Answer Sheet for Spring 2023 ECE45 Final Exam Part 1

(Tear this sheet off and turn it in. Do not turn in the rest of the exam.)

Name _____

UCSD ID Number _____

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	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	Override Answer
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Problem 1:

What value of C would make the function $f(t) = \sin(2Ct/\pi)\cos(2Ct/\pi)$ periodic with period 2?

(a) $\pi^2/4$

(b) $\pi/4$

(c) π^2

(d) $\pi^2/2$

(e) $2/\pi^2$

(f) $2/\pi$

(g) $1/\pi^2$

(h) $4/\pi^2$

(i) 1

(j) 2

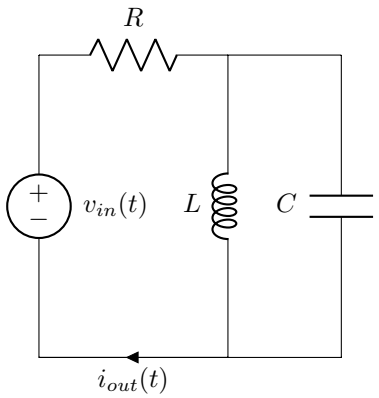
(k) 1/2

(l) $1/\pi$

(m) None of these

Problem 2:

The steady-state circuit below has input voltage $v_{in}(t) = \cos(t)$ and output current $i_{out}(t)$. If $C = 0.5F$, $L = 1H$, and $R = 2\Omega$, then what is the magnitude of the circuit's frequency response?



(a) $\sqrt{2}/4$

(b) $\sqrt{2}/2$

(c) $\sqrt{2}$

(d) $1/2$

(e) 2

(f) $2\sqrt{2}$

(g) $4\sqrt{2}$

(h) $\sqrt{5}$

(i) $2\sqrt{5}$

(j) 0

(k) $5/2$

(l) 4

(m) None of these

Problem 3:

If $u(t-2)+1$ is the input signal to a linear, time-invariant system with impulse response $e^{-t}u(t)$, then what is the value of the output signal when $t = 3$?

(a) $2 - \frac{1}{e}$

(b) $2 - \frac{2}{e}$

(c) $1 - \frac{1}{e}$

(d) $1 - \frac{2}{e}$

(e) $\frac{1}{e}$

(f) $\frac{2}{e}$

(g) $2 - \frac{1}{e^2}$

(h) $1 - \frac{1}{e^2}$

(i) $\frac{1}{e^2}$

(j) $\frac{2}{e^2}$

(k) 1

(l) 0

(m) None of these

Problem 4:

Consider two systems whose input/output relations are shown below:

$$\text{(a)} \quad x(t) \longrightarrow \frac{\mathrm{d}x(t)}{\mathrm{d}t}$$
$$\text{(b)} \quad x(t) \longrightarrow tx(t)$$

Which of these statements is true?

(a) System (a) is linear and time-invariant, System (b) is linear but not time-invariant

(b) System (a) is linear and time-invariant, System (b) is linear and time-invariant

(c) System (a) is not linear but time-invariant, System (b) is linear and time-invariant

(d) System (a) is linear but not time-invariant, System (b) is linear and time-invariant

(e) System (a) is neither linear nor time-invariant, System (b) is linear and time-invariant

(f) System (a) is not linear but time-invariant, System (b) is linear but not time-invariant

(g) System (a) is linear but not time-invariant, System (b) is linear but not time-invariant

(h) System (a) is linear and time-invariant, System (b) is neither linear nor time-invariant

(i) System (a) is neither linear nor time-invariant, System (b) is linear but not time-invariant

(j) System (a) is neither linear nor time-invariant, System (b) is neither linear nor time-invariant

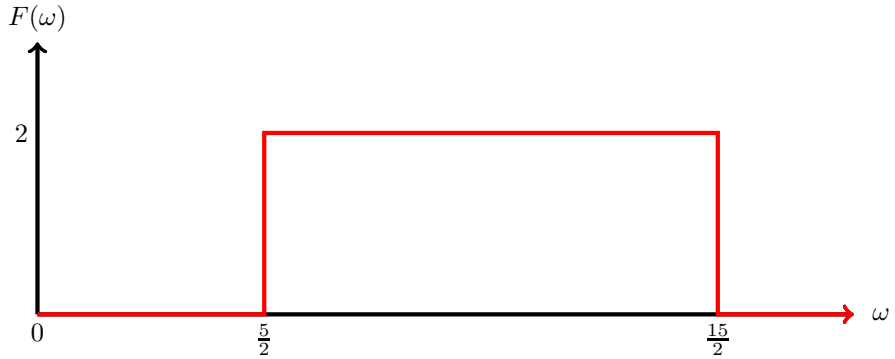
(k) System (a) is time-invariant but not linear, System (b) is time-invariant but not linear

(l) System (a) is time-invariant but not linear, System (b) is linear but not time-invariant

(m) None of these

Problem 5:

What is the inverse Fourier transform of the real-valued function $F(\omega)$ shown below?



