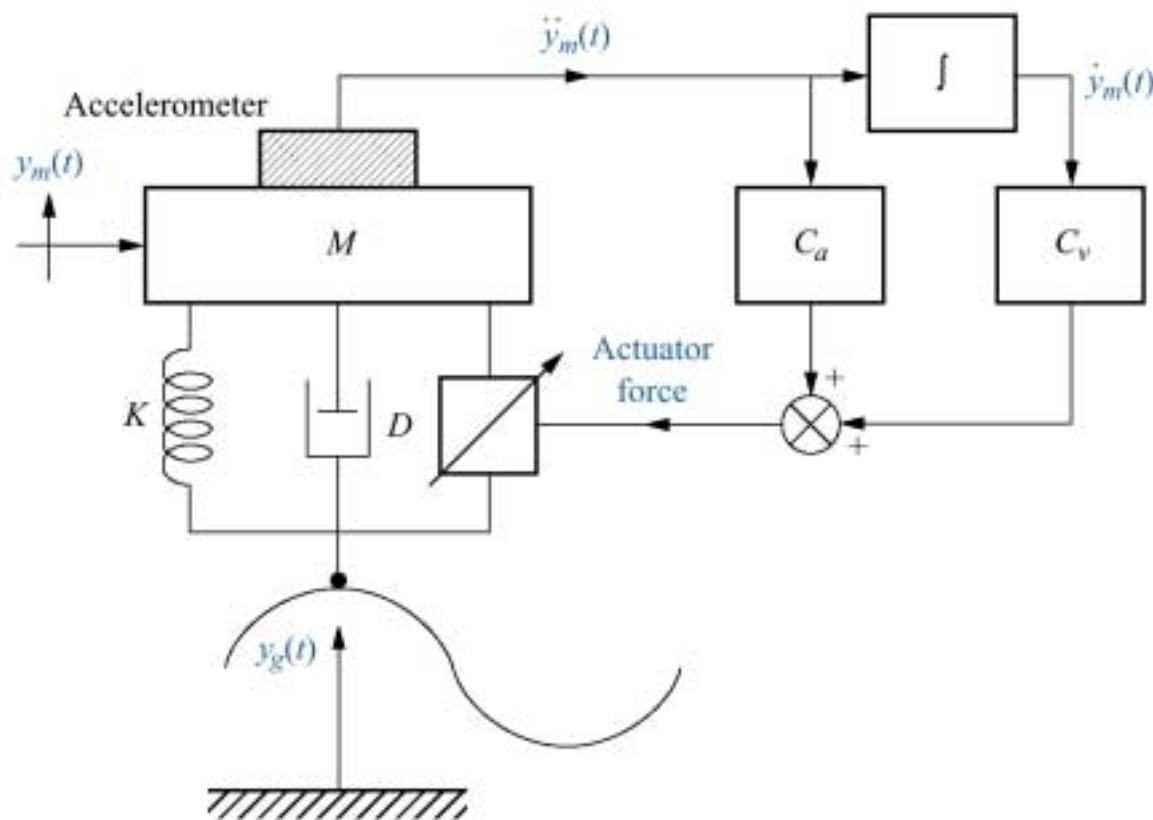


Figure P8.19
F4- E pitch
stabilization loop

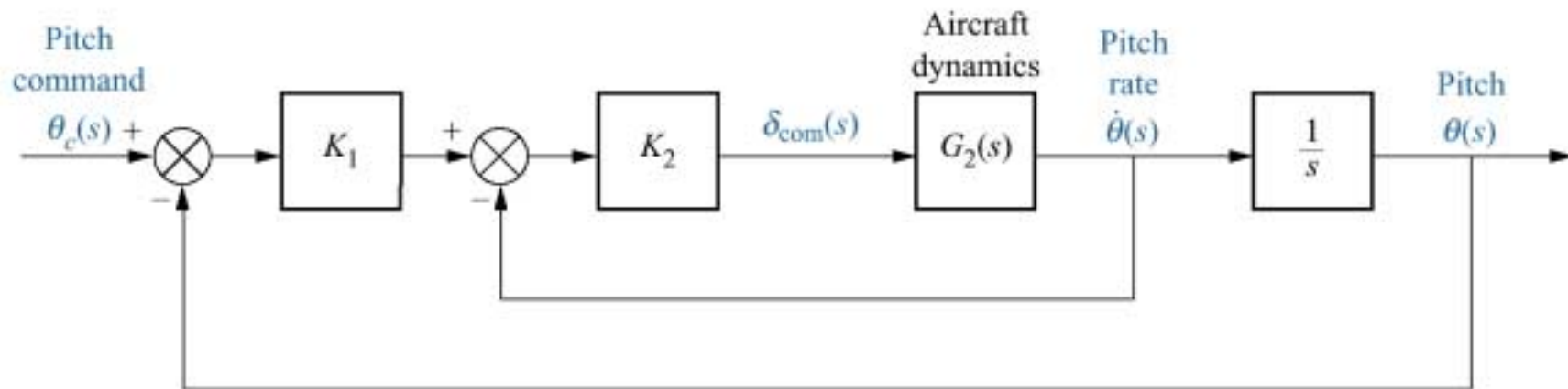


Figure P8.20
Pitch axis attitude
control system
