VIETNAM NATIONAL UNIVERSITY, HANOI
UNIVERSITY OF ENGINEERING AND TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM
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EXAMINATION QUESTIONS AND EXERCISES

1. Course Information

- Course title: Signals and Systems
- Course ID: ELT2035
- Number of credits: 03
- Number of credit hours (Lec/Lab/Prep): 45 (42/3/0)
- Presiquisite: MAT1095
- Course group: Compulsory ☒ Elective ☐

2. Lecturer's Information

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3. List of Questions and Exercises

3.1. Multiple-choice questions

Question 1. Which one of the following statements is INCORRECT?

A. An energy signal can not be periodic.
B. A power signal can not have finite energy.
C. A sinusoidal is a power signal.
D. A finite-length signal can be a power signal.

Question 2. Which one of the following statements is INCORRECT?

A. The impulse response of a causal LTI system is a causal signal.
B. The impulse response of a stable LTI system is an energy signal.
C. The impulse response of a stable LTI system is a finite-length signal.
D. The frequency response of a discrete-time stable LTI system is a continuous-frequency function.
E. The frequency response of a discrete-time LTI system is periodic.

Question 3. Given a system described by the equation $y(n)-y(n-1) = x(n)$, which one of the following statements is INCORRECT about this system?

A. The system is linear.
B. The system is time-invariant.
C. The system is stable.
D. The system is causal.

Types of credit hours: Lecture hours; Tutorial/Lab hours; Self preparatory hours.

Question 4. Which one of the following statements is INCORRECT?

A. All poles of a stable continuous-time causal LTI system must be in the right half of the s-plane.

B. All poles of a stable discrete-time causal LTI system must be inside the unit circle in the z-plane.

C. The region of convergence (ROC) of the transfer function of a stable continuous-time LTI system must contain the $j\omega$ axis of the s-plane.

D. The region of convergence (ROC) of the transfer function of a stable discrete-time LTI system must contain the unit circle in the z-plane.

Question 5. Which one of the following signals is NOT periodic:

A. $x(t)=[\cos(2\pi t)]^2$

B. $x(t)=\sum_{k=-\infty}^{+\infty} w(t-3k)$, where $w(t)=\begin{cases} 0 & (t\le -1 \vee t>1) \\ 1+t & (-1<t\le 0) \\ 1-t & (0<t\le 1) \end{cases}$

C. $x(t)=\sum_{k=-5}^{5} w(t-2k)$, where $w(t)=\begin{cases} 0 & (t\le -1 \vee t>1) \\ 1+t & (-1<t\le 0) \\ 1-t & (0<t\le 1) \end{cases}$

D. $x(n)=(-1)^n$

Question 6. Which one of the following signals is NOT periodic:

A. $x(n)=\cos(2n)$

B. $x(n)=\cos(2\pi n)$

C. $x(n)=\sum_{k=-\infty}^{+\infty} \{(-1)^k[\delta(n-2k)+\delta(n+3k)]\}$

D. $x(n)=2\sin(4\pi n/19)+\cos(10\pi n/19)+1$

Question 7. Which of the systems described by the following impulse responses is memoryless?

A. $h(t)=\cos(\pi t)$

B. $h(t)=e^{-2t}u(t-1)$

C. $h(t)=u(t+1)$

D. $h(t)=3\delta(t)$

Question 8. Which of the systems described by the following impulse responses is memoryless?

A. $h(n)=(-1)^n u(-n)$

B. $h(n)=(1/2)^{|n|}$

C. $h(n)=2^n[u(n)-u(n-1)]$

D. $h(n)=\cos(\pi n/8)[u(n)-u(n-10)]$

Question 9. Which of the systems described by the following impulse responses is causal?

A. $h(t)=\cos(\pi t)$

B. $h(t)=e^{-2t}u(t-1)$

C. $h(t)=u(t+1)$

D. $h(t)=\cos(\pi t)u(-t)$

Question 10. Which of the systems described by the following impulse responses is causal?

A. $h(n)=(-1)^n u(-n)$

B. $h(n)=(1/2)^{|n|}$

C. $h(n)=u(n)-2u(n-5)$

D. $h(n)=\sin(\pi n/2)$

Question 11. Which of the systems described by the following impulse responses is stable?

A. $h(t)=\cos(\pi t)$

B. $h(t)=e^{-2t}u(t-1)$

C. $h(t)=u(t+1)$

D. $h(t)=\cos(\pi t)u(-t)$

Question 12. Which of the systems described by the following impulse responses is stable?

A. $h(n)=\sin(\pi n/2)$

B. $h(n)=(-1)^n u(-n)$

C. $h(n)=u(n)-2u(n-5)$

D. $h(n)=\sum_{k=0}^{+\infty}\delta(n-2k)$

Question 13. Which of the following systems is a causal linear time-invariant system?

A. $y(t)=(t-1)x(t)$

B. $y(t)=x(t)-2x(t/2)$

C. $y(n)=x(n)+y(n-1)$

D. $y(n)=|x(n)-x(n-1)|$

Question 14. What is the appropriate Fourier representation of the following signal:

$$x(t)=e^{-t}\cos(2\pi t)u(t)$$

A. The continuous-time Fourier transform (FT).

B. The discrete-time Fourier transform (DTFT).

C. The continuous-time Fourier series (FS).

D. The discrete-time Fourier series (DTFS).

Question 15. What is the appropriate Fourier representation of the following signal:

$$x(n)=\begin{cases} \cos(\pi n/10)+j\sin(\pi n/10) & (|n|<10) \\ 0 & (|n|\geq 10) \end{cases}$$

