

Chapter 7

Steady-State Errors

Figure 7.1

Test inputs for steady-state error analysis and design vary with target type

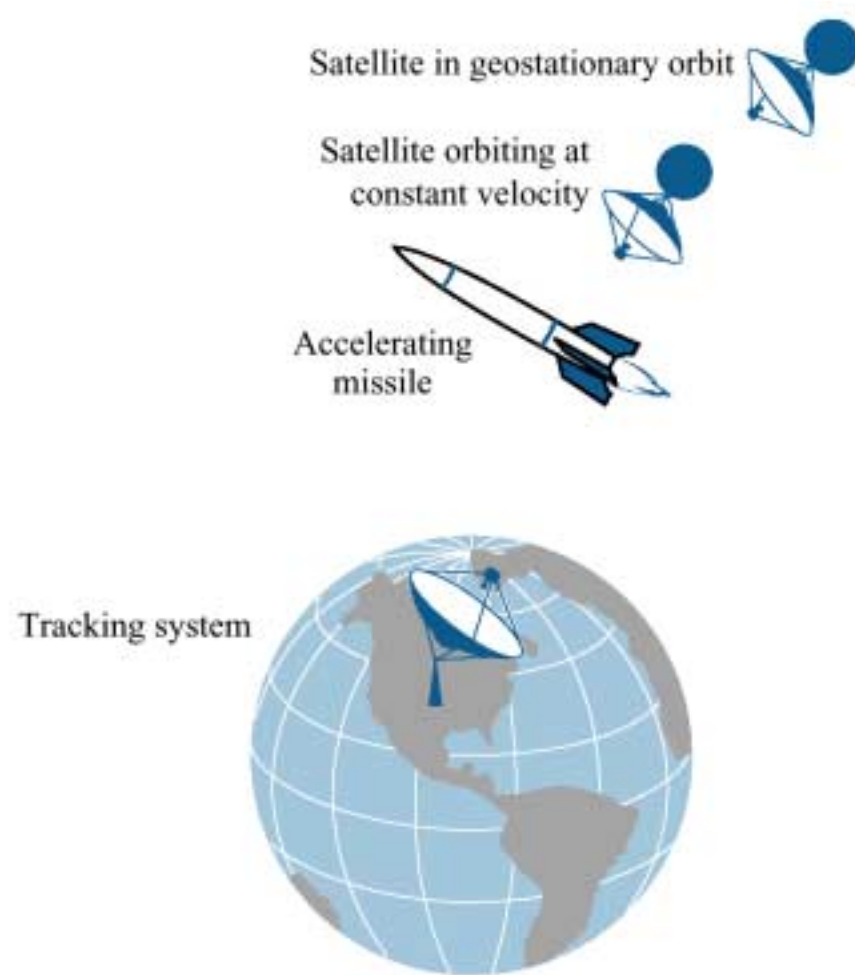


Figure 7.2
Steady-state error:
a. step input;
b. ramp input

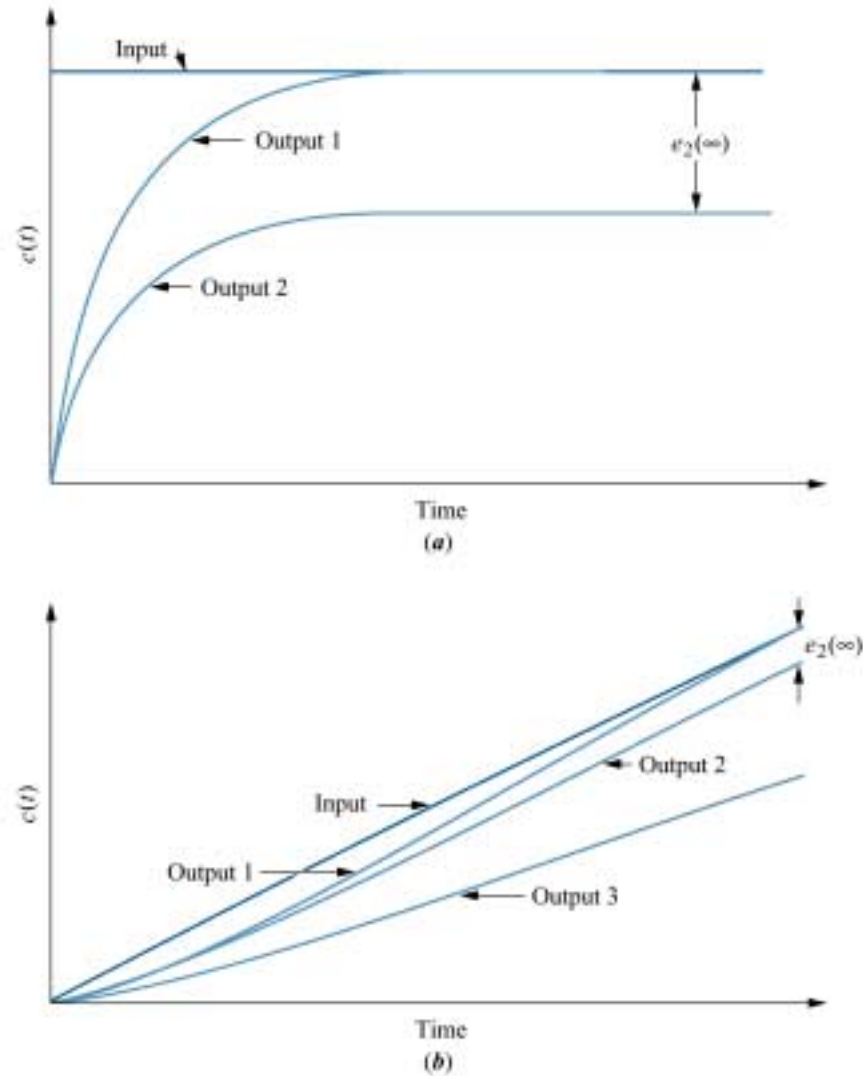


Figure 7.3

Closed-loop control
system error:

- a.** general representation;
- b.** representation for
unity feedback
systems

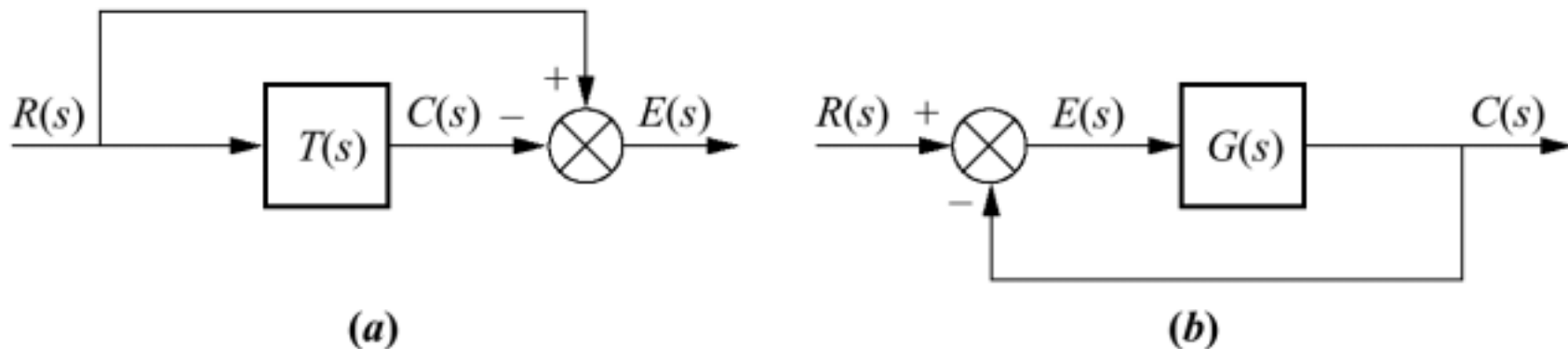


Figure 7.4

System with:

- a.** finite steady-state error for a step input;
- b.** zero steady-state error for step input

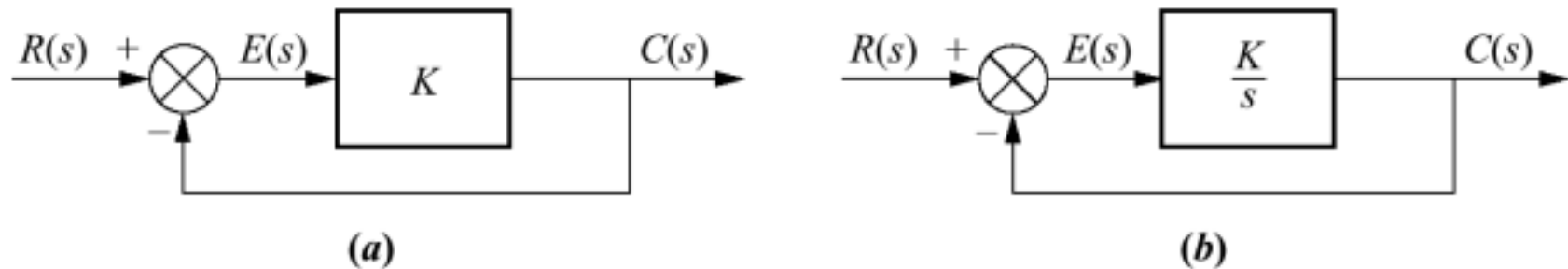


Figure 7.5
Feedback
control system for
Example 7.2

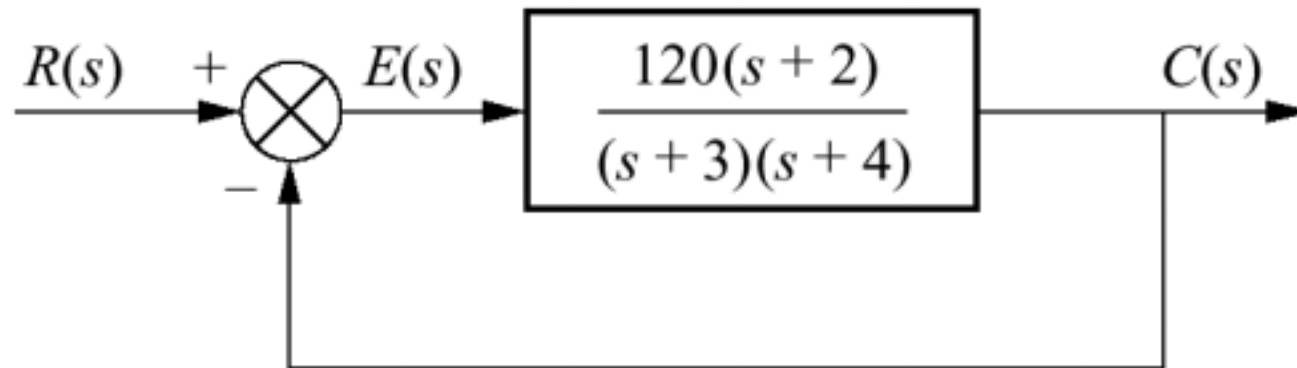


Figure 7.6
Feedback
control system for
Example 7.3

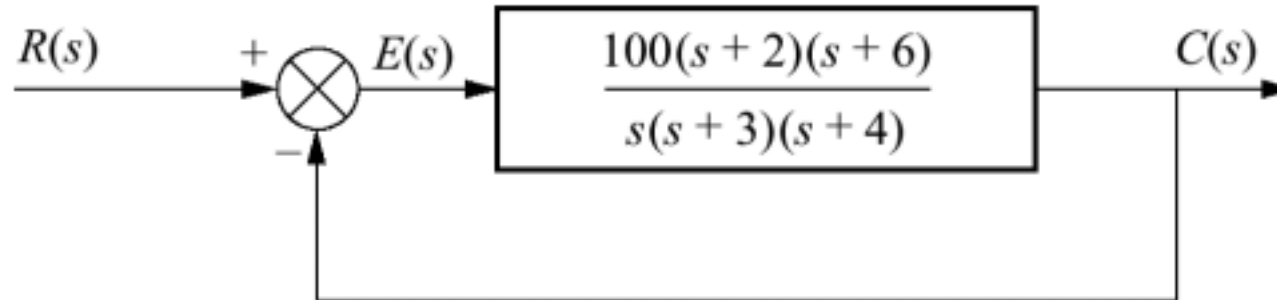
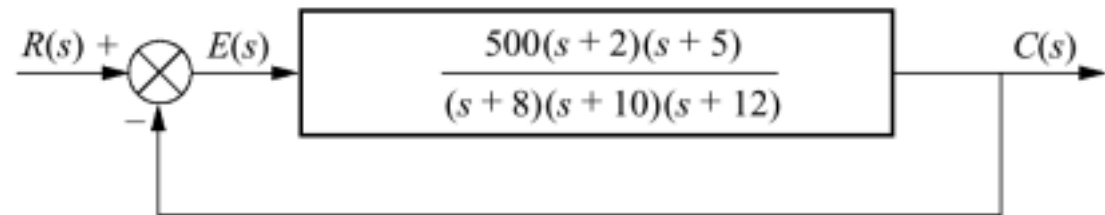
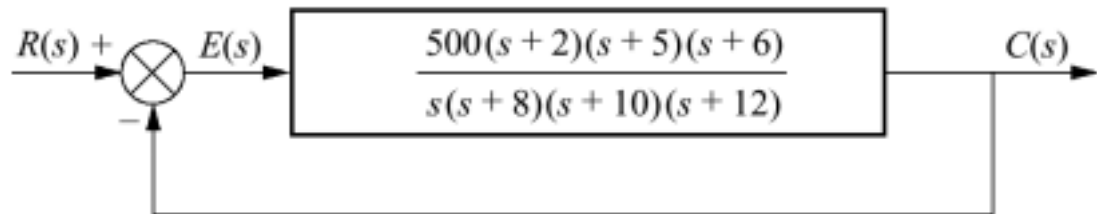