(a) $\frac{5}{\pi} \cdot \text{sinc}(\frac{5t}{2})e^{j5t}$

(b) $\frac{5}{\pi} \cdot \text{sinc}(\frac{5t}{2})e^{jt}$

(c) $\frac{5}{2\pi} \cdot \text{sinc}(\frac{5t}{2})e^{j5t}$

(d) $\frac{10}{\pi} \cdot \text{sinc}(\frac{5t}{2})e^{j5t}$

(e) $\frac{5}{\pi} \cdot \text{sinc}(\frac{5t}{2})e^{-j5t}$

(f) $\frac{5}{\pi} \cdot \text{sinc}(5t)e^{j5t}$

(g) $\frac{5}{2\pi} \cdot \text{sinc}(\frac{5t}{2})e^{-j5t}$

(h) $\frac{5}{\pi} \cdot \text{sinc}(\frac{5t}{2})$

(i) $\frac{5}{2\pi} \cdot \text{sinc}(\frac{5t}{2})$

(j) $\frac{\pi}{5} \cdot \text{sinc}(\frac{5t}{2})e^{j5t}$

(k) $\frac{5}{2} \cdot \text{sinc}(\frac{5t}{2})e^{j5t}$

(l) None of these

Problem 6:

If a linear, time-invariant system has frequency response $\frac{8+2j\omega}{4-j\omega}$ and input $3 + 2e^{j4t} + 2e^{-j4t}$, then what is the output of the system ?

(a) $6 - 8\sin(4t)$

(b) $6 + 8\sin(4t)$

(c) $6 + 8\cos(4t)$

(d) $6 - 8\cos(4t)$

(e) $6 + 2\cos(4t)$

(f) $3 - 8\sin(4t)$

(g) $3 + 4\sin(4t)$

(h) $3 - 4\sin(4t)$

(i) 6

(j) $8\sin(4t)$

(k) $8\cos(4t)$

(l) 0

(m) None of these

Problem 7:

What is the value of the Fourier transform $X(\omega)$ of

$$x(t) = \begin{cases} e^{-t^2} & t > 0 \\ -e^{-t^2} & t < 0 \\ 0 & t = 0 \end{cases}$$

when $\omega = 0$?

(a) 0

(b) 2π

(c) -2π

(d) 1

(e) -1

(f) 4π

(g) -4π

(h) π

(i) $\sqrt{\pi}$

(j) $\sqrt{\pi}/2$

(k) $1/\sqrt{2\pi}$

(l) $1/\sqrt{\pi}$

(m) None of these

Problem 8:

What is the magnitude of the coefficient F_0 of the exponential form of the Fourier Series for the signal $f(t) = (\sin t)^4$?

(a) 3/8

(b) 1/4

(c) 1/16

(d) 1/8

(e) 1/2

(f) 1/32

(g) 5/8

(h) 0

(i) 1

(j) 8/3

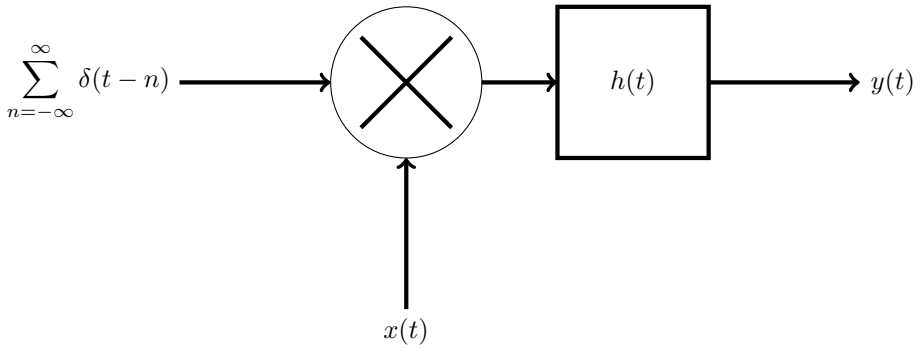
(k) 8/5

(l) 2

(m) None of these

Problem 9:

The block diagram below consists of a multiplier and a linear time-invariant system with inpulse response $h(t)$.