A. The continuous-time Fourier transform (FT).

B. The discrete-time Fourier transform (DTFT).

C. The continuous-time Fourier series (FS).

D. The discrete-time Fourier series (DTFS).

Question 16. What is the appropriate Fourier representation of the following signal:

$$x(t)=e^{1+t}u(2-t)$$

A. The continuous-time Fourier transform (FT).

B. The discrete-time Fourier transform (DTFT).

C. The continuous-time Fourier series (FS).

D. The discrete-time Fourier series (DTFS).

Question 17. What is the appropriate Fourier representation of the following signal:

$$x(t)=|\sin(2\pi t)|$$

A. The continuous-time Fourier transform (FT).

B. The discrete-time Fourier transform (DTFT).

C. The continuous-time Fourier series (FS).

D. The discrete-time Fourier series (DTFS).

Question 18. What is the appropriate description of the system described by the following impulse response:

$$h(t)=\delta(t)-2e^{-2t}u(t)$$

A. A low-pass filter.

B. A high-pass filter.

C. A band-pass filter.

D. A band-reject filter.

Question 19. What is the appropriate description of the system described by the following impulse response:

$$h(t)=4e^{-2t}\cos(50t)$$

A. A low-pass filter.

B. A high-pass filter.

C. A band-pass filter.

D. A band-reject filter.

Question 20. What is the appropriate description of the system described by the following impulse response:

$$h(n)=\frac{1}{8}\left(\frac{7}{8}\right)^n u(n)$$

A. A low-pass filter.

B. A high-pass filter.

C. A band-pass filter.

D. A band-reject filter.

<u>Question 21</u>. What is the appropriate description of the system described by the following impulse response:

$$h(n)=\begin{cases}(-1)^n & (|n|\leq 10)\\ 0 & (|n|>10)\end{cases}$$

A. A low-pass filter.

B. A high-pass filter.

C. A band-pass filter.

D. A band-reject filter.

<u>Question 22</u>. What is the initial value of the signal $x(t)$, given its Laplace transform as follows:

$$X(s)=\frac{1}{s^2+5s-2}$$

A. 0

B. 1

C. 2

D. −1

<u>Question 23</u>. What is the initial value of the signal $x(t)$, given its Laplace transform as follows:

$$X(s)=\frac{s+2}{s^2+2s-3}$$

A. 0

B. 1

C. 2

D. −1

<u>Question 24</u>. What is the initial value of the signal $x(t)$, given its Laplace transform as follows:

$$X(s)=e^{-2s}\frac{6s^2+s}{s^2+2s-2}$$

A. 0

B. 1

C. 2

D. −1

Question 25. What is the final value of the signal $x(t)$, given its Laplace transform as follows:

$$X(s)=\frac{2s^2+3}{s^2+5s+1}$$

A. 0

B. 2

C. 1/2

D. 1/4

Question 26. What is the final value of the signal $x(t)$, given its Laplace transform as follows:

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

A. 0

B. 2

C. 1/2

D. 1/4

Question 27. What is the final value of the signal $x(t)$, given its Laplace transform as follows:

$$X(s)=e^{-3s}\frac{2s^2+1}{s(s+2)^2}$$

A. 0

B. 2

C. 1/2

D. 1/4

Question 28. Which one of the systems described by the following transfer functions can NOT be both causal and stable?

A. $H(s)=\frac{(s+1)(s+2)}{(s+1)(s^2+2s+10)}$

B. $H(s)=\frac{s^2-3s+2}{(s+2)(s^2-2s+8)}$

C. $H(s)=\frac{s^2+2s-3}{(s+3)(s^2+2s+5)}$

D. $H(s)=\frac{(s+1)(s^2+2s+10)}{(s+1)(s+2)}$

Question 29. For which of the following signals does the discrete-time Fourier transform NOT exist?

A. $x(n)=\delta(n-1)$

B. $x(n)=\delta(n+1)$

C. $x(n)=(2/3)^{|n|}$

D. $x(n)=(1/4)^n u(-n)$

Question 30. Which one of the systems described by the following transfer functions can be both causal and stable?

A. $H(z)=\dfrac{2z+3}{z^2+z-5/16}$

B. $H(z)=\dfrac{z^{-1}}{[1-(1/2)z^{-1}](1+3z^{-1})}$

C. $H(z)=\dfrac{z^2-1/4}{6z^2+7z+3}$

D. $H(z)=\dfrac{z^{-2}}{1-(1/2)z^{-1}+(1/4)z^{-2}}$

3.2. Exercises

Exercise 1. Find the fundamental period of the following periodic signal:

$$x(t)=[\cos(2\pi t)]^2$$

Exercise 2. Find the fundamental period of the following periodic signal:

$$x(t)=\sum_{k=-\infty}^{+\infty} w(t-3k) \quad \text{, where} \quad w(t)=\begin{cases} 0 & (t\le -1 \vee t>1) \\ 1+t & (-1<t\le 0) \\ 1-t & (0<t\le 1) \end{cases}$$

Exercise 3. Find the fundamental period of the following periodic signal:

$$x(n)=(-1)^n$$

Exercise 4. Find the fundamental period of the following periodic signal:

$$x(n)=\cos(2\pi n)$$

Exercise 5. Determine the impulse response of a continuous-time LTI system described by the following equation:

$$y(t)+3\frac{dy(t)}{dt}+2\frac{d^2y(t)}{dt^2}=\frac{dx(t)}{dt}$$

Exercise 6. Determine the magnitude response and the phase response of a continuous-time LTI system decsribed by the following equation:

$$y(t)+3\frac{dy(t)}{dt}+2\frac{d^2y(t)}{dt^2}=\frac{dx(t)}{dt}$$

Exercise 7. Determine the transfer function of a causal discrete-time LTI system described by the following equation:

$$y(n)+3y(n-1)+2y(n-2)=x(n-1)$$

Exercise 8. Determine the step response of a causal discrete-time LTI system described by the following equation:

$$y(n)+3y(n-1)+2y(n-2)=x(n-1)$$

Exercise 9. A discrete-time LTI system has the following impulse response:

$$h(n)=2^{-n}u(n)$$

Determine the output of the system when the input signal is:

$$x(n)=\sin(\pi n/3+\pi/4)+2$$

Exercise 10. Determine the impulse response of the following causal LTI system:

$$\frac{dy(t)}{dt}-y(t)=x(t)+x(t-1)$$

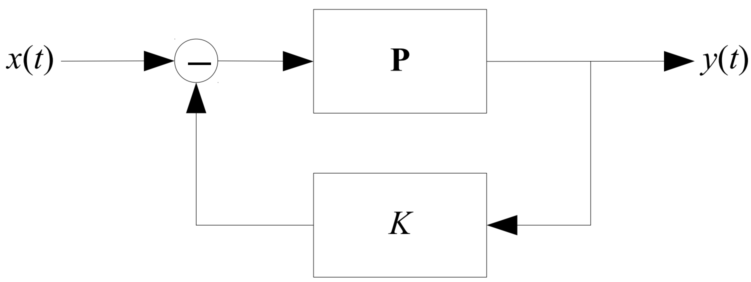
Exercise 11. Determine the impulse response of the following causal LTI system:

$$4y(n)-y(n-2)=x(n)-2x(n-1)$$

Exercise 12. The negative feedback control system shown in figure bellow has a plant **P** and a feedback coefficient of *K*, in which the plant **P** is described by the equation

$$\frac{dy(t)}{dt}-2y(t)=x(t)$$

and *K* is a real value.