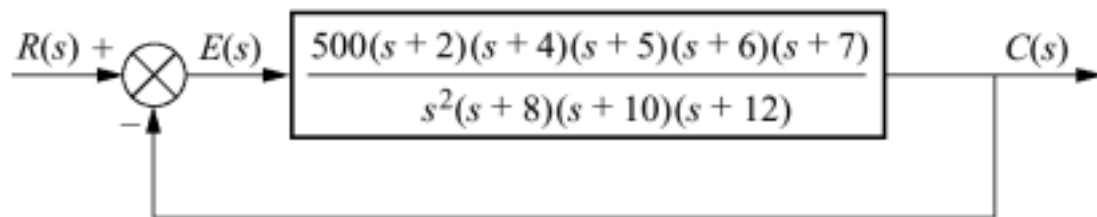
Figure 7.7
Feedback
control systems
for Example 7.4



(a)



(b)



(c)

Figure 7.8
Feedback control
system for defining
system type

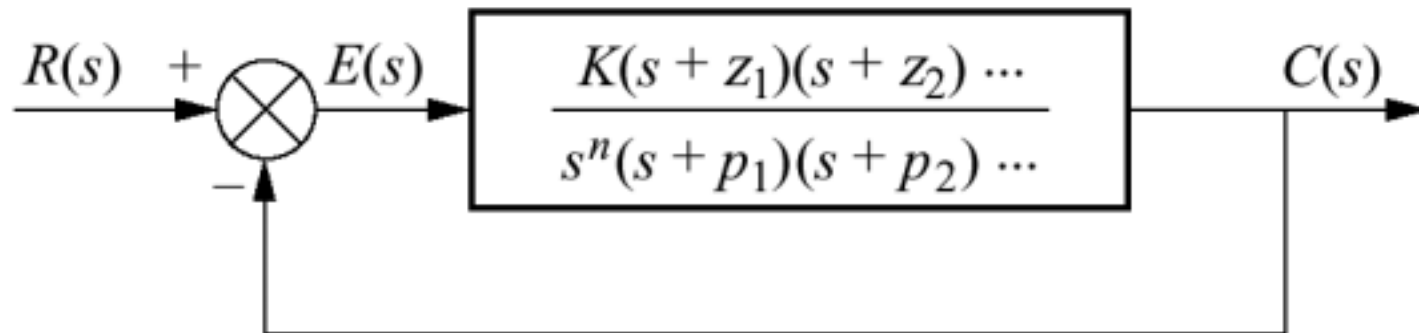


Figure 7.9

A robot used in the manufacturing of semiconductor random-access memories (RAMs) similar to those in personal computers. Steady-state error is an important design consideration for assembly-line robots.



Figure 7.10
Feedback
control system
for Example 7.6

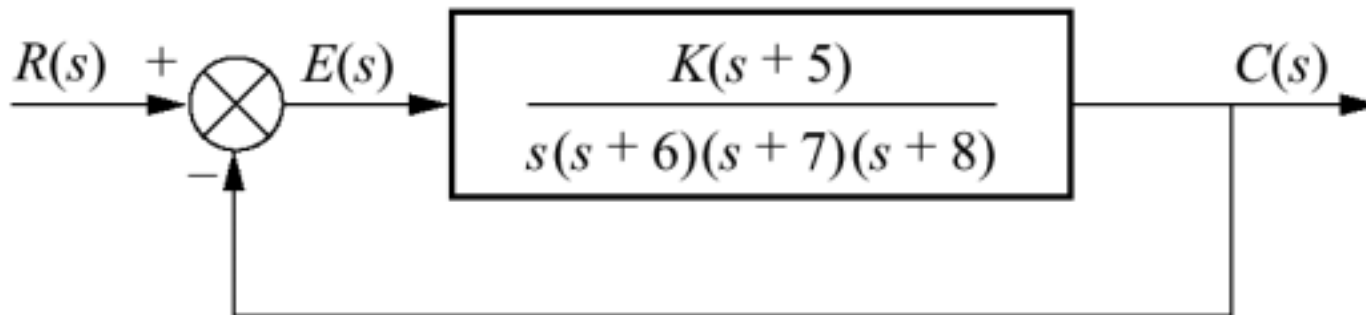


Figure 7.11
Feedback control
system showing
disturbance

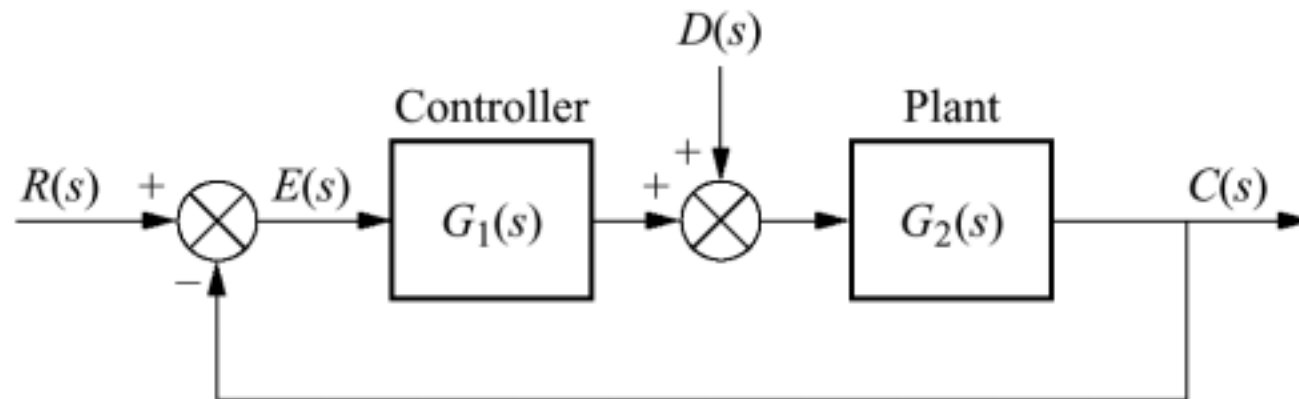


Figure 7.12

Figure 7.11 system rearranged to show disturbance as input and error as output, with $R(s) = 0$

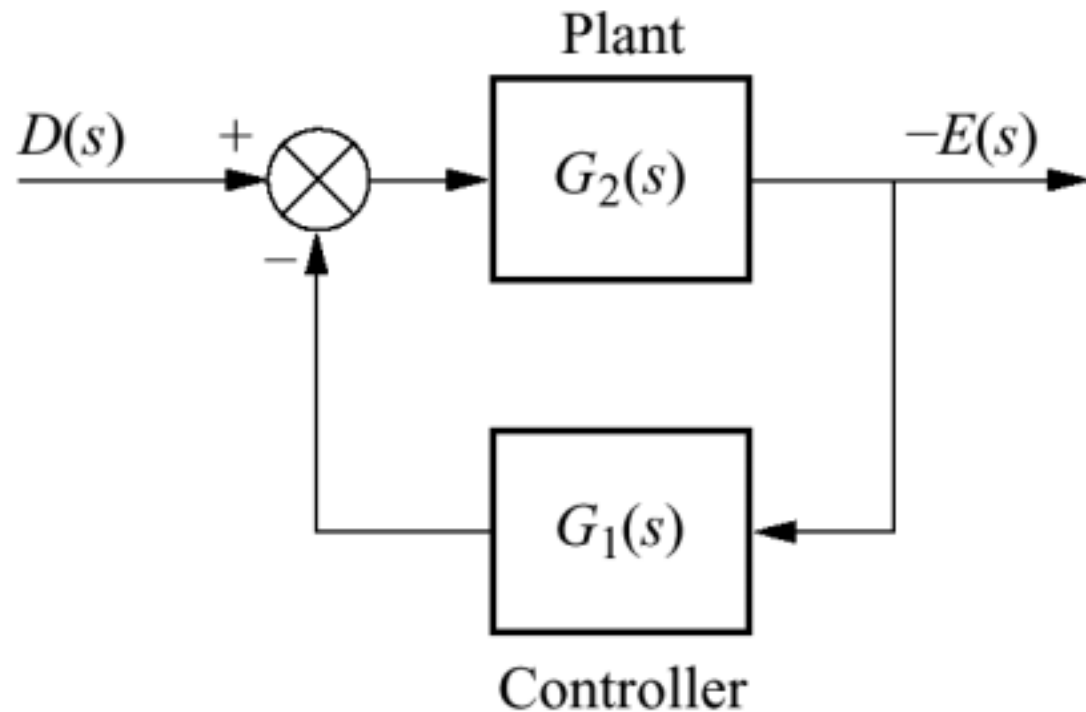


Figure 7.13
Feedback control
system for Example
7.7

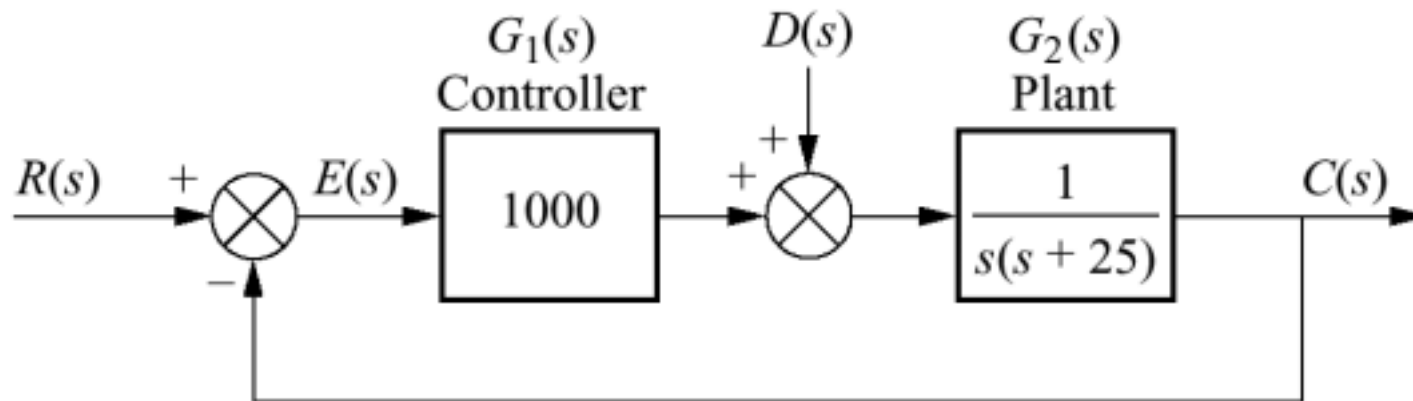


Figure 7.14
System for
Skill-Assessment
Exercise 7.4

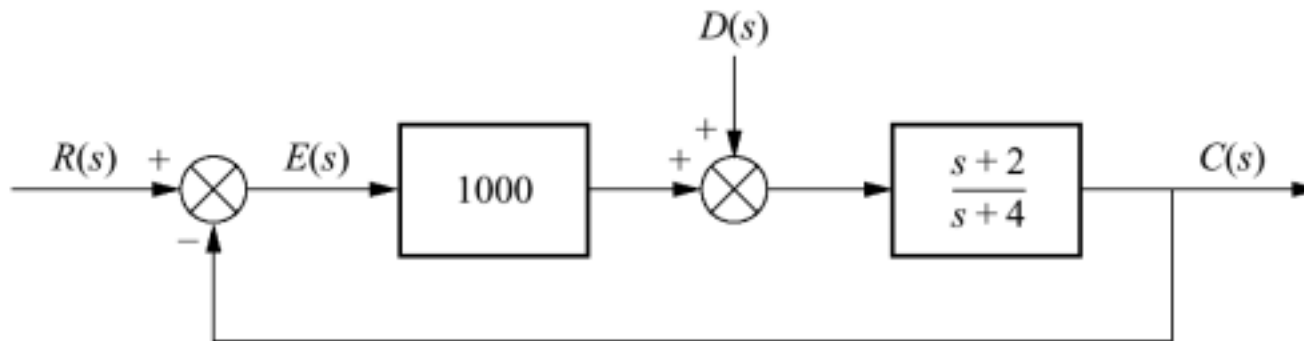


Figure 7.15
Forming an
equivalent
unity feedback
system from a
general nonunity
feedback system