If the Fourier transforms of $x(t)$ and $h(t)$ are

$$X(\omega) = \begin{cases} \omega^2 & -1 \leq \omega \leq 1 \\ 0 & \text{else} \end{cases} \qquad H(\omega) = \begin{cases} 1 & -3\pi < \omega < 3\pi \\ 0 & \text{else} \end{cases}$$

then which one of the following choices for ω would make the Fourier transform of $y(t)$ non-zero?

(a) -6.1

(b) -1.5

(c) 1.5

(d) 7.5

(e) -7.5

(f) 3.2

(g) -2023

(h) 2023

(i) -3.2

(j) -4

(k) 4

(l) 5

(m) None of these

Problem 10:

What is the output of a linear, time-invariant system whose frequency response is

$$H(\omega) = \begin{cases} 0 & |\omega| \leq 2.5 \\ 2 & \text{else} \end{cases}$$

when the input is $(e^{j2t} + 1)(e^{j3t} + 1)$?

(a) $2e^{j5t} + 2e^{j3t}$

(b) $e^{j5t} + e^{j3t}$

(c) $2e^{j2t} + 2$

(d) $e^{j2t} + 1$

(e) $2e^{j5t} + 2e^{j3t} + 2e^{j2t} + 2$

(f) $e^{j5t} + e^{j3t} + e^{j2t} + 1$

(g) $e^{j2.5t}$

(h) $2e^{j2.5t}$

(i) 0

(j) 2

(k) $2e^{j3t}$

(l) $2e^{j5t}$

(m) None of these

Problem 11:

If $f(t) = \text{sinc}(50t)\cos(10t)$, then what is the smallest $B > 0$ such that $F(\omega) = 0$ whenever $\omega > B$?

(a) 60

(b) $30/\pi$

(c) $60/\pi$

(d) $15/\pi$

(e) $120/\pi$

(f) 30π

(g) 30

(h) 120

(i) 120π

(j) 40

(k) 15

(l) None of these

Problem 12:

If a linear, time-invariant system has input $e^{-3t}u(t)$ and output $e^{3t}u(-t)$, then what is the impulse response of the system?

(a) $6e^{3t}u(-t) - \delta(t)$

(b) $6e^{3t}u(-t) + \delta(t)$

(c) $6e^{-3t}u(-t) - \delta(t)$

(d) $6e^{3t}u(t) - \delta(t)$

(e) $6e^{-3t}u(t) - \delta(t)$

(f) $6e^{-3t}u(-t) + \delta(t)$

(g) $6e^{3t}u(t) + \delta(t)$

(h) $6e^{-3t}u(t) + \delta(t)$

(i) $\delta(t)$

(j) $-\delta(t)$

(k) $6e^{3t}u(t)$

(l) $6e^{-3t}u(-t)$

(m) None of these

Problem 13:

What is the period of the function $2023\cos(4t) + 2^{2023}(e^{j3t} + e^{-j3t}) - 2023$?

(a) 2π

(b) π

(c) 4π

(d) 8π

(e) $2^{2023}\pi$

(f) $\pi/2$

(g) $2\pi/3$

(h) 2

(i) 1

(j) 4

(k) 8

(l) 2023

(m) None of these

Problem 14:

The frequency response $H(\omega)$ of an LTI system is $-2 + 2\cos(4\omega)$. If the system has input $x(t)$, then which of the following is the output of the system?