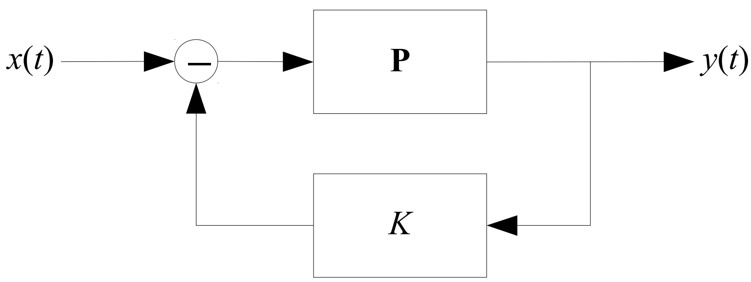


Compute the transfer function of the feedback control system.

Exercise 13. The negative feedback control system shown in figure bellow has a plant **P** and a feedback coefficient of *K*, in which the plant **P** is described by the equation

$$\frac{dy(t)}{dt}-2y(t)=x(t)$$

and *K* is a real value.



Determine *K* so that the system is causal and stable.

Exercise 14. Determine the frequency response of an LTI system having the following impulse response:

$$h(t)=\sin(t)[u(t)-u(t-1)]$$

Exercise 15. Determine the response of an LTI system having the following impulse response:

$$h(t)=\sin(t)[u(t)-u(t-1)]$$

to the input signal:

$$x(t)=\cos(2t+\pi/4)+1$$

Exercise 16. Determine the step response of the system having the following impulse response:

$$h(n)=(-1/2)^n u(n)$$

Exercise 17. Determine the step response of the system having the following impulse response:

$$h(n)=\delta(n)-\delta(n-2)$$

Exercise 18. Determine the step response of the system having the following impulse response:

$$h(n)=(-1)^n[u(n+2)-u(n-3)]$$

Exercise 19. Determine the step response of the system having the following impulse response:

$$h(n)=nu(n)$$

Exercise 20. Determine the step response of the system having the following impulse response:

$$h(t)=(1/4)[u(t)-u(t-4)]$$

Exercise 21. Determine the step response of the system having the following impulse response:

$$h(t)=u(t)$$

Exercise 22. Determine the homogeneous solution for the system described by the following differential equation:

$$5\frac{dy(t)}{dt}+10\,y(t)=2\,x(t)$$

Exercise 23. Determine the homogeneous solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8\,y(t)=\frac{dx(t)}{dt}$$

Exercise 24. Determine the homogeneous solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+4\,y(t)=3\frac{dx(t)}{dt}$$

Exercise 25. Determine the homogeneous solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+2\,y(t)=x(t)$$

Exercise 26. Determine the homogeneous solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

Exercise 27. Determine the homogeneous solution for the system described by the following difference equation:

$$y(n)-ay(n-1)=2\,x(n)$$

Exercise 28. Determine the homogeneous solution for the system described by the following difference equation:

$$y(n)-(1/4)\,y(n-1)-(1/8)\,y(n-2)=x(n)+x(n-1)$$

Exercise 29. Determine the homogeneous solution for the system described by the following difference equation:

$$y(n)+(9/16)\,y(n-2)=x(n-1)$$

Exercise 30. Determine the homogeneous solution for the system described by the following difference equation:

$$y(n)+y(n-1)+(1/4)\,y(n-2)=x(n)+2\,x(n-1)$$

Exercise 31. Determine the particular solution for the system described by the following differential equation:

$$5\frac{dy(t)}{dt}+10\,y(t)=2\,x(t)$$

given the input:

$$x(t)=2$$

Exercise 32. Determine the particular solution for the system described by the following differential equation:

$$5\frac{dy(t)}{dt}+10\,y(t)=2\,x(t)$$

given the input:

$$x(t)=e^{-t}$$

Exercise 33. Determine the particular solution for the system described by the following differential equation:

$$5\frac{dy(t)}{dt}+10\,y(t)=2\,x(t)$$

given the input:

$$x(t)=\cos(3t)$$

Exercise 34. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+4\,y(t)=3\frac{dx(t)}{dt}$$

given the input:

$$x(t)=t$$

Exercise 35. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+4\,y(t)=3\frac{dx(t)}{dt}$$

given the input:

$$x(t)=e^{-t}$$

Exercise 36. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+4\,y(t)=3\frac{dx(t)}{dt}$$

given the input:

$$x(t)=\cos(t)+\sin(t)$$

Exercise 37. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

given the input:

$$x(t)=e^{-3t}$$

Exercise 38. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

given the input $x(t)=2e^{-t}$.