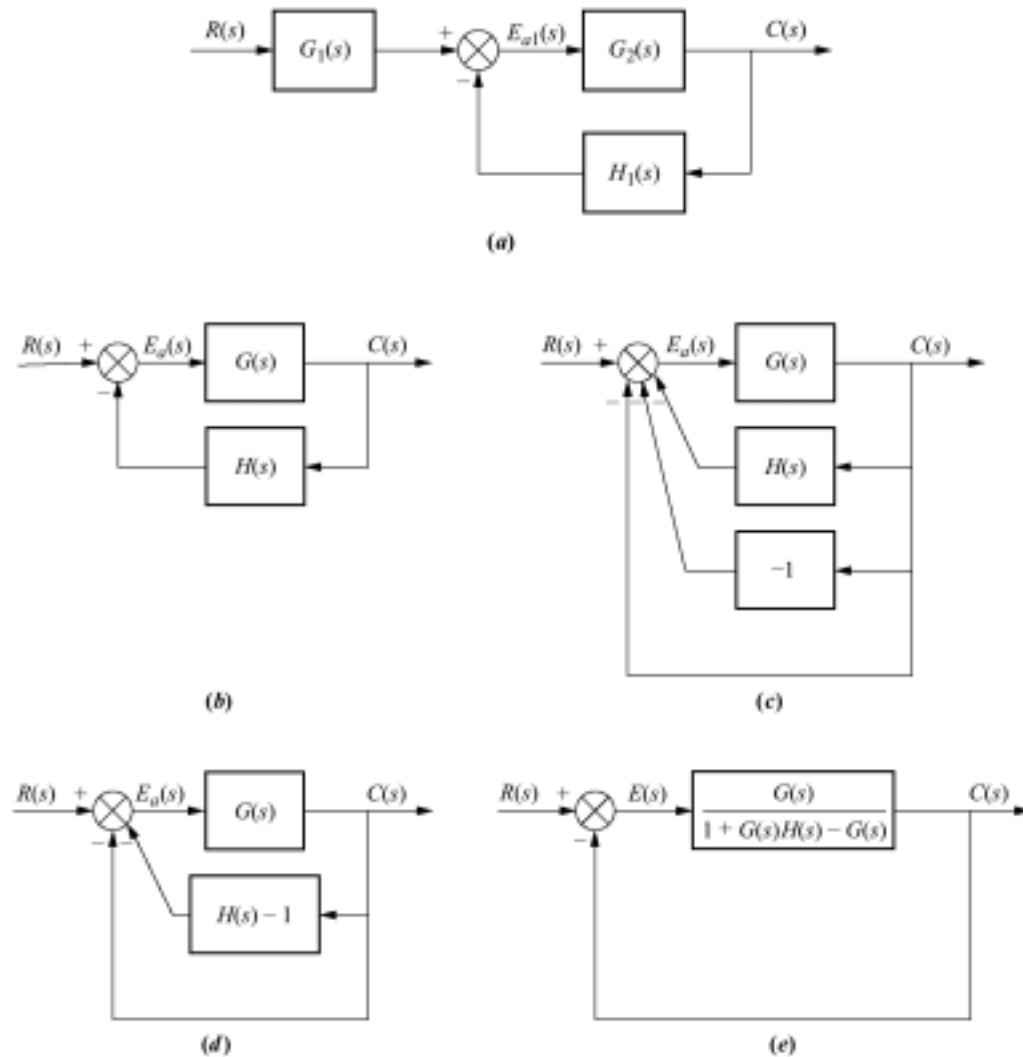


Figure 7.16
Nonunity feedback
control system for
Example 7.8

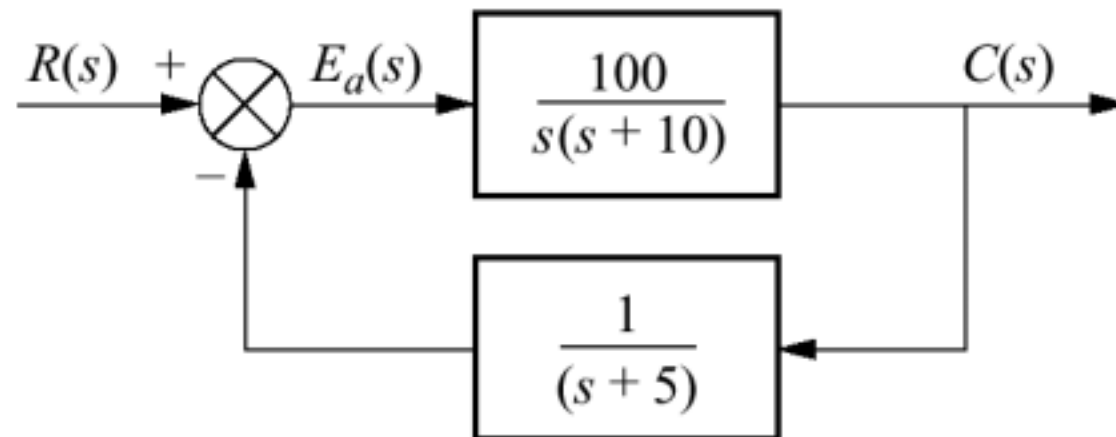


Figure 7.17
Nonunity feedback
control system with
disturbance

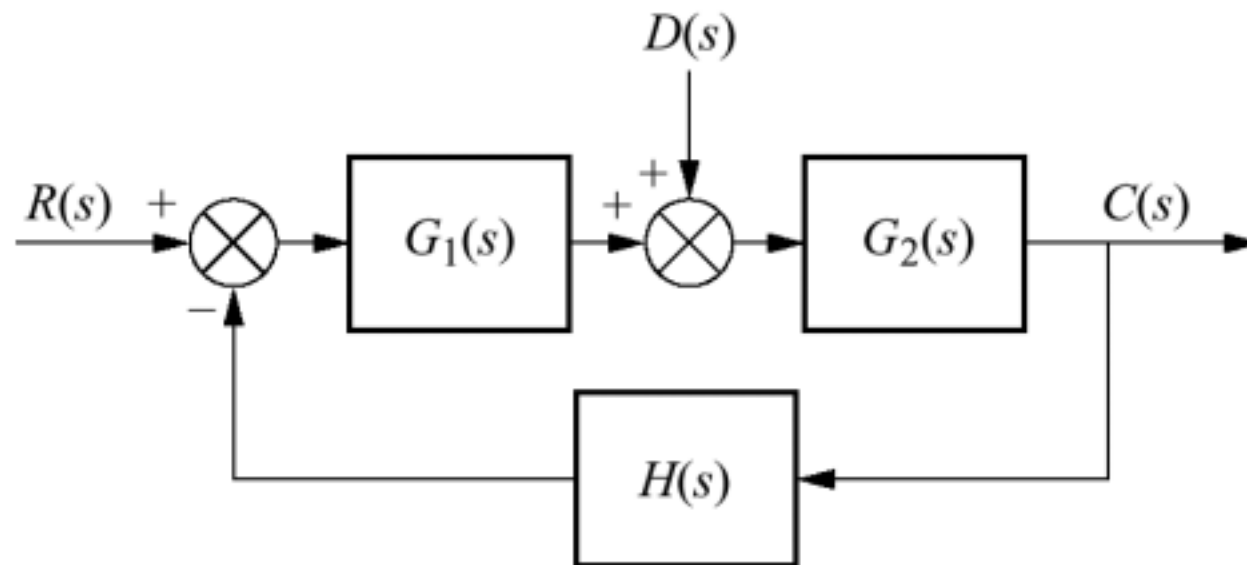


Figure 7.18
Nonunity feedback
system for
Skill-Assessment
Exercise 7.5

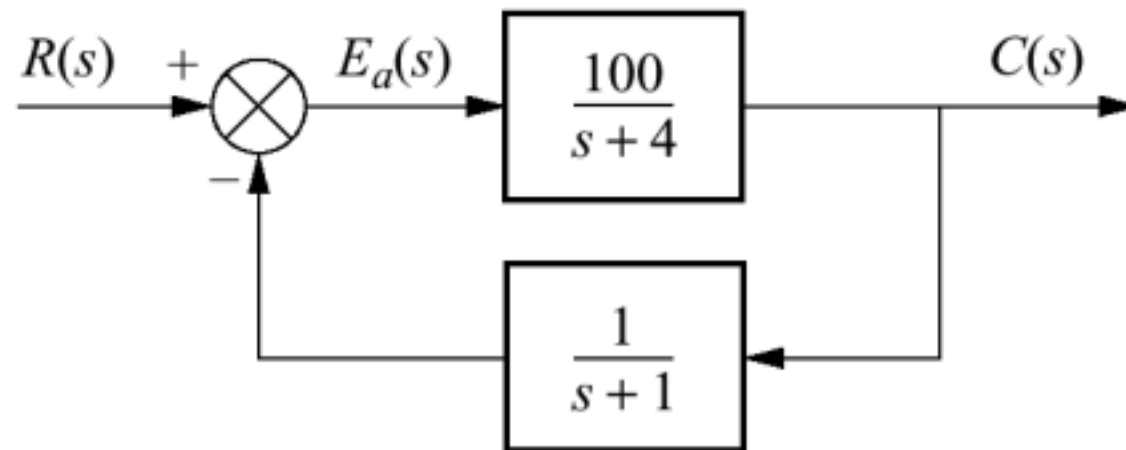


Figure 7.19
Feedback control
system for Examples
7.10 and 7.11

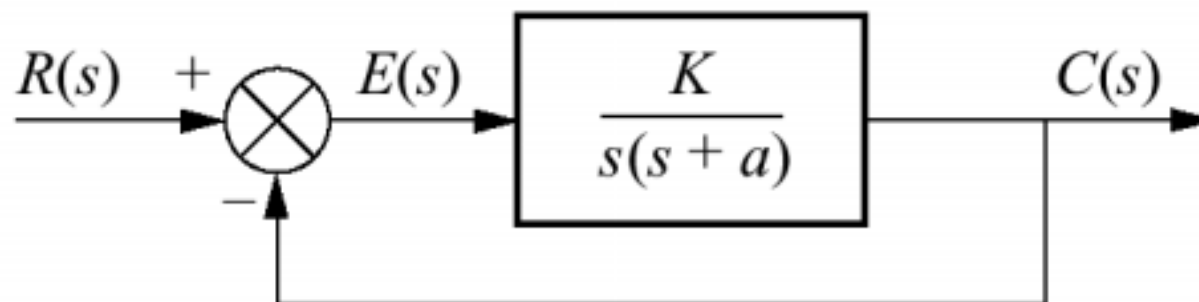


Figure 7.20
Feedback
control system
for Example 7.12

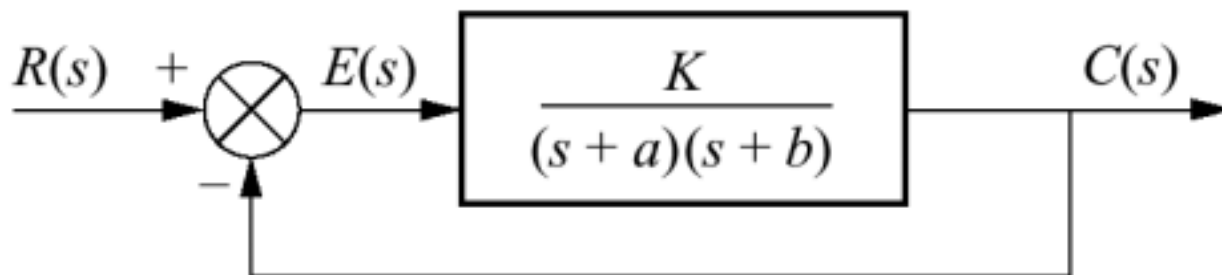


Figure 7.21
System for
Skill-Assessment
Exercise 7.6

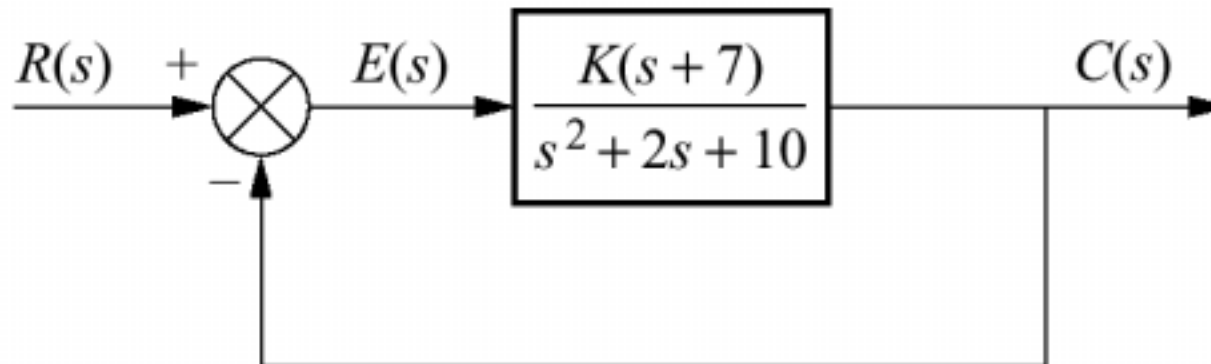


Figure 7.22
Video laser disc
recording:
control system for
focusing write beam

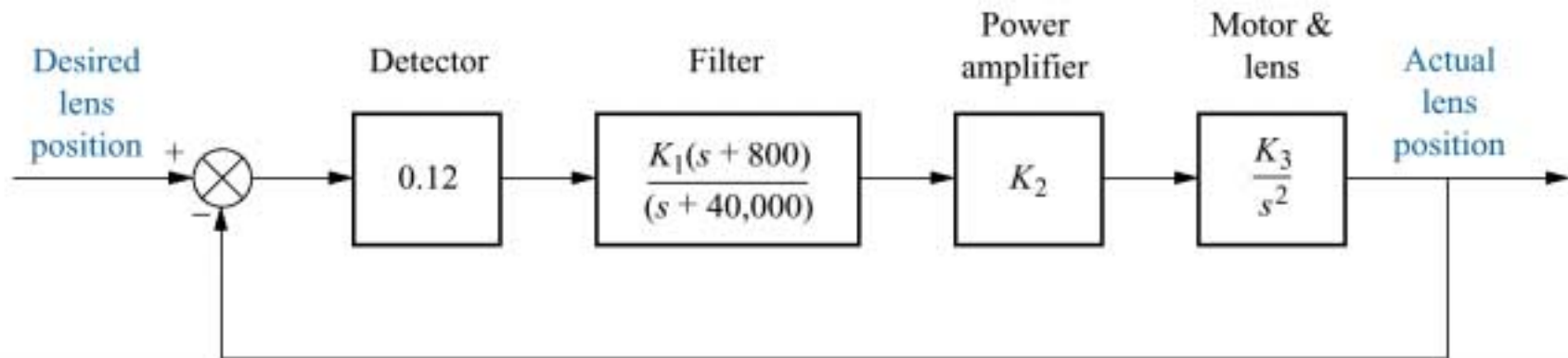


Figure 7.23

Video disc laser
recording:

a. focus detector
optics;