(a) $-2x(t) + x(t-4) + x(t+4)$

(b) $-2x(t) - x(t-4) - x(t+4)$

(c) $-2x(t) + x(t-2) + x(t+2)$

(d) $-2x(t) - x(t-2) - x(t+2)$

(e) $-2 + x(t-4) + x(t+4)$

(f) $-2 + x(t-2) + x(t+2)$

(g) $-2x(t) + 2x(t-4) + 2x(t+4)$

(h) $-2x(t) - 2x(t-4) - 2x(t+4)$

(i) $-2x(t) + 2x(t-2) + 2x(t+2)$

(j) $-2x(t) - 2x(t-2) - 2x(t+2)$

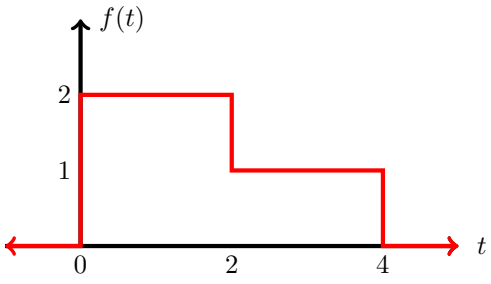
(k) $-2x(t)$

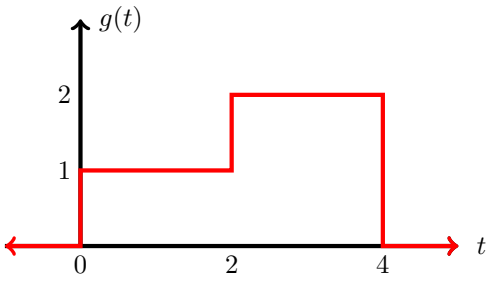
(l) $x(t-4) + x(t+4)$

(m) None of these

Problem 15:

If $h(t)$ is the convolution of $f(t)$ and $g(t)$, then what is $h(3)$?





(a) 7

(b) 10

(c) 4

(d) 2

(e) 1

(f) 0

(g) 3

(h) 5

(i) 6

(j) 8

(k) 9

(l) 15

(m) None of these

Problem 16:

Which of the following four time signals are bandlimited?

$$v(t) = (\sin(2t))^3 \cdot \frac{\cos(4t)}{t^2}$$
$$x(t) = \text{rect}\,(t) \cdot \cos(4t)$$
$$y(t) = (\text{rect}\,(t))^2$$
$$z(t) = (\sin t)^4 + (\cos t)^4$$