Exercise 39. Determine the particular solution for the system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

given the input:

$$x(t)=2\sin(t)$$

Exercise 40. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(2/5)y(n-1)=2x(n)$$

given the input:

$$x(n)=2u(n)$$

Exercise 41. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(2/5)y(n-1)=2x(n)$$

given the input:

$$x(n)=-(1/2)^n u(n)$$

Exercise 42. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(2/5)y(n-1)=2x(n)$$

given the input:

$$x(n)=\cos(\pi n/5)$$

Exercise 43. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input:

$$x(n)=nu(n)$$

Exercise 44. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input:

$$x(n)=(1/8)^n u(n)$$

Exercise 45. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input:

$$x(n)=e^{j\pi n/4}u(n)$$

Exercise 46. Determine the particular solution for the system described by the following difference equation:

$$y(n)-(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input:

$$x(n)=(1/2)^n u(n)$$

Exercise 47. Determine the particular solution for the system described by the following difference equation:

$$y(n)+y(n-1)+(1/2)y(n-2)=x(n)+2\mathrm{x}(n-1)$$

given the input:

$$x(n)=u(n)$$

Exercise 48. Determine the particular solution for the system described by the following difference equation:

$$y(n)+y(n-1)+(1/2)y(n-2)=x(n)+2\mathrm{x}(n-1)$$

given the input:

$$x(n)=(-1/2)^n u(n)$$

Exercise 49. Determine the output of the system described by the following differential equation:

$$\frac{dy(t)}{dt}+10\,y(t)=2\,x(t)$$

given the input:

$$x(t)=u(t)$$

and the initial condition:

$$y(0-)=1$$

Exercise 50. Determine the output of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

given the input:

$$x(t)=\sin(t)u(t)$$

and the initial conditions:

$$y(0-)=0 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

Exercise 51. Determine the output of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8\,y(t)=2\,x(t)$$

given the input:

$$x(t)=e^{-t}u(t)$$

and the initial conditions:

$$y(0-)=-1 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

Exercise 52. Determine the output of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+y(t)=3\frac{dx(t)}{dt}$$

given the input:

$$x(t)=2te^{-t}u(t)$$

and the initial conditions:

$$y(0-)=-1 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

<u>Exercise 53</u>. Determine the natural and forced responses of the system described by the following differential equation:

$$\frac{dy(t)}{dt}+10y(t)=2x(t)$$

given the input:

$$x(t)=u(t)$$

and the initial condition:

$$y(0-)=1$$

<u>Exercise 54</u>. Determine the natural and forced responses of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\frac{dx(t)}{dt}$$

given the input:

$$x(t)=\sin(t)u(t)$$

and the initial conditions:

$$y(0-)=0 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

<u>Exercise 55</u>. Determine the natural and forced responses of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$$

given the input:

$$x(t)=e^{-t}u(t)$$

and the initial conditions:

$$y(0-)=-1 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

<u>Exercise 56</u>. Determine the natural and forced responses of the system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+y(t)=3\frac{dx(t)}{dt}$$

given the input:

$$x(t)=2te^{-t}u(t)$$

and the initial conditions:

$$y(0-)=-1 \quad \text{and} \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=1$$

<u>Exercise 57</u>. Determine the output of the system described by the following difference equation:

$$y(n)-(1/2)y(n-1)=2x(n)$$

given the input:

$$x(n)=(-1/2)^n u(n)$$

and the initial condition:

$$y(-1)=3$$

Exercise 58. Determine the output of the system described by the following difference equation:

$$y(n)-(1/9)y(n-2)=x(n-1)$$

given the input:

$$x(n)=u(n)$$

the initial conditions:

$$y(-1)=1 \quad \text{and} \quad y(-2)=0$$

Exercise 59. Determine the output of the system described by the following difference equation:

$$y(n)+(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input

$$x(n)=(-1)^n u(n)$$

and the initial conditions:

$$y(-1)=4 \quad \text{and} \quad y(-2)=-2$$

Exercise 60. Determine the output of the system described by the following difference equation:

$$y(n)-(3/4)y(n-1)+(1/8)y(n-2)=2x(n)$$

given the input:

$$x(n)=2u(n)$$

and the initial conditions:

$$y(-1)=1 \quad \text{and} \quad y(-2)=-1$$

Exercise 61. Determine the natural and forced responses of the system described by the following difference equation:

$$y(n)-(1/2)y(n-1)=2x(n)$$

given the input:

$$x(n)=(-1/2)^n u(n)$$

and the initial condition:

$$y(-1)=3$$

Exercise 62. Determine the natural and forced responses of the system described by the following difference equation:

$$y(n)-(1/9)y(n-2)=x(n-1)$$

given the input:

$$x(n)=u(n)$$

and the initial conditions:

$$y(-1)=1 \quad \text{and} \quad y(-2)=0$$

Exercise 63. Determine the natural and forced responses of the system described by the following difference equation:

$$y(n)+(1/4)y(n-1)-(1/8)y(n-2)=x(n)+x(n-1)$$

given the input:

$$x(n)=(-1)^n u(n)$$

and the initial conditions:

$$y(-1)=4 \quad \text{and} \quad y(-2)=-2$$

Exercise 64. Determine the natural and forced responses of the system described by the following difference equation:

$$y(n)-(3/4)\,y(n-1)+(1/8)\,y(n-2)=2\,x(n)$$

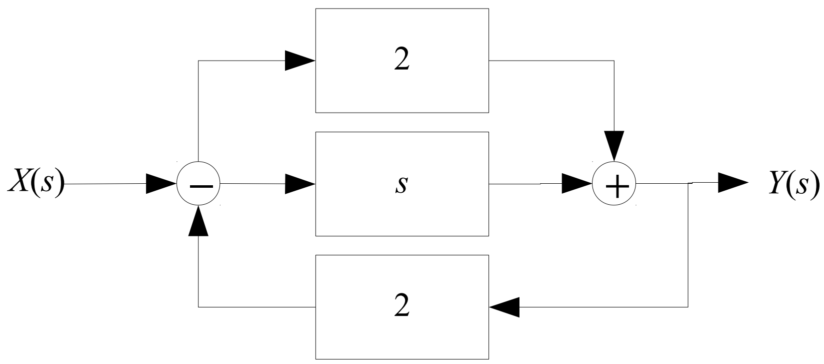
given the input:

$$x(n)=2\,u(n)$$

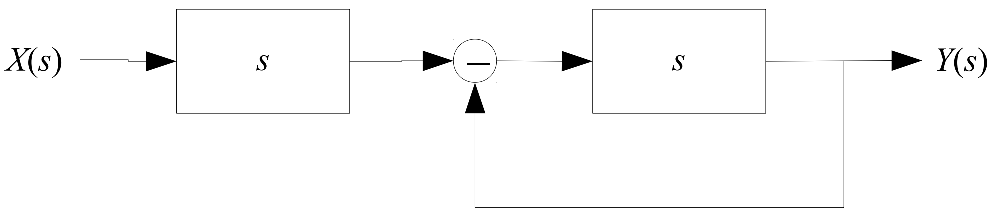
and the initial conditions:

$$y(-1)=1 \quad \text{and} \quad y(-2)=-1$$

Exercise 65. Find the difference equation describing the discrete-time system represented by the following block diagram:



Exercise 66. Find the difference equation describing the discrete-time system represented by the following block diagram:



Exercise 67. Draw the block-diagram representation of a discrete-time LTI system described by the following state-variable representation matrices:

$$\boldsymbol{A}=\begin{bmatrix} 1 & -1/2 \\ 1/3 & 0 \end{bmatrix}, \quad \boldsymbol{B}=\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \boldsymbol{C}=\begin{bmatrix} 1 & 1 \end{bmatrix}, \text{ and } \boldsymbol{D}=\begin{bmatrix} 0 \end{bmatrix}$$

Exercise 68. Draw the block-diagram representation of a discrete-time LTI system described by the following state-variable representation matrices:

$$\boldsymbol{A}=\begin{bmatrix} 1 & -1/2 \\ 1/3 & 0 \end{bmatrix}, \quad \boldsymbol{B}=\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \boldsymbol{C}=\begin{bmatrix} 1 & -1 \end{bmatrix}, \text{ and } \boldsymbol{D}=\begin{bmatrix} 0 \end{bmatrix}$$

Exercise 69. Draw the block-diagram representation of a discrete-time LTI system described by the following state-variable representation matrices:

$$\boldsymbol{A}=\begin{bmatrix} 0 & -1/2 \\ 1/3 & -1 \end{bmatrix}, \quad \boldsymbol{B}=\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad \boldsymbol{C}=\begin{bmatrix} 1 & 0 \end{bmatrix}, \text{ and } \boldsymbol{D}=\begin{bmatrix} 1 \end{bmatrix}$$

Exercise 70. Draw the block-diagram representation of a discrete-time LTI system described by the following state-variable representation matrices:

$$A=\begin{bmatrix}0 & 0\\ 0 & 1\end{bmatrix}\ ,\ B=\begin{bmatrix}2\\ 3\end{bmatrix}\ ,\ C=\begin{bmatrix}1 & -1\end{bmatrix}\ \text{, and}\ D=\begin{bmatrix}0\end{bmatrix}$$

Exercise 71. Draw the block-diagram representation of a continuous-time LTI system described by the following state-variable representation matrices:

$$A=\begin{bmatrix}1/3 & 0\\ 0 & -1/2\end{bmatrix}\ ,\ B=\begin{bmatrix}-1\\ 2\end{bmatrix}\ ,\ C=\begin{bmatrix}1 & 1\end{bmatrix}\ \text{, and}\ D=\begin{bmatrix}0\end{bmatrix}$$

Exercise 72. Draw the block-diagram representation of a continuous-time LTI system described by the following state-variable representation matrices:

$$A=\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}\ ,\ B=\begin{bmatrix}-1\\ 2\end{bmatrix}\ ,\ C=\begin{bmatrix}0 & -1\end{bmatrix}\ \text{, and}\ D=\begin{bmatrix}0\end{bmatrix}$$

Exercise 73. Draw the block-diagram representation of a continuous-time LTI system described by the following state-variable representation matrices:

$$A=\begin{bmatrix}1 & -2\\ 1 & 1\end{bmatrix}\ ,\ B=\begin{bmatrix}2\\ 3\end{bmatrix}\ ,\ C=\begin{bmatrix}1 & 1\end{bmatrix}\ \text{, and}\ D=\begin{bmatrix}0\end{bmatrix}$$

Exercise 74. Determine the discrete-time Fourier series representation for the following signal:

$$x(n)=\cos(6\pi n/17+\pi/3)\ .$$

Exercise 75. Determine the discrete-time Fourier series representation for the following signal:

$$x(n)=2\sin(4\pi n/19)+\cos(10\pi n/19)+1\ .$$

Exercise 76. Determine the discrete-time Fourier series representation for the following signal:

$$x(n)=\sum_{k=-\infty}^{+\infty}\{(-1)^k[\delta(n-2k)+\delta(n+3k)]\}\ .$$

Exercise 77. Determine the time-domain signal represented by the following discrete-time Fourier series coefficients:

$$X_k=\cos(8\pi k/21)$$

Exercise 78. Determine the time-domain signal represented by the following discrete-time Fourier series coefficients:

$$X_k=\cos(10\pi k/19)+2j\sin(4\pi k/19)$$

Exercise 79. Determine the time-domain signal represented by the following discrete-time Fourier series coefficients:

$$X_k=\sum_{m=-\infty}^{+\infty}\{(-1)^m[\delta(k-2m)-2\delta(k+3m)]\}$$

Exercise 80. Determine the Fourier series representation for the following signal:

$$x(t)=\sin(3\pi t)+\cos(4\pi t)\ .$$

Exercise 81. Determine the Fourier series representation for the following signal:

$$x(t)=\sum_{k=-\infty}^{+\infty}\{(-1)^k[\delta(t-k/3)+\delta(t+2k/3)]\}\ .$$

Exercise 82. Determine the Fourier series representation for the following signal:

$$x(t)=\sum_{k=-\infty}^{+\infty}[e^{2\pi k/7}\delta(t-2k)]\ .$$

Exercise 83. Determine the time-domain signal represented by the following Fourier series coefficients:

$$X_k=j\delta(k-1)-j\delta(k+1)+\delta(k-3)+\delta(k+3)\qquad(\omega_0=2\pi)$$

Exercise 84. Determine the time-domain signal represented by the following Fourier series coefficients:

$$X_k = j\delta(k-1) - j\delta(k+1) + \delta(k-3) + \delta(k+3) \qquad (\omega_0 = 4\pi)$$

Exercise 85. Determine the time-domain signal represented by the following Fourier series coefficients:

$$X_k = (-1/3)^{|k|} \qquad (\omega_0 = 1)$$

Exercise 86. Determine the magnitude and phase spectra of the following signal:

$$x(n) = (3/4)^n u(n-4) \quad .$$

Exercise 87. Determine the magnitude and phase spectra of the following signal:

$$x(n) = a^{|n|} \qquad (|a| < 1) \quad .$$

Exercise 88. Determine the magnitude and phase spectra of the following signal:

$$x(n) = \begin{cases} 1/2 + 1/2\cos(\pi n / N) & (|n| \le N) \\ 0 & (|n| > N) \end{cases}$$