b. linearized transfer
function for focus
detector

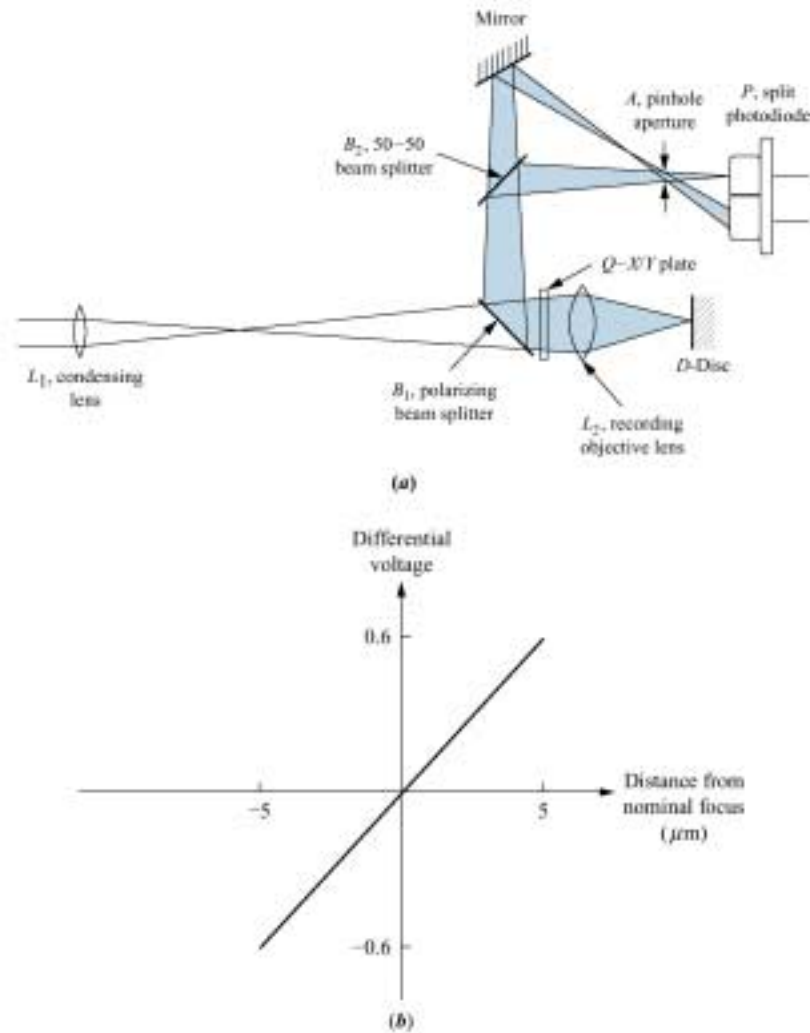


Figure 7.24
Video laser disc
recording focusing
system

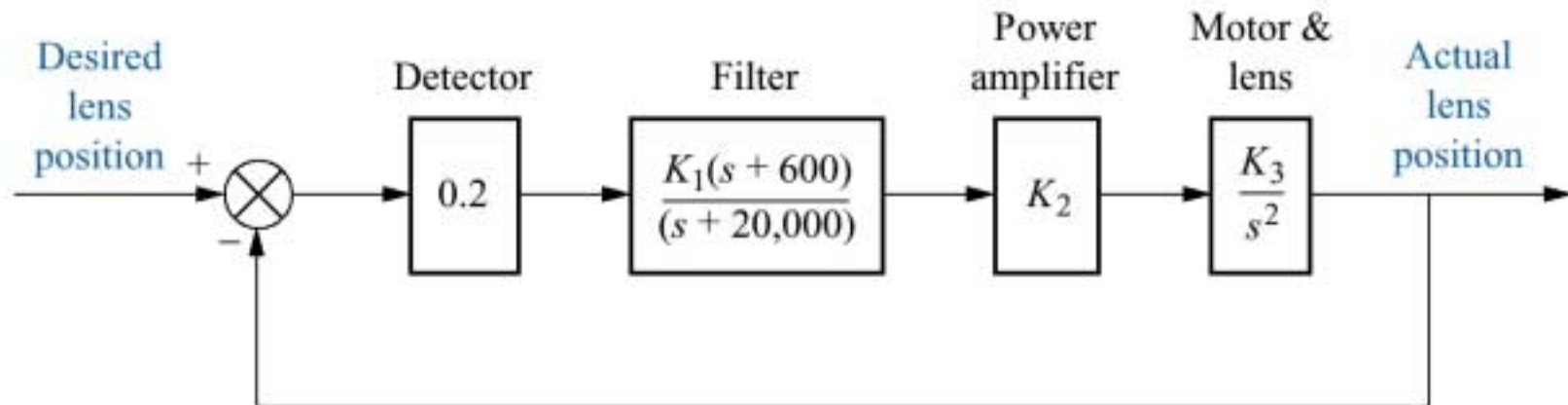


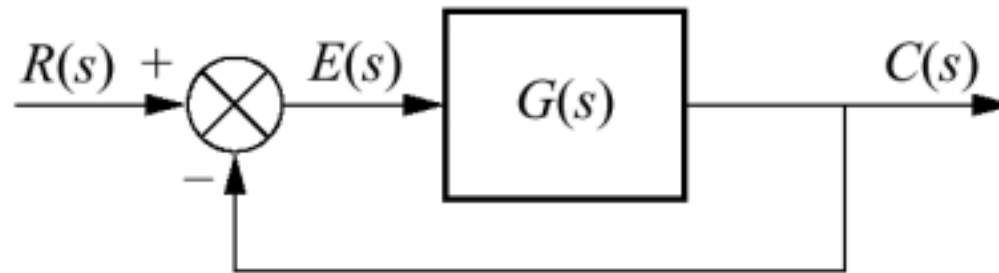
Figure P7.1

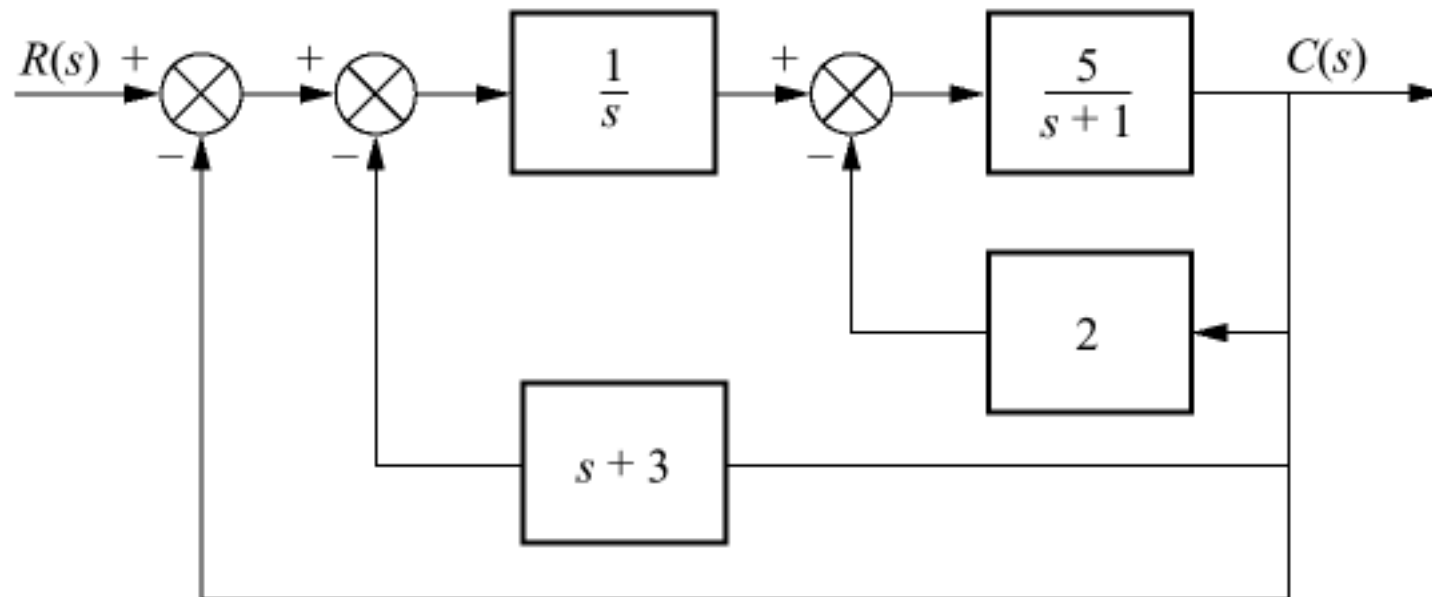
Figure P7.2

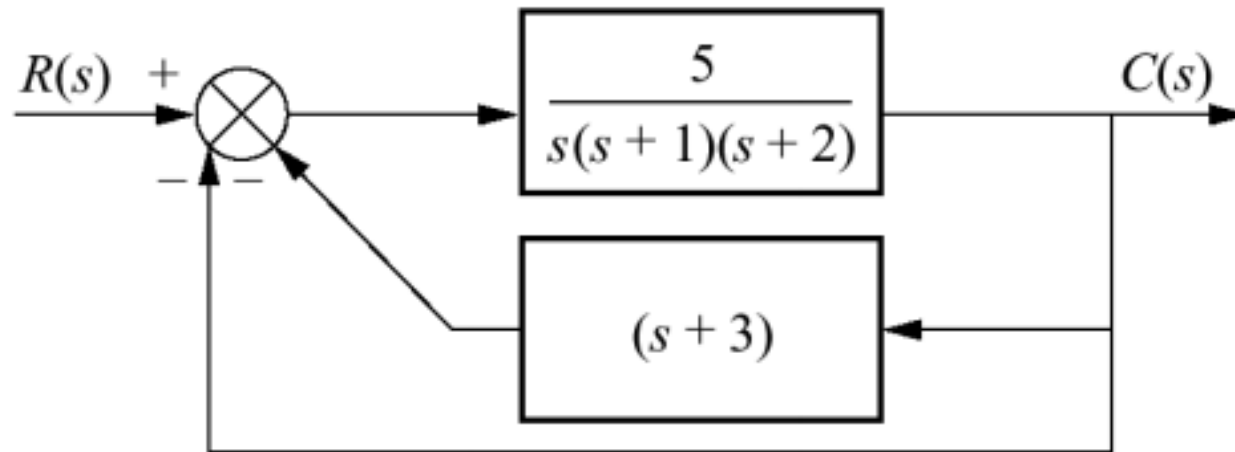
Figure P7.3

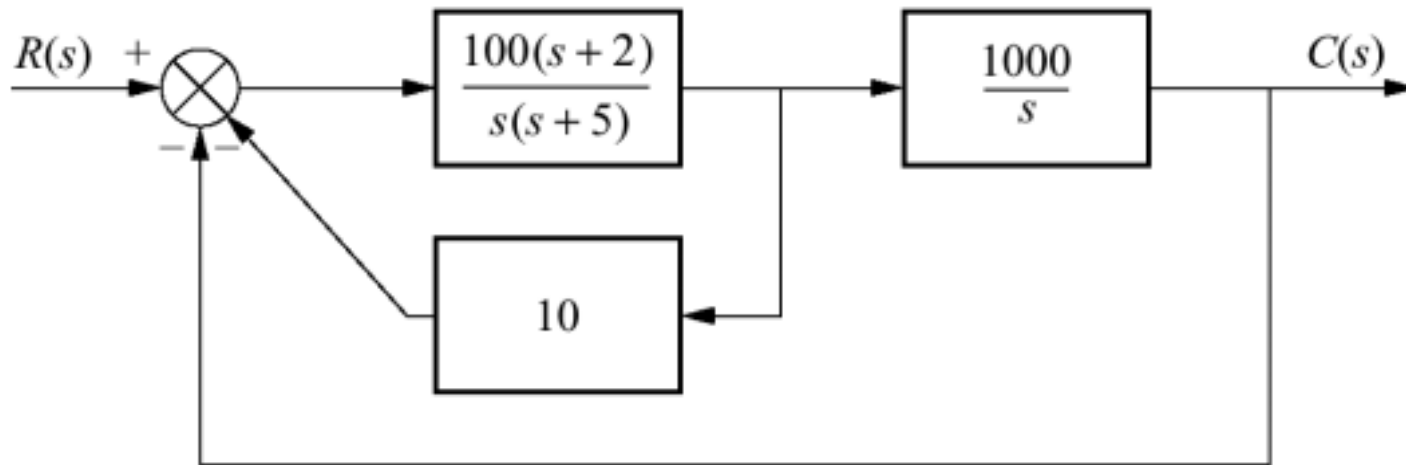
Figure P7.4

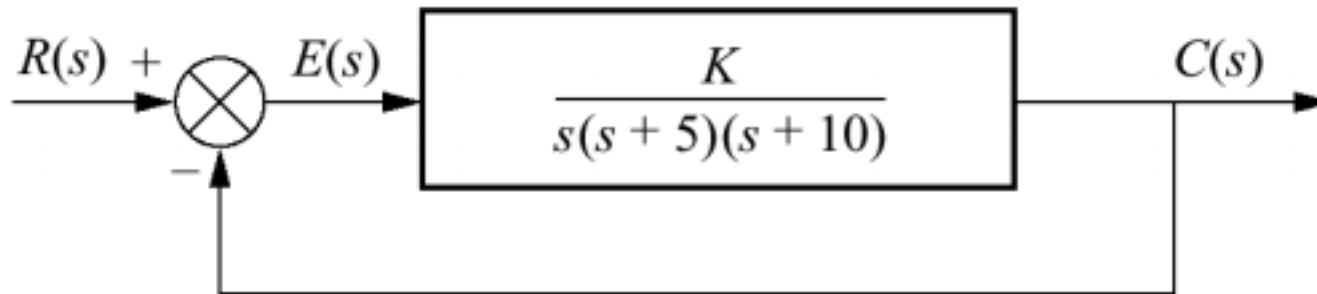
Figure P7.5