utilizing momentum
wheel

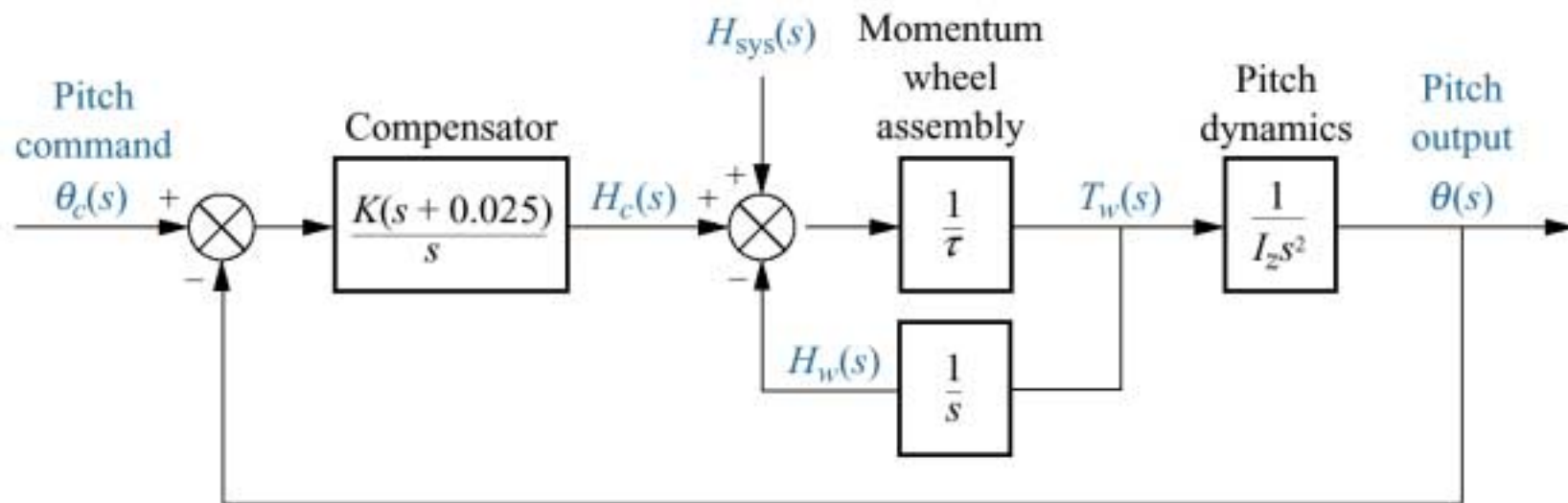


Figure P8.21

Combustor with microphone and loud speaker

a. (1995 IEEE);
b. block diagram (1995 IEEE)