Exercise 89. Determine the magnitude and phase spectra of the following signal:

$$x(n) = 2\delta(4-2n) \quad .$$

Exercise 90. Determine the time-domain signal corresponding to the following discrete-time Fourier transform:

$$X(\Omega) = \cos(2\Omega) + j\sin(2\Omega)$$

Exercise 91. Determine the time-domain signal corresponding to the following discrete-time Fourier transform:

$$X(\Omega) = \sin(\Omega) + \cos(\Omega/2)$$

Exercise 92. Determine the time-domain signal corresponding to the following discrete-time Fourier transform:

$$|X(\Omega)| = \begin{cases} 1 & (\pi/4 < |\Omega| < 3\pi/4) \\ 0 & (|\Omega| \le \pi/4 \vee |\Omega| \ge 3\pi/4) \end{cases}$$

$$arg\{X(\Omega)\} = -4\Omega$$

Exercise 93. Determine the Fourier transform of the following signal:

$$x(t) = e^{-2t} u(t-3)$$

Exercise 94. Determine the Fourier transform of the following signal:

$$x(t) = e^{-4|t|}$$

Exercise 95. Determine the Fourier transform of the following signal:

$$x(t) = te^{-t} u(t)$$

Exercise 96. Determine the Fourier transform of the following signal:

$$x(t) = \sum_{k=0}^{\infty} a^k \delta(t-k) \qquad (|a| < 1)$$

Exercise 97. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega) = \begin{cases} \cos(2\omega) & (|\omega| < \pi/4) \\ 0 & (|\omega| \ge \pi/4) \end{cases}$$

Exercise 98. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega) = e^{-2\omega} u(\omega)$$

Exercise 99. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=e^{-2|\omega|}$$

Exercise 100. Determine the appropriate Fourier representation of the following signal:

$$x(t)=e^{-t}\cos(2\pi t)u(t)$$

Exercise 101. Determine the appropriate Fourier representation of the following signal:

$$x(n)=\begin{cases}\cos(\pi n/10)+j\sin(\pi n/10) & (|n|<10)\\ 0 & (|n|\geq 10)\end{cases}$$

Exercise 102. Determine the appropriate Fourier representation of the following signal:

$$x(t)=e^{1+t}u(2-t)$$

Exercise 103. Determine the appropriate Fourier representation of the following signal:

$$x(t)=|\sin(2\pi t)|$$

Exercise 104. Determine the time-domain signal corresponding to the following frequency-domain representation:

$$X_k=\begin{cases}e^{-jk\pi/2} & (|k|<10)\\ 0 & (|k|\geq 10)\end{cases}$$

and the fundamental period of the signal $T=1$.

Exercise 105. Determine the time-domain signal corresponding to the following frequency-domain representation:

$$X(\omega)=\begin{cases}\cos(\omega/4)+j\sin(\omega/4) & (|\omega|<\pi)\\ 0 & (|\omega|\geq\pi)\end{cases}$$

Exercise 106. Determine the time-domain signal corresponding to the following frequency-domain representation:

$$X(\Omega)=|\sin(\Omega)|$$

Exercise 107. Determine the Fourier transform of the following signal:

$$x(t)=\sin(2\pi t)e^{-t}u(t)$$

Exercise 108. Determine the Fourier transform of the following signal:

$$x(t)=te^{-3|t-1|}$$

Exercise 109. Determine the Fourier transform of the following signal:

$$x(t)=\frac{2\sin(3\pi t)}{\pi t}\frac{\sin(2\pi t)}{\pi t}$$

Exercise 110. Determine the Fourier transform of the following signal:

$$x(t)=\frac{d}{dt}te^{-2t}\sin(t)u(t)$$

Exercise 111. Determine the Fourier transform of the following signal:

$$x(t)=\int_{-\infty}^{t}\frac{\sin(2\pi\tau)}{\pi\tau}d\tau$$

Exercise 112. Determine the Fourier transform of the following signal:

$$x(t)=e^{-t+2}u(t-2)$$

Exercise 113. Determine the Fourier transform of the following signal:

$$x(t)=\frac{\sin(t)}{\pi t}*\frac{d}{dt}\frac{\sin(2t)}{\pi t}$$

Exercise 114. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{j\omega}{(1+j\omega)^2}$$

Exercise 115. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{4\sin(2\omega-4)}{2\omega-4}-\frac{4\sin(2\omega+4)}{2\omega+4}$$

Exercise 116. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{1}{j\omega(j\omega+2)}-\pi\delta(\omega)$$

Exercise 117. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{d}{d\omega}\left[4\sin(4\omega)\frac{\sin(2\omega)}{\omega}\right]$$

Exercise 120. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{2\sin(\omega)}{\omega(j\omega+2)}$$

Exercise 121. Determine the time-domain signal corresponding to the following Fourier transform:

$$X(\omega)=\frac{4\sin^2(\omega)}{\omega^2}$$

Exercise 122. Given the following Fourier transform pair:

$$x(t)=\begin{cases}1 & (|t|<1)\\ 0 & (|t|\geq 1)\end{cases} \leftrightarrow X(\omega)=\frac{2\sin(\omega)}{\omega}$$

Evaluate the Fourier transform of the following signal:

$$y(t)=x\left(\frac{t-2}{2}\right)$$

Exercise 123. Given the following Fourier transform pair:

$$x(t)=\begin{cases}1 & (|t|<1)\\ 0 & (|t|\geq 1)\end{cases} \leftrightarrow X(\omega)=\frac{2\sin(\omega)}{\omega}$$

Evaluate the Fourier transform of the following signal:

$$y(t)=\sin(\pi t)x(t)$$

Exercise 124. Given the following Fourier transform pair:

$$x(t)=\begin{cases}1 & (|t|<1)\\ 0 & (|t|\geq 1)\end{cases} \leftrightarrow X(\omega)=\frac{2\sin(\omega)}{\omega}$$