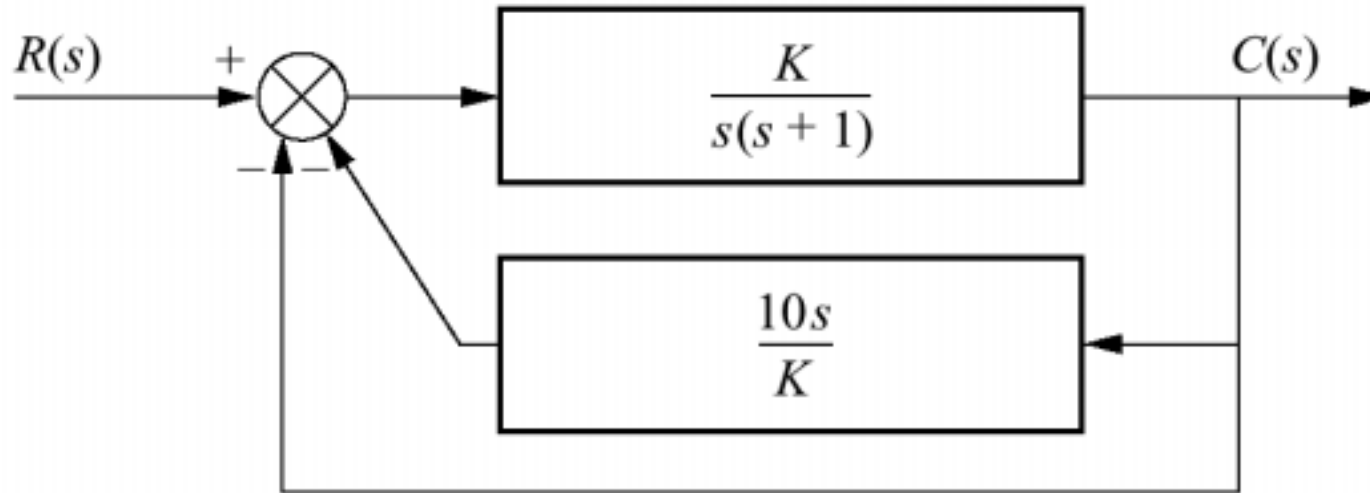
Figure P7.6

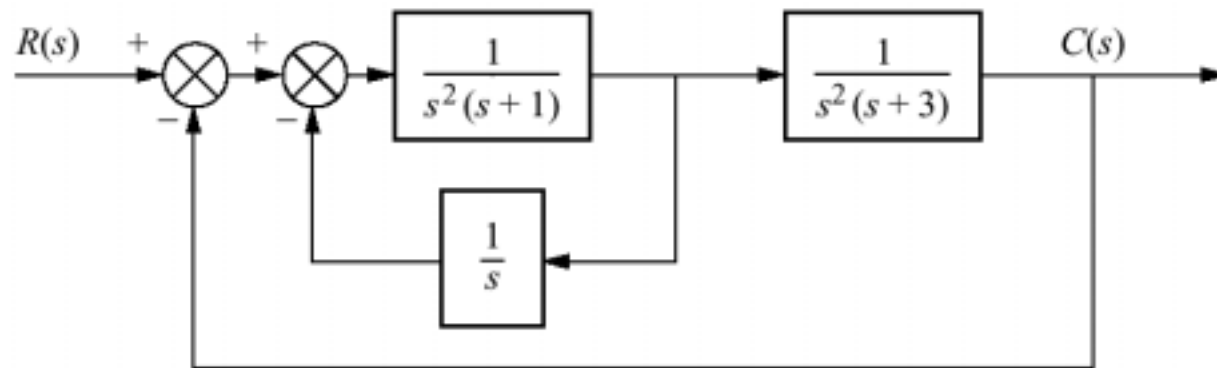
Figure P7.7

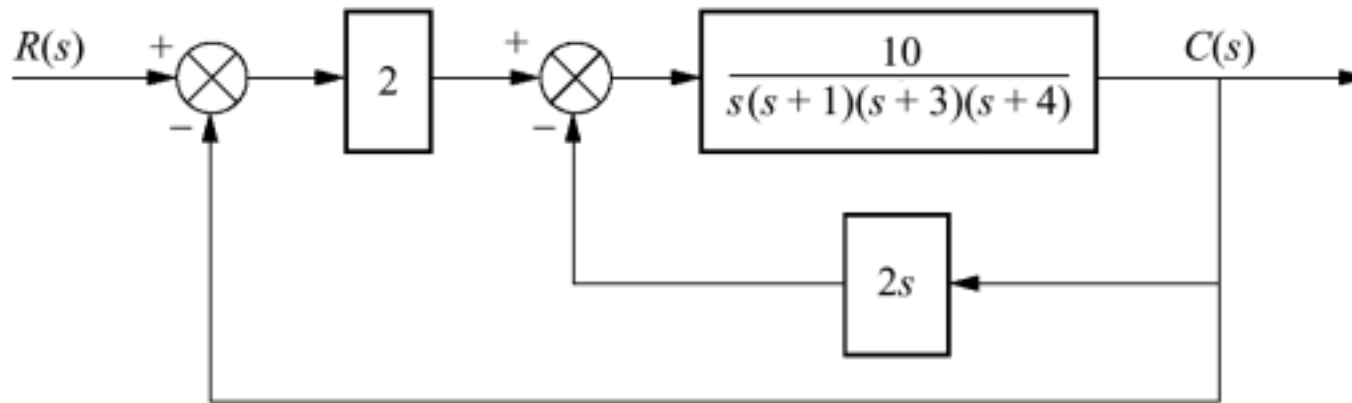
Figure P7.8

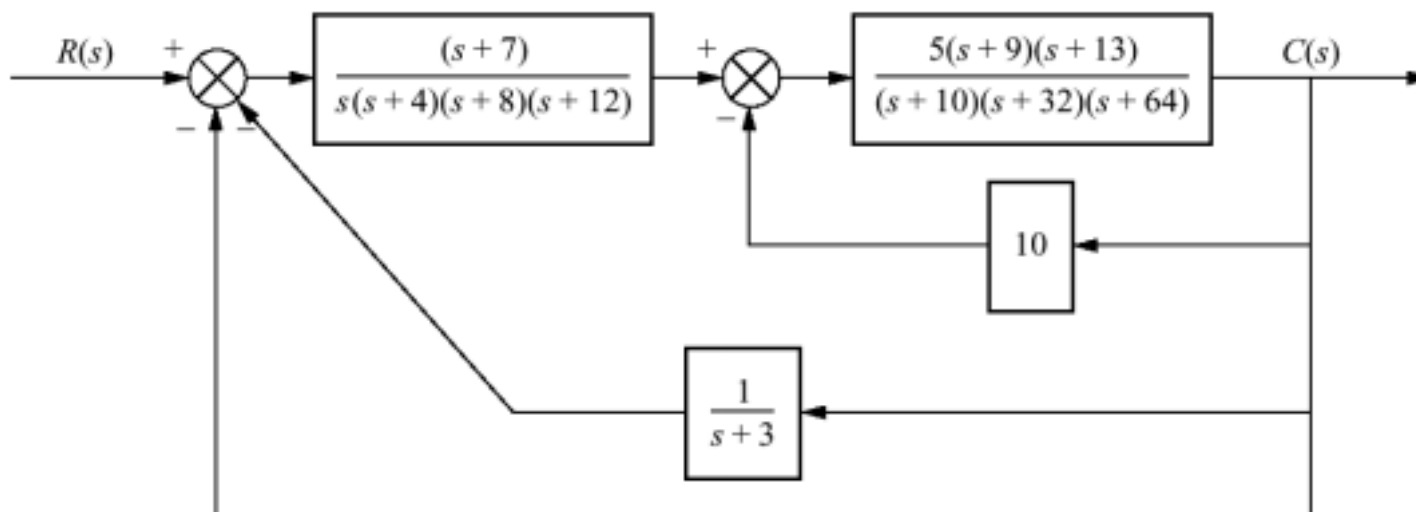
Figure P7.9

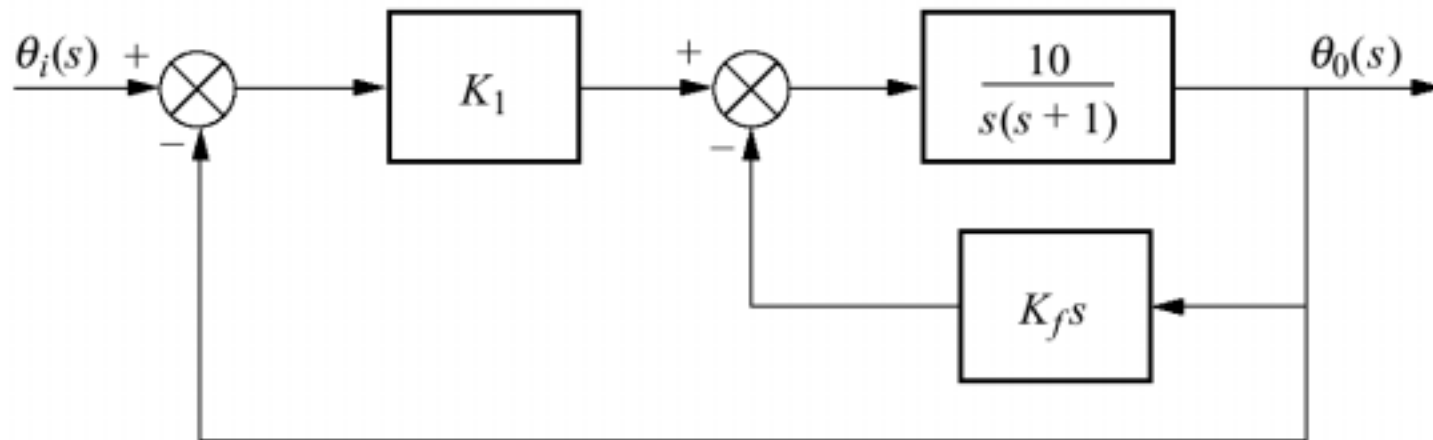
Figure P7.10

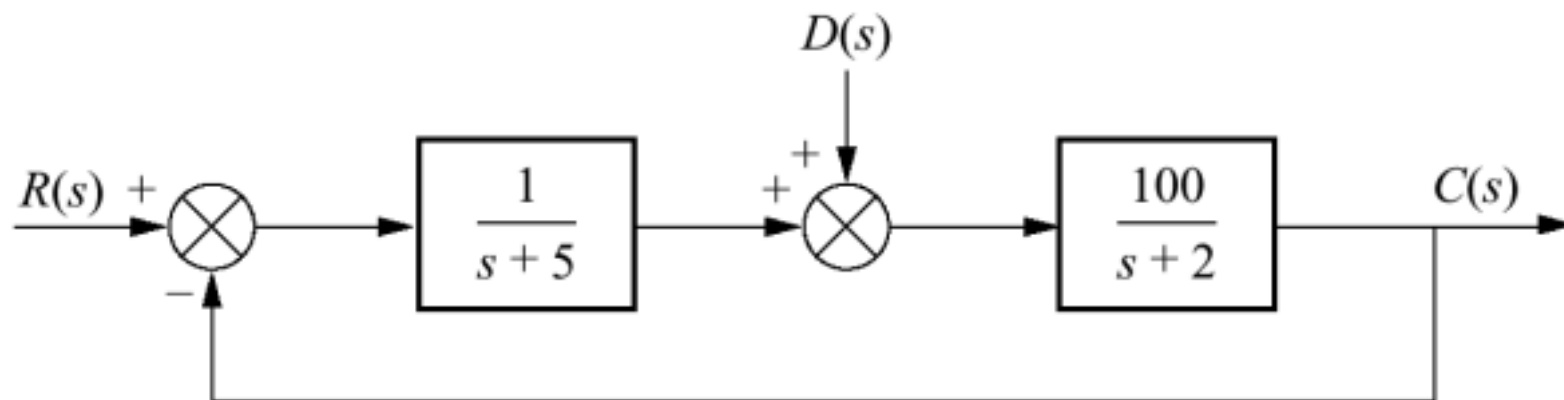
Figure P7.11

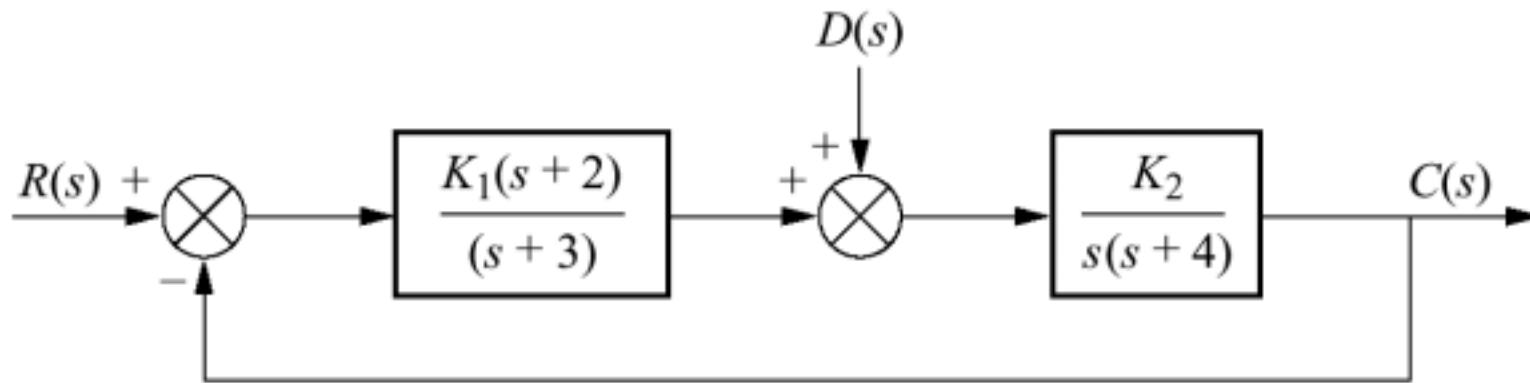
Figure P7.12

Figure P7.13
Closed-loop systems with
nonunity
feedback

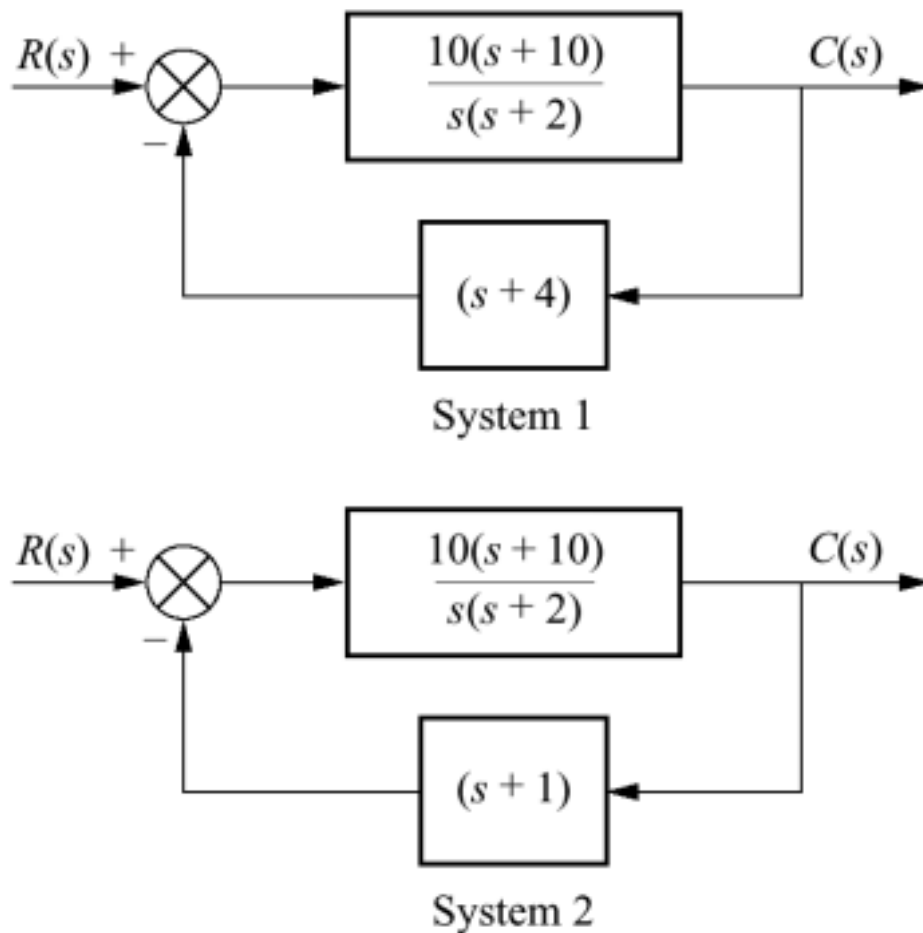