(a) $v(t)$, $z(t)$, not $x(t)$, not $y(t)$

(b) $v(t)$, $x(t)$, not $y(t)$, not $z(t)$

(c) $v(t)$, $y(t)$, not $x(t)$, not $z(t)$

(d) $x(t)$, $y(t)$, not $v(t)$, not $z(t)$

(e) $x(t)$, $z(t)$, not $v(t)$, not $y(t)$

(f) $y(t)$, $z(t)$, not $v(t)$, not $x(t)$

(g) $v(t)$, not $x(t)$, not $y(t)$, not $z(t)$

(h) $z(t)$, not $v(t)$, not $x(t)$, not $y(t)$

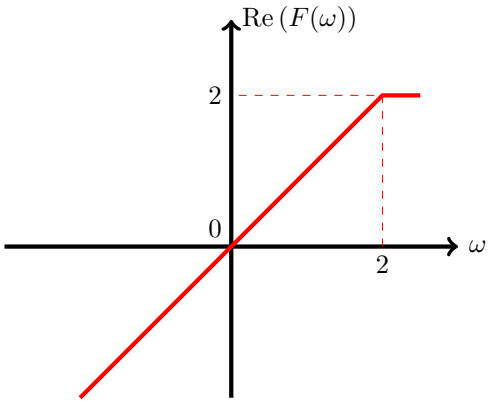
(i) $v(t)$, $x(t)$, $z(t)$, not $y(t)$

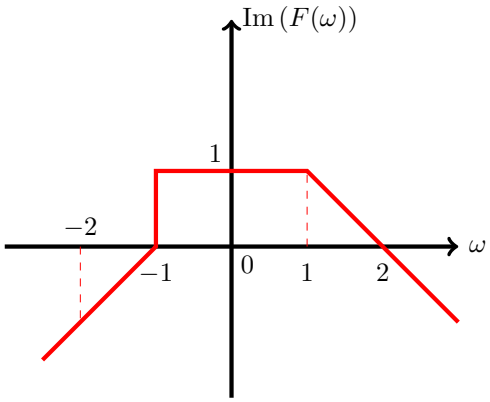
(j) $v(t)$, $x(t)$, $y(t)$, not $z(t)$

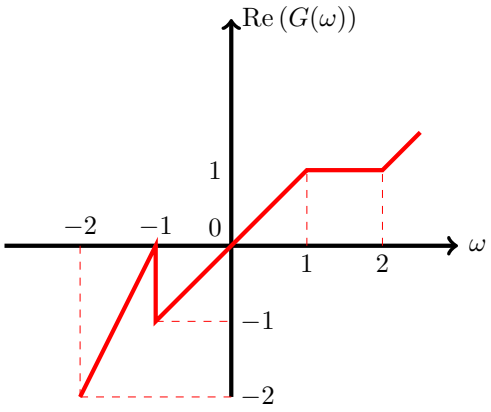
(k) $v(t)$, $x(t)$, $y(t)$, $z(t)$

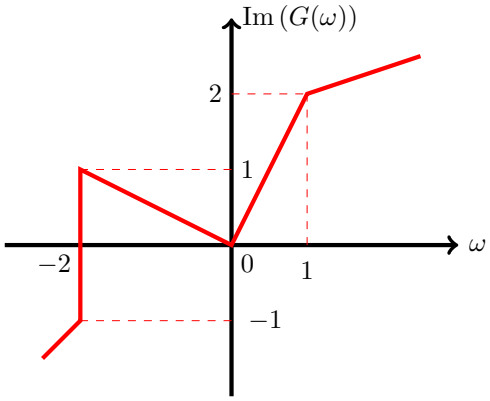
Problem 17:

The real and imaginary parts of the Fourier transforms of the signals $f(t)$ and $g(t)$ are shown below. If the convolution of these two time signals is $z(t) = f(t) * g(t)$, then what is its Fourier transform $Z(\omega)$ when $\omega = 1$?









(a) $3j - 1$

(b) $3j + 1$

(c) $j - 1$

(d) $j + 1$

(e) $2j - 1$

(f) $2j + 1$

(g) 3

(h) 2

(i) 9

(j) $-j$

(k) 4

(l) None of these

Problem 18:

If the impulse response of a linear, time-invariant system is $e^{-t}u(t)$, then what is the system's output when the input is also $e^{-t}u(t)$?

(a) $te^{-t}u(t)$

(b) $e^{-t}u(t)$

(c) $t^2e^{-t}u(t)$

(d) $(t - e^{-t})u(t)$

(e) $te^{t}u(t)$

(f) $e^{-2t}u(t)$

(g) $te^{-(t-1)}u(t-1)$

(h) $e^{-(t-1)}u(t-1)$

(i) $\delta(t-1)$

(j) $-e^{-t}u(t)$

(k) $2e^{-t}u(t)$

(l) None of these

Answer Sheet for Spring 2023 ECE45 Final Exam Part 2

(Tear this sheet off and turn it in. Do not turn in the rest of the exam.)

Name _____

UCSD ID Number _____

Signature _____

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	Override Answer
P19:	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
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Problem 19:

Which of the following signals has a Fourier Series ?

(a) $e^{j2t} + 3\sin(3t)$

(b) $e^{j2t} + 3\sin(\pi t)$

(c) $\frac{\sin(t)}{t}$

(d) $\frac{\cos(t)}{t}$

(e) $\text{rect}(t)$

(f) e^{2t}

(g) $u(t)$

(h) $\delta(t)$

(i) $e^{-|t|}u(t)$

(j) $\sin(t) + \cos(\pi t)$

(k) $\sin(t^2)$

(l) t^2

(m) $\frac{1}{t}$

(n) None of these

Problem 20:

What is the impedance of a two Henry inductor when the frequency of a sinusoidal current through the inductor is $\omega = 2$?

(a) $4e^{j\pi/2}$

(b) $4e^{-j\pi/2}$

(c) $2e^{j\pi/2}$

(d) $e^{j\pi/2}$

(e) $4e^{j\pi}$

(f) $4e^{j\pi/4}$

(g) $4e^{-j\pi/4}$

(h) $4e^{-j\pi}$

(i) $\frac{1}{4}e^{j\pi/2}$

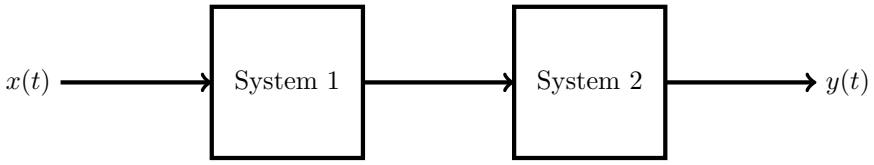
(j) $e^{-j\pi/2}$

(k) $4e^{j2\pi}$

(l) None of these

Problem 21:

Suppose two linear, time-invariant systems are cascaded as shown below. The first system has impulse response $e^{-\pi jt/2}$. The second system produces the derivative of its input as its output. If $x(t) = u(t-1) - u(t+1)$, then what is the output $y(t)$ of the cascaded system?