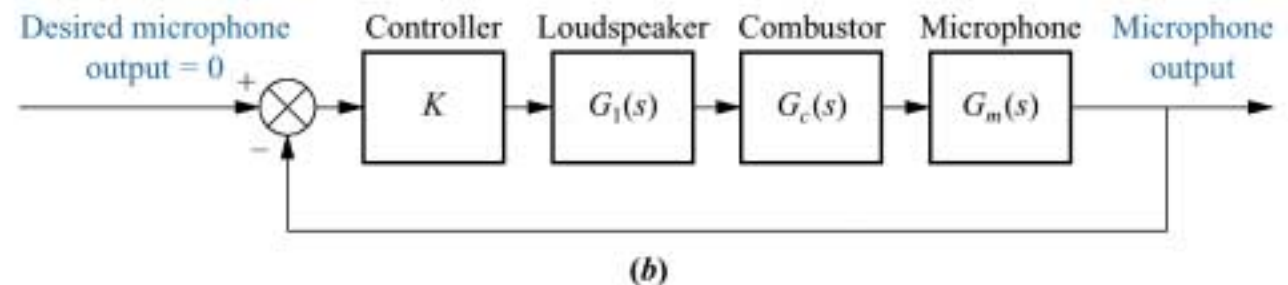
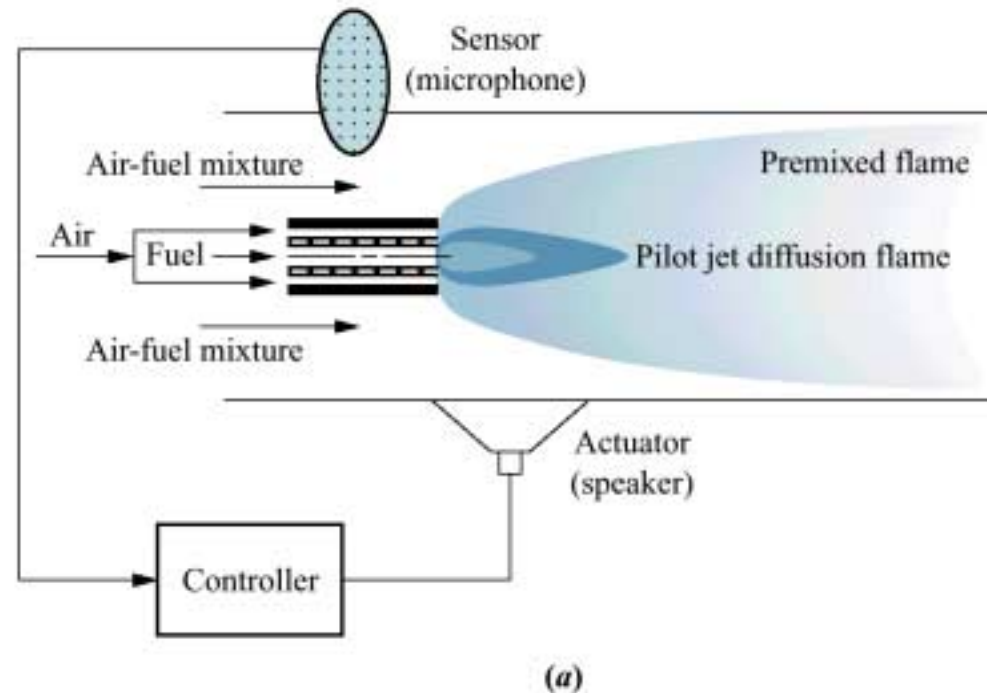


Figure P8.22

a. Wind turbines generating electricity near Palm Springs, California (1998 IEEE); *(figure continues)*



(a)

Figure P8.22*(continued)*

b. Control loop for a constant-speed pitch-controlled wind turbine (1998 IEEE);

c. Drivetrain (1998 IEEE)