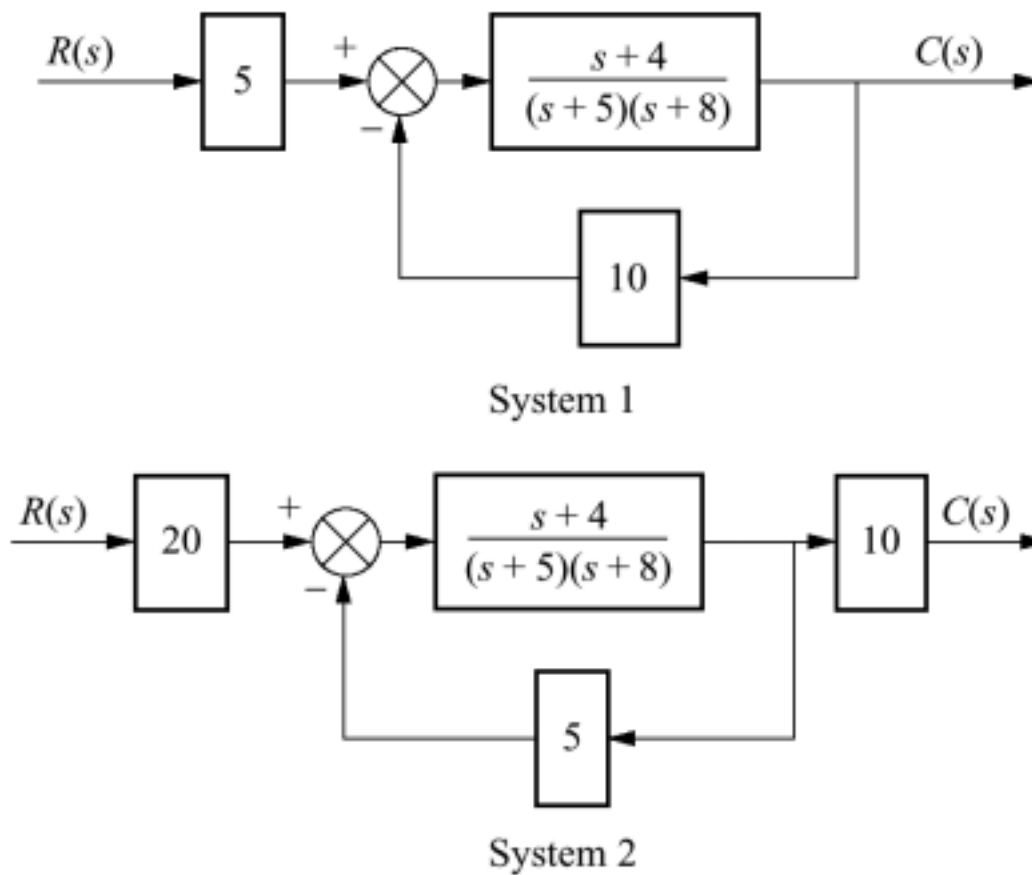
Figure P7.14

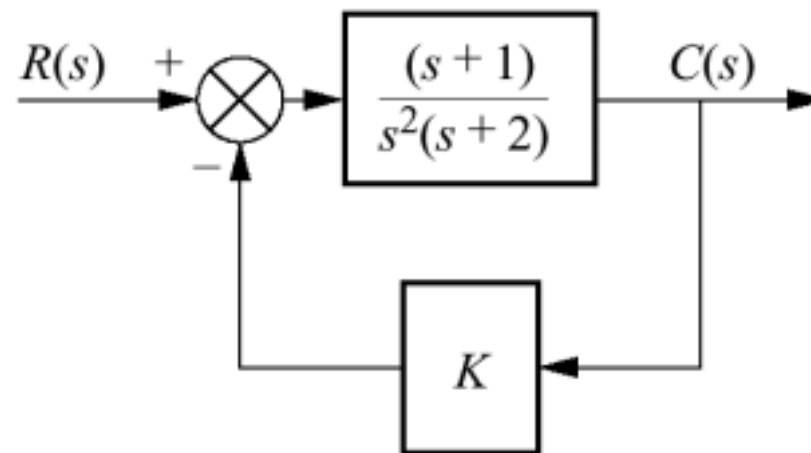
Figure P7.15

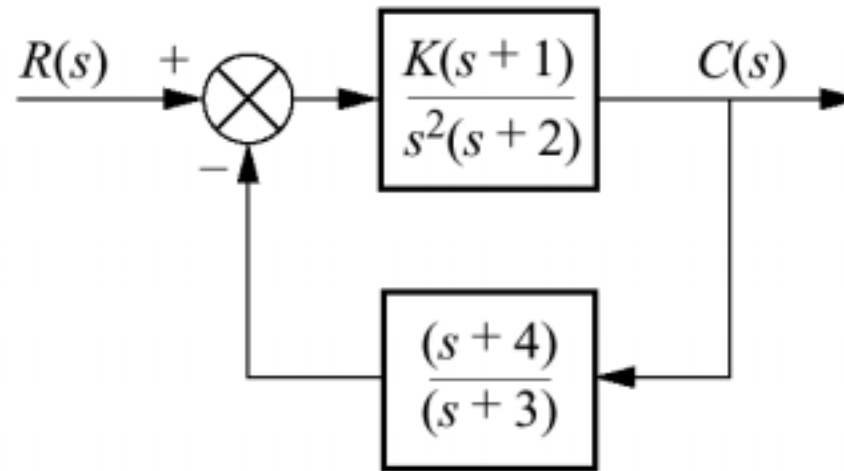
Figure P7.16

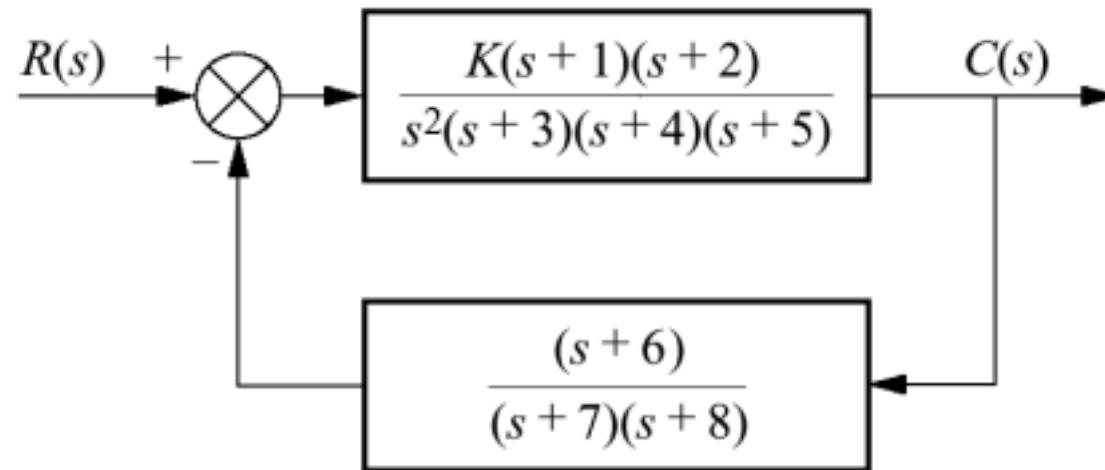
Figure P7.17

Figure P7.18

System with input and disturbance

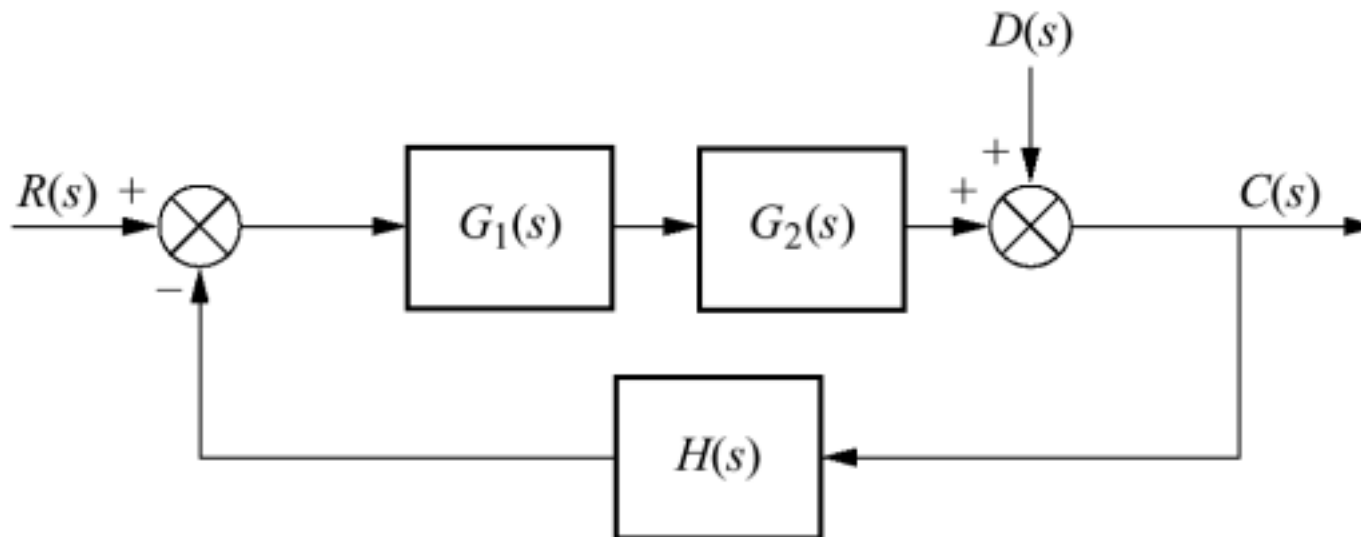


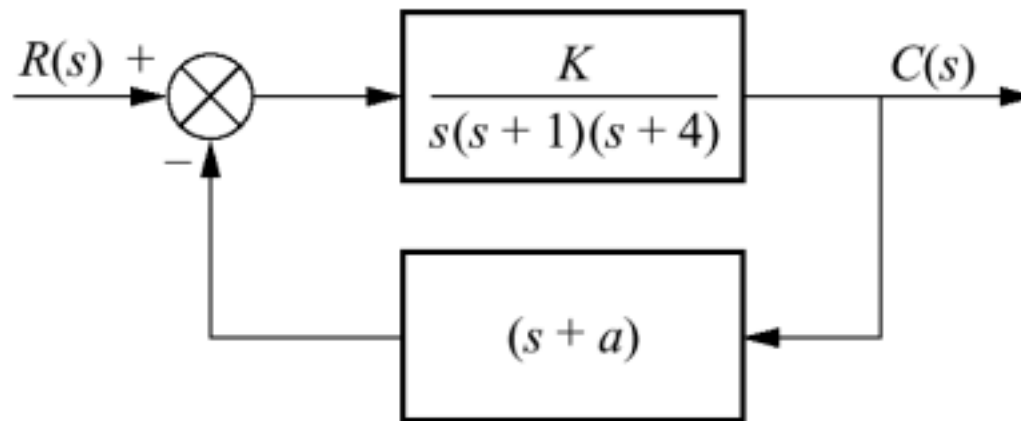
Figure P7.19

Figure P7.20

System with input and disturbance

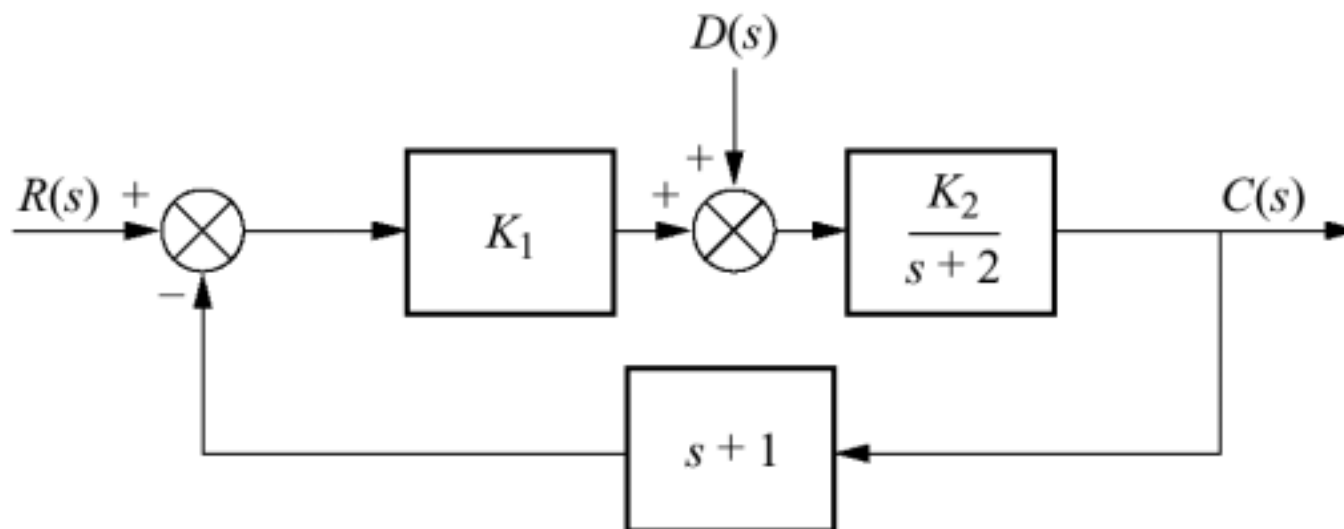


Figure P7.21