(a) $2je^{-j\pi t/2}$

(b) $je^{-j\pi t/2}$

(c) $2je^{j\pi t/2}$

(d) $2je^{-j\pi t}$

(e) $2je^{-2j\pi t}$

(f) $4je^{-j\pi t/2}$

(g) $e^{-j\pi t/2}$

(h) $2e^{-j\pi t}$

(i) $2je^{j\pi t}$

(j) $je^{-j\pi t}$

(k) $2je^{-j\pi t/4}$

(l) $4je^{-j\pi t/4}$

(m) None of these

Problem 22:

What is the Fourier transform of the convolution of $e^{-t}u(t)$ and $\cos(2t)$?

(a) $\frac{\pi}{1+2j} \cdot \delta(\omega - 2) + \frac{\pi}{1-2j} \cdot \delta(\omega + 2)$

(b) $\frac{\pi}{1+2j} \cdot \delta(\omega - 2) - \frac{\pi}{1-2j} \cdot \delta(\omega + 2)$

(c) $\frac{\pi}{1-2j} \cdot \delta(\omega - 2) + \frac{\pi}{1+2j} \cdot \delta(\omega + 2)$

(d) $\frac{\pi j}{1+2j} \cdot \delta(\omega - 2) + \frac{\pi j}{1-2j} \cdot \delta(\omega + 2)$

(e) $\frac{2\pi}{1+2j} \cdot \delta(\omega - 2) + \frac{2\pi}{1-2j} \cdot \delta(\omega + 2)$

(f) $\frac{2\pi}{1-2j} \cdot \delta(\omega - 2) + \frac{2\pi}{1+2j} \cdot \delta(\omega + 2)$

(g) $\frac{1}{1+2j} \cdot \delta(\omega - 2) + \frac{1}{1-2j} \cdot \delta(\omega + 2)$

(h) $\frac{1}{1+2j} \cdot \delta(\omega - 2) - \frac{1}{1-2j} \cdot \delta(\omega + 2)$

(i) $\pi \cdot \delta(\omega - 2) + \pi \cdot \delta(\omega + 2)$

(j) $\frac{\pi}{2} \cdot \delta(\omega - 2) + \frac{\pi}{2} \cdot \delta(\omega + 2)$

(k) $\frac{\pi}{1+j} \cdot \delta(\omega - 2) + \frac{\pi}{1-j} \cdot \delta(\omega + 2)$

(l) None of these

Problem 23:

A particular system's input $x(t)$ and output $y(t)$ always satisfy the differential equation

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

What is the output signal when the input to the system is $\delta(t)$?

(a) $e^{-3t}u(t)$

(b) $e^{-2t}u(t)$

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

(d) $2e^{-2t}u(t) + e^{-3t}u(t)$

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

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

(g) $e^{-2t}u(t) + 2e^{-3t}u(t)$

(h) $e^{-4t}u(t) - e^{-5t}u(t)$

(i) $2e^{-2t} - e^{-3t}$

(j) $2e^{-2t} + e^{-3t}$

(k) $2e^{-2t}u(t)$

(l) $u(t)$

(m) None of these

Problem 24:

If $x(t) = \sum_{n=-\infty}^{\infty} \delta(t - 2n - 1)$ and $X(\omega)$ is the Fourier transform for $x(t)$, then what is $\int_1^7 |X(\omega)| d\omega$?

(a) 2π

(b) 4π

(c) 6π

(d) 6

(e) 4

(f) 2

(g) π

(h) 1

(i) 0

(j) $7/\pi$

(k) 7

(l) 14π

(m) 14

(n) None of these

Problem 25:

Which of the following is **not** a periodic function of t?

(a) $\frac{1}{1+\sin|t|}$

(b) $(\sin t)^{\cos t}$

(c) $\sum_{n=-\infty}^{\infty} \text{rect}\left(t - n\sqrt{2}\right)$

(d) $e^{j(\cos(3t)+\sqrt{2}\sin(2t))}$

(e) $e^{\cos(3t)+\sqrt{2}\sin(2t)}$

(f) $\cos(\cos(\cos(\cos t)))$

(g) $\frac{1}{1+\cos t}$

(h) $\frac{1}{1+|\sin t|}$

(i) $e^{e^{\sin t}}$

(j) $\text{rect}\left(10\cos(t\sqrt{2})\right)$

(k) $\text{sinc}\left(\cos t\right)$

(l) $e^{-(\tan t)^2}$

(m) All are periodic

Problem 26:

What is the bilateral Laplace transform of $u(t) + e^t u(-t)$ and its region of convergence (ROC)?