Evaluate the Fourier transform of the following signal:

$$y(t)=x(t+1)-x(2t-1)$$

Exercise 125. Given the following Fourier transform pair:

$$x(t)=\begin{cases}1 & (|t|<1)\\ 0 & (|t|\geq 1)\end{cases} \leftrightarrow X(\omega)=\frac{2\sin(\omega)}{\omega}$$

Evaluate the Fourier transform of the following signal:

$$y(t)=2tx(t)$$

Exercise 126. Given the following Fourier transform pair:

$$x(t)=\begin{cases}1 & (|t|<1)\\ 0 & (|t|\geq 1)\end{cases} \leftrightarrow X(\omega)=\frac{2\sin(\omega)}{\omega}$$

Evaluate the Fourier transform of the following signal:

$$y(t)=x(t)*x(t)$$

Exercise 127. Given the discrete-time Fourier transform $X(\Omega)$ of the following signal:

$$x(n)=n(3/4)^{|n|}$$

Without evaluating $X(\Omega)$, find the signal $y(n)$ if its discrete-time Fourier transform $Y(\Omega)$ is given by:

$$Y(\Omega)=e^{-j4\Omega}X(\Omega)$$

Exercise 128. Given the discrete-time Fourier transform $X(\Omega)$ of the following signal:

$$x(n)=n(3/4)^{|n|}$$

Without evaluating $X(\Omega)$, find the signal $y(n)$ if its discrete-time Fourier transform $Y(\Omega)$ is given by:

$$Y(\Omega)=\mathrm{Re}[X(\Omega)]$$

Exercise 129. Given the discrete-time Fourier transform $X(\Omega)$ of the following signal:

$$x(n)=n(3/4)^{|n|}$$

Without evaluating $X(\Omega)$, find the signal $y(n)$ if its discrete-time Fourier transform $Y(\Omega)$ is given by:

$$Y(\Omega)=\frac{dX(\Omega)}{d\Omega}$$

Exercise 130. Given the discrete-time Fourier transform $X(\Omega)$ of the following signal:

$$x(n)=n(3/4)^{|n|}$$

Without evaluating $X(\Omega)$, find the signal $y(n)$ if its discrete-time Fourier transform $Y(\Omega)$ is given by:

$$Y(\Omega)=X(\Omega)+X(-\Omega)$$

Exercise 131. Given the discrete-time Fourier transform $X(\Omega)$ of the following signal:

$$x(n)=n(3/4)^{|n|}$$

Without evaluating $X(\Omega)$, find the signal $y(n)$ if its discrete-time Fourier transform $Y(\Omega)$ is given by:

$$Y(\Omega)=\frac{dX(2\Omega)}{d\Omega}$$

Exercise 132. A periodic signal $x(t)$ has the following Fourier series representation:

$$X_k=-k\,2^{-|k|}$$

Without determining $x(t)$, find the Fourier series representation of the following signal:

$$y(t)=x(3t)$$

Exercise 133. A periodic signal $x(t)$ has the following Fourier series representation:

$$X_k=-k\,2^{-|k|}$$

Without determining $x(t)$, find the Fourier series representation of the following signal:

$$y(t)=x(t-1)$$

Exercise 134. A periodic signal $x(t)$ has the following Fourier series representation:

$$X_k=-k\,2^{-|k|}$$

Without determining $x(t)$, find the Fourier series representation of the following signal:

$$y(t)=\frac{dx(t)}{dt}$$

Exercise 135. A periodic signal $x(t)$ has the following Fourier series representation:

$$X_k=-k\,2^{-|k|}$$

Without determining $x(t)$, find the Fourier series representation of the following signal:

$$y(t)=\cos(4\pi t)x(t)$$

Exercise 136. Sketch the magnitude response and the phase response of the system described by the following impulse response:

$$h(t)=\delta(t)-2e^{-2t}u(t)$$

Exercise 137. Sketch the magnitude response and the phase response of the system described by the following impulse response:

$$h(t)=4e^{-2t}\cos(50t)$$

Exercise 138. Sketch the magnitude response and the phase response of the system described by the following impulse response:

$$h(n)=\frac{1}{8}\left(\frac{7}{8}\right)^n u(n)$$

Exercise 139. Sketch the magnitude response and the phase response of the system described by the following impulse response:

$$h(n)=\begin{cases}(-1)^n & (|n|\leq 10)\\ 0 & (|n|>10)\end{cases}$$

Exercise 140. Determine the frequency response and the impulse response of a system, given the following pair of input and output signals for the system:

$$x(t)=e^{-t}u(t) \text{ and } y(t)=e^{-2t}u(t)+e^{-3t}u(t)$$

Exercise 141. Determine the frequency response and the impulse response of a system, given the following pair of input and output signals for the system:

$$x(t)=e^{-3t}u(t) \text{ and } y(t)=e^{-3(t-2)}u(t-2)$$

Exercise 142. Determine the frequency response and the impulse response of a system, given the following pair of input and output signals for the system:

$$x(t)=e^{-2t}u(t) \text{ and } y(t)=2te^{-2t}u(t)$$

Exercise 143. Determine the frequency response and the impulse response of a system, given the following pair of input and output signals for the system:

$$x(n)=(1/2)^n u(n) \text{ and } y(n)=(1/4)(1/2)^n u(n)+(1/4)^n u(n)$$

Exercise 144. Determine the frequency response and the impulse response of a system, given the following pair of input and output signals for the system:

$$x(n)=(1/4)^n u(n) \text{ and } y(n)=(1/4)^n u(n)-(1/4)^{n-1}u(n-1)$$

Exercise 145. Determine the frequency response and the impulse response of the system described by the following differential equation:

$$\frac{dy(t)}{dt}+3y(t)=x(t)$$

Exercise 146. Determine the frequency response and the impulse response of the system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2}+5\frac{dy(t)}{dt}+6\,y(t)=\frac{-dx(t)}{dt}$$