Automobile
guidance
system

a. displacement
control system;
b. velocity control
loop

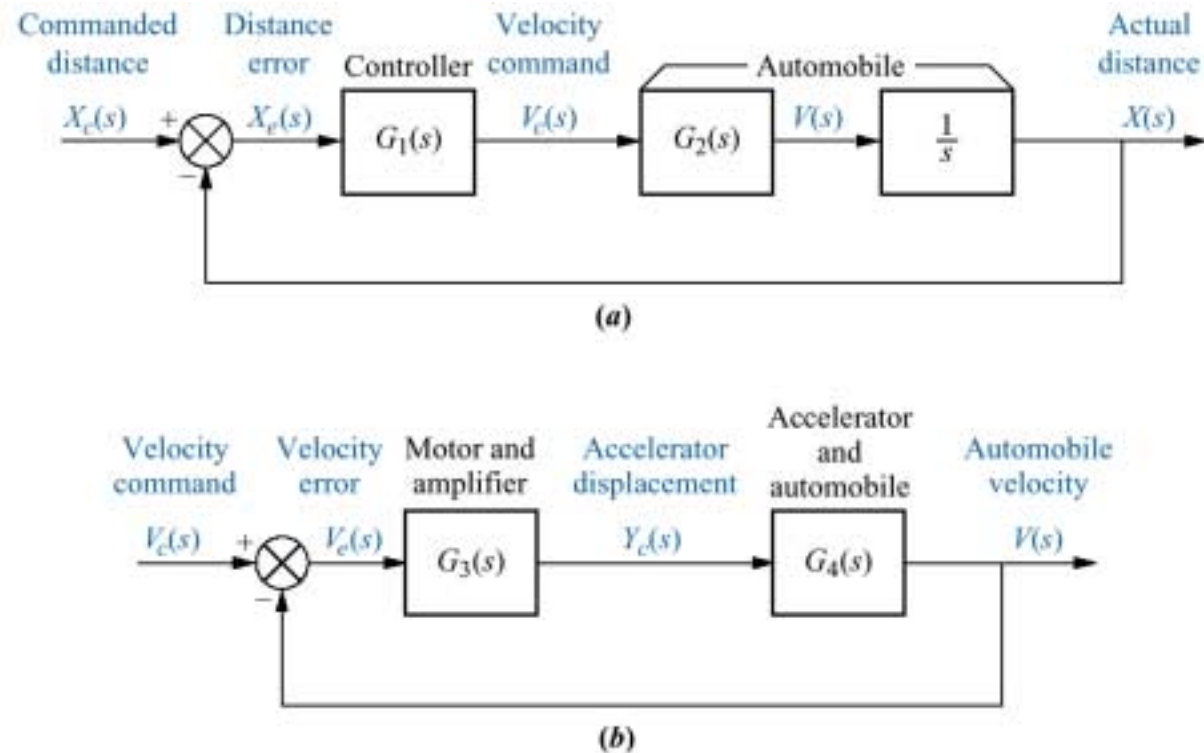


Figure P7.22

Block diagram of a
paramagnetic oxygen
analyzer

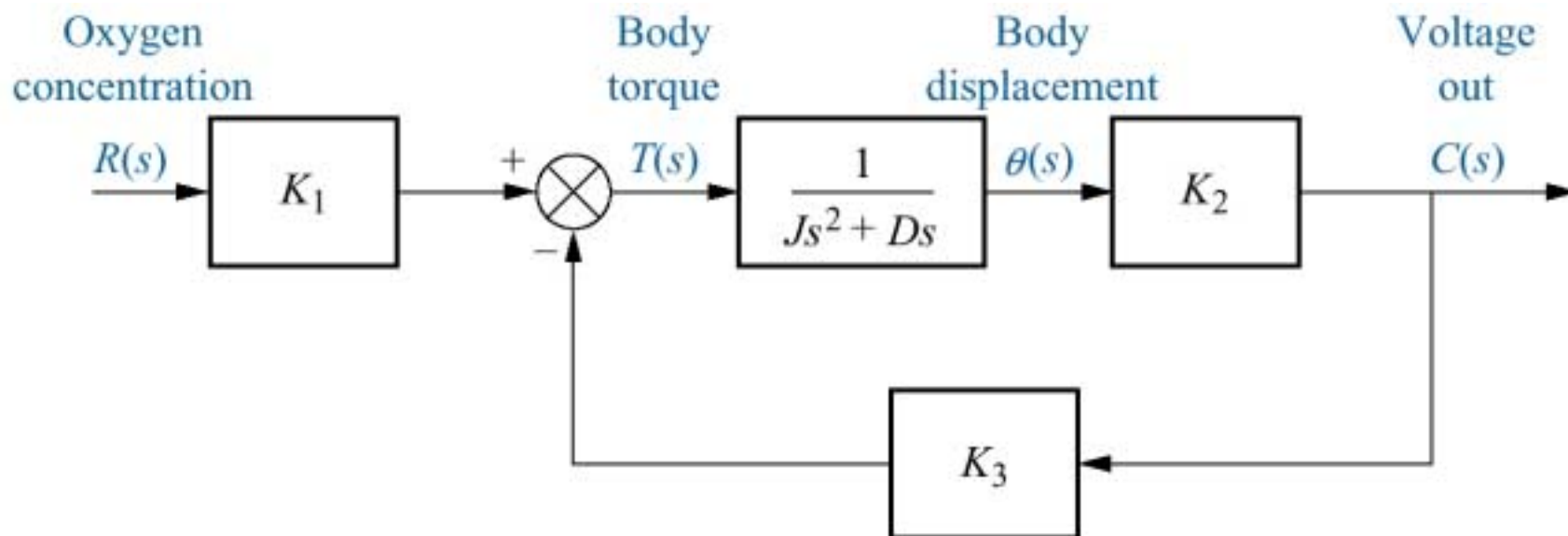
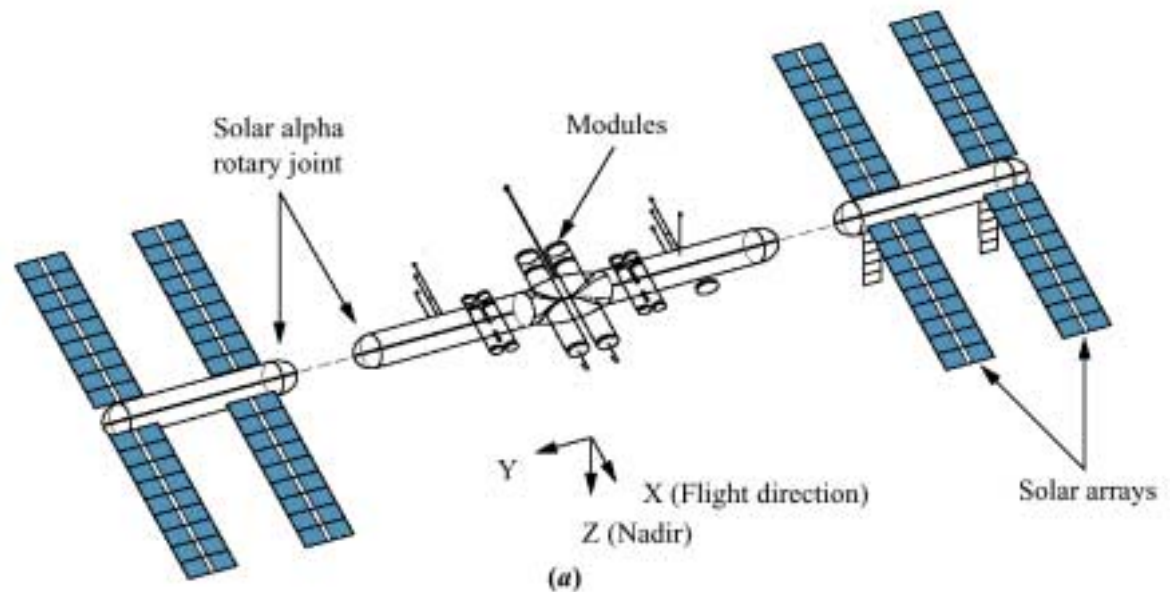


Figure P7.23
Space
station Freedom:
a. configuration
(© 1992 AIAA)
(figure continues)



**c. alpha joint drive
train and control
system (©1992 AIAA)**



Figure P7.24
Position control
system