(a) $\frac{1}{s-s^2}$, ROC: $0 < \mathrm{Re}\,(s) < 1$

(b) $\frac{1}{s-s^2}$, ROC: $\mathrm{Re}\,(s) < 0$

(c) $\frac{1}{s-s^2}$, ROC: $\mathrm{Re}\,(s) > 1$

(d) $\frac{1}{1-s}$, ROC: $0 < \mathrm{Re}\,(s) < 1$

(e) $\frac{1}{1-s}$, ROC: $\mathrm{Re}\,(s) < 1$

(f) $\frac{1}{1-s}$, ROC: $\mathrm{Re}\,(s) > 1$

(g) $\frac{1-2s}{s-s^2}$, ROC: $0 < \mathrm{Re}\,(s) < 1$

(h) $\frac{1-2s}{s-s^2}$, ROC: $\mathrm{Re}\,(s) < 0$

(i) $\frac{1-2s}{s-s^2}$, ROC: $\mathrm{Re}\,(s) > 1$

(j) $\frac{1}{s}$, ROC: $\mathrm{Re}\,(s) < 0$

(k) $\frac{1}{s}$, ROC: $\mathrm{Re}\,(s) > 0$

(l) None of these

Problem 27:

Suppose a linear, time-invariant system has frequency response $\frac{2+j\omega}{3+j\omega}$, and the input to this system is a periodic function with Fourier series $\sum_{n=-\infty}^{\infty} \frac{n}{1+n^2} \cdot e^{-jn4t}$. If the Fourier series of the output of the system is $\sum_{n=-\infty}^{\infty} Y_n e^{-jn4t}$, then what is the magnitude of Y_1 ?

(a) $\frac{\sqrt{5}}{5}$

(b) $\frac{2\sqrt{5}}{5}$

(c) $\sqrt{2}/2$

(d) $\sqrt{2}/4$

(e) $1/4$

(f) $1/2$

(g) 1

(h) $\sqrt{2}$

(i) $\sqrt{5}$

(j) 2

(k) 0

(l) 4

(m) None of these

Problem 28:

If the Fourier transform of $f(t)$ is $F(\omega)$, then what is the Fourier transform of $(t-2)f(t)$?

(a) $j\frac{dF(\omega)}{d\omega} - 2F(\omega)$

(b) $(\omega - 2)F(\omega)$

(c) $\frac{dF(\omega)}{d\omega} - 2F(\omega)$

(d) $-j\frac{dF(\omega)}{d\omega} - 2F(\omega)$

(e) $j\frac{dF(\omega)}{d\omega}$

(f) $-j\frac{dF(\omega)}{d\omega}$

(g) $\frac{dF(\omega)}{d\omega}$

(h) $-\frac{dF(\omega)}{d\omega}$

(i) $j\frac{dF(\omega-2)}{d\omega}$

(j) $-j\frac{dF(\omega-2)}{d\omega}$

(k) $\frac{dF(\omega-2)}{d\omega}$

(l) $-\frac{dF(\omega-2)}{d\omega}$

(m) None of these

Problem 29:

For each input $x(t)$, a system creates the output $e^{x(t)}$. Which of the following properties must the system have?

(a) Nonlinear, time-invariant, causal, BIBO stable

(b) Nonlinear, time-invariant, causal, not BIBO stable

(c) Linear, time-invariant, causal, BIBO stable

(d) Linear, time-invariant, causal, not BIBO stable

(e) Linear, time-invariant, non-causal, BIBO stable

(f) Linear, time-invariant, non-causal, not BIBO stable

(g) Nonlinear, time-invariant, non-causal, BIBO stable

(h) Nonlinear, time-invariant, non-causal, not BIBO nstable

(i) Nonlinear, not time-invariant, non-causal, BIBO stable

(j) Nonlinear, not time-invariant, non-causal, not BIBO stable

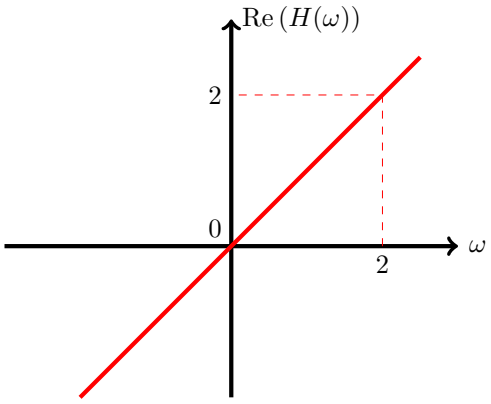
(k) Nonlinear, not time-invariant, causal, not BIBO stable