Exercise 147. Determine the frequency response and the impulse response of the system described by the following difference equation:

$$y(n)-(1/4)\,y(n-1)-(1/8)\,y(n-2)=3\,x(n)-(3/4)\,x(n-1)$$

Exercise 148. Determine the frequency response and the impulse response of the system described by the following difference equation:

$$y(n)+(1/2)\,y(n-1)=x(n)-2\,x(n-1)$$

Exercise 149. Determine the time-domain signal corresponding to the following unilateral Laplace transform:

$$X^1(s)=\frac{1}{(s+2)(s+3)}$$

Exercise 150. Determine the time-domain signal corresponding to the following unilateral Laplace transform:

$$X^1(s)=e^{-2s}\frac{d}{ds}\left[\frac{1}{(s+1)^2}\right]$$

Exercise 151. Determine the time-domain signal corresponding to the following unilateral Laplace transform:

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

Exercise 152. Given the Laplace transform $X(s)$ of the following signal:

$$x(t)=\cos(2t)u(t)$$

Determine the signal $y(t)$ if its Laplace transform is given by:

$$Y(s)=(s+1)X(s)$$

Exercise 153. Given the Laplace transform $X(s)$ of the following signal:

$$x(t)=\cos(2t)u(t)$$

Determine the signal $y(t)$ if its Laplace transform is given by:

$$Y(s)=X(3s)$$

Exercise 154. Given the Laplace transform $X(s)$ of the following signal:

$$x(t)=\cos(2t)u(t)$$

Determine the signal $y(t)$ if its Laplace transform is given by:

$$Y(s)=s^{-2}X(s)$$

Exercise 155. Given the Laplace transform of the signal $x(t)$ as follows:

$$X(s)=\frac{2s}{s^2+2}$$

Determine Laplace transform of the following signal:

$$y(t)=x(3t)$$

Exercise 156. Given the Laplace transform of the signal $x(t)$ as follows:

$$X(s)=\frac{2s}{s^2+2}$$

Determine Laplace transform of the following signal:

$$y(t)=x(t-2)$$

Exercise 157. Given the Laplace transform of the signal $x(t)$ as follows:

$$X(s)=\frac{2s}{s^2+2}$$

Determine Laplace transform of the following signal:

$$y(t)=x(t)*\frac{dx(t)}{dt}$$

Exercise 158. Given the Laplace transform of the signal $x(t)$ as follows:

$$X(s)=\frac{2s}{s^2+2}$$

Determine Laplace transform of the following signal:

$$y(t)=e^{-t}x(t)$$

Exercise 159. Given the Laplace transform of the signal $x(t)$ as follows:

$$X(s)=\frac{2s}{s^2+2}$$

Determine Laplace transform of the following signal:

$$y(t)=2tx(t)$$

Exercise 160. Given the following Laplace transform pair:

$$x(t)=e^{-at}u(t) \leftrightarrow X(s)=\frac{1}{s+a}$$

Evaluate the unilateral Laplace transform of the following signal:

$$y(t)=e^{-at}\cos(\omega_0 t)u(t)$$

Exercise 160. Determine the forced and natural responses for the LTI system described by the following differential equation with the specified initial and input conditions:

$$\frac{dy(t)}{dt}+10y(t)=10x(t) \quad , \quad y(0-)=1 \quad \text{, and} \quad x(t)=u(t)$$

Exercise 161. Determine the forced and natural responses for the LTI system described by the following differential equation with the specified initial and input conditions:

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=-4x(t)-3\frac{dx(t)}{dt} \quad , \quad y(0-)=-1 \quad , \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=5 \quad \text{and}$$

$$x(t)=e^{-t}u(t)$$

Exercise 162. Determine the forced and natural responses for the LTI system described by the following differential equation with the specified initial and input conditions:

$$\frac{d^2y(t)}{dt^2}+y(t)=8x(t) \quad , \quad y(0-)=0 \quad , \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=2 \quad \text{and} \quad x(t)=e^{-t}u(t)$$

Exercise 163. Determine the forced and natural responses for the LTI system described by the following differential equation with the specified initial and input conditions:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+5y(t)=\frac{dx(t)}{dt} \quad , \quad y(0-)=2 \quad , \quad \left.\frac{dy(t)}{dt}\right|_{t=0-}=0 \quad \text{and} \quad x(t)=u(t)$$

Exercise 164. Determine the time-domain signal corresponding to the following bilateral Laplace transform:

$$X(s)=\frac{e^{5s}}{s+2} \qquad (\mathrm{Re}(s)<-2)$$

Exercise 165. Determine the time-domain signal corresponding to the following bilateral Laplace transform:

$$X(s)=\frac{d^2}{ds^2}\left(\frac{1}{s-3}\right) \qquad (\mathrm{Re}(s)>3)$$

Exercise 166. Determine the time-domain signal corresponding to the following bilateral Laplace transform:

$$X(s)=\frac{-s-4}{s^2+3s+2} \qquad (-2<\mathrm{Re}(s)<-1)$$

Exercise 167. Determine the impulse response of a causal system having the following transfer function:

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

Exercise 168. Determine the impulse response of a stable system having the following transfer function:

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

Exercise 169. Determine the impulse response of a causal system having the following transfer function:

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

Exercise 170. Determine the impulse response of a stable system having the following transfer function:

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

Exercise 171. Determine the impulse response of a causal system having the following transfer function:

$$H(s)=e^{-5s}+\frac{2}{s-2}$$

Exercise 172. Determine the impulse response of a stable system having the following transfer function:

$$H(s)=e^{-5s}+\frac{2}{s-2}$$

Exercise 173. Determine the transfer function and the impulse response of a stable system, given a pair of its input and output signals as follows:

$$x(t)=e^{-t}u(t) \quad \text{and} \quad y(t)=e^{-2t}\cos(t)u(t)$$

Exercise 174. Determine the transfer function and the impulse response of a stable system, given a pair of its input and output signals as follows:

$$x(t)=e^{-2t}u(t) \quad \text{and} \quad y(t)=-2e^{-t}u(t)+2e^{-3t}u(t)$$

Exercise 175. Determine the transfer function and the impulse response of a causal system described by the following differential equation:

$$\frac{dy(t)}{dt}+10y(t)=10x(t)$$

Exercise 176. Determine the transfer function and the impulse response of a causal system described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=x(t)+\frac{dx(t)}{dt}$$

Exercise 177. Determine the transfer function and the impulse response of a causal system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = -4x(t) + 5\frac{dx(t)}{dt}$$

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