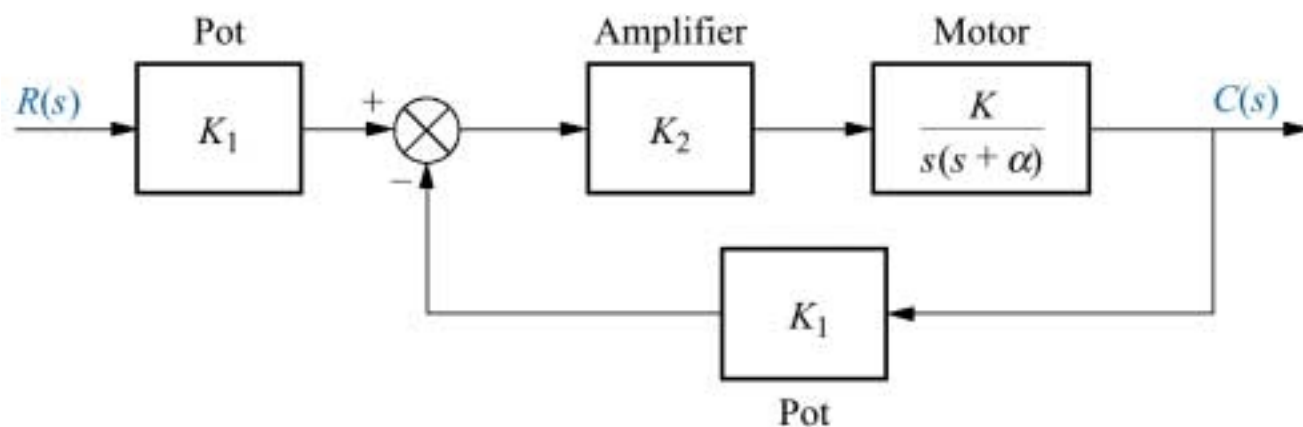


Figure P7.25

Boat tracked
by ship's radar:

- a.** physical arrangement;
- b.** block diagram of tracking system

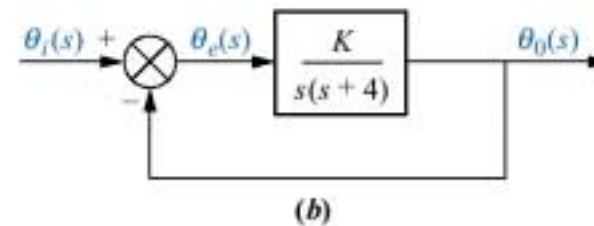
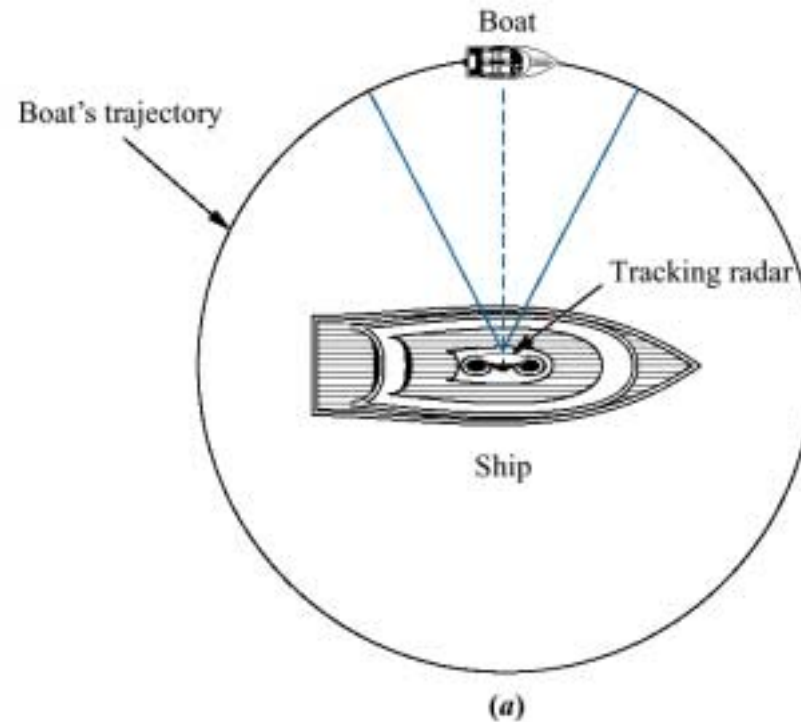


Figure P7.26
Simplified block
diagram of a pilot in
a loop (©1992 AIAA)

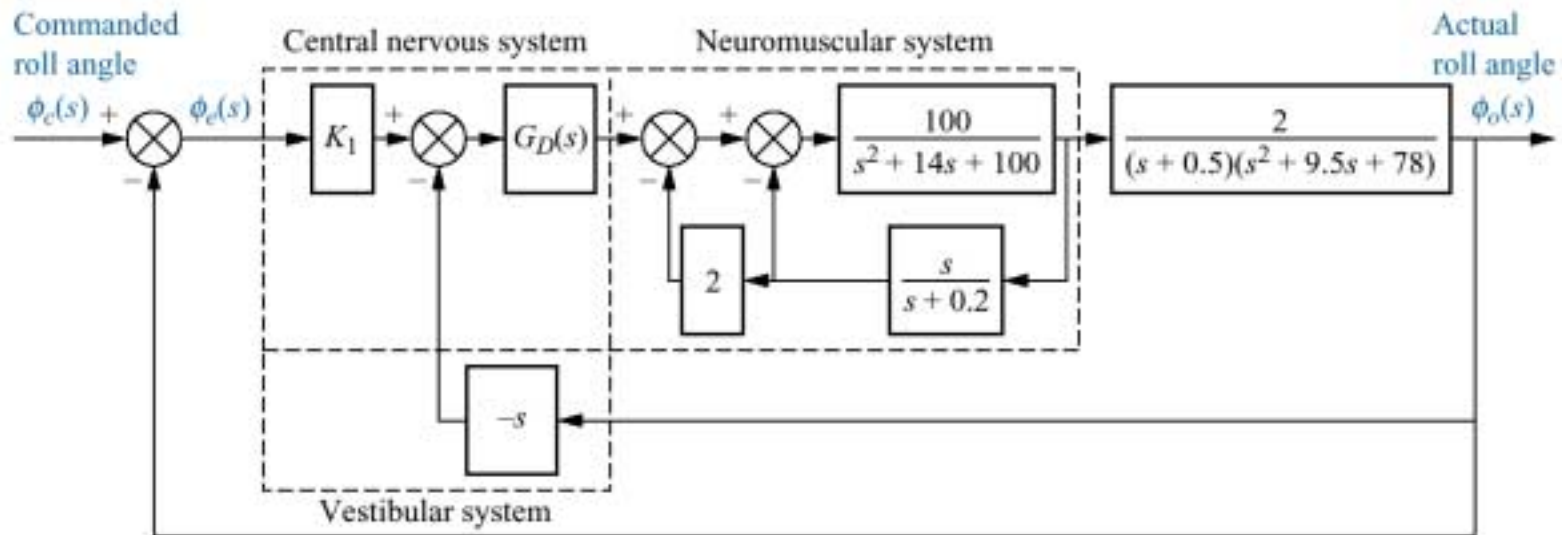


Figure P7.27

- a.** Force control mechanical loop under contact motion
(©1996 IEEE);
- b.** block diagram
(©1996 IEEE)