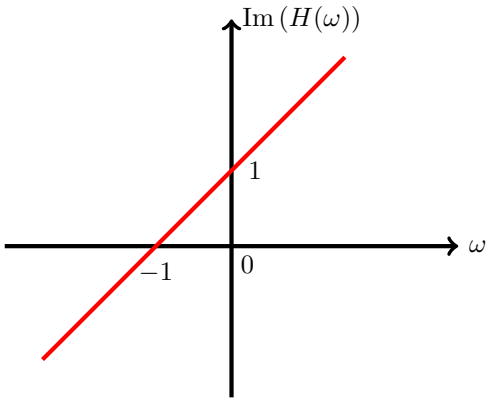
(l) Nonlinear, not time-invariant, causal, BIBO stable

(m) None of these

Problem 30:

Suppose rect $\left(\omega - \frac{1}{2}\right)$ is the Fourier transform of the input signal to an LTI system whose frequency response is $H(\omega)$. The real and imaginary parts of $H(\omega)$ are plotted below. If $Y(\omega)$ is the Fourier transform of the output signal, then what is the value of $\int_0^2 |Y(\omega)|^2 d\omega$?





(a) 8/3

(b) 4/3

(c) 8

(d) 4

(e) 1/3

(f) 2/3

(g) 2

(h) 5/3

(i) 1/9

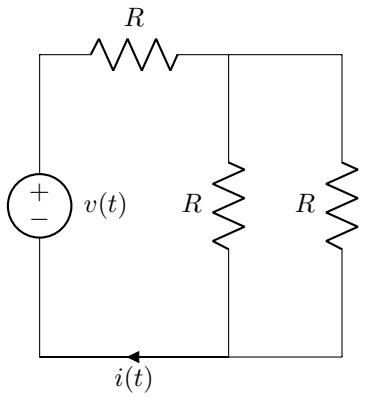
(j) 1/6

(k) 5/6

(l) None of these

Problem 31:

In the circuit below, the three resistors each have resistance 2/3 Ohm. The voltage $v(t)$ is sinusoidal with frequency $\omega = 2$ and its phasor value is $V = 2j + 3e^{-j\pi/6}$. What is the current $i(t)$?



(a) $2\cos(2t + \frac{\pi}{2}) + 3\cos(2t - \frac{\pi}{6})$

(b) $2\cos(2t) + 3\cos(2t - \frac{\pi}{6})$

(c) $2 + 3\cos(2t - \frac{\pi}{6})$

(d) $2\sin(2t + \frac{\pi}{2}) + 3\sin(2t - \frac{\pi}{6})$

(e) $2 + 3\sin(2t - \frac{\pi}{6})$

(f) $2\sin(2t - \frac{\pi}{2}) + 3\sin(2t - \frac{\pi}{6})$

(g) $3\sin(2t - \frac{\pi}{6})$

(h) $-2\cos(2t + \frac{\pi}{2}) + 3\cos(2t - \frac{\pi}{6})$

(i) $-2\sin(2t - \frac{\pi}{2}) + 3\sin(2t - \frac{\pi}{6})$

(j) $-2 + 3\sin(2t - \frac{\pi}{6})$

(k) $-2 + 3\cos(2t - \frac{\pi}{6})$

(l) $2\cos(2\pi t + \frac{\pi}{2}) + 3\cos(4\pi t - \frac{\pi}{6})$

(m) None of these

Problem 32:

Suppose $x(t)$ is an even function and $x(t) = u(t-1) - u(t-2)$ for all $t \geq 0$. If $X(\omega)$ is the Fourier transform of $x(t)$, then what is the value of $\int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$?

(a) 4π

(b) 2π

(c) π

(d) 4

(e) 2

(f) 1

(g) 0

(h) $1/2$

(i) $\pi/2$

(j) 8π

(k) 8

(l) 16π

(m) None of these

Problem 33:

If $F(\omega)$ is the Fourier transform of the signal $f(t) = \sum_{n=-\infty}^{\infty} \frac{1}{1+|n|} e^{jn2t}$, then what is $\int_{-3}^{3} F(\omega) d\omega$?

(a) 4π

(b) 2π

(c) π

(d) $\frac{10\pi}{3}$

(e) 4

(f) 2

(g) 1

(h) $\frac{5}{3}$

(i) 3π

(j) $\frac{1}{2}$

(k) $\frac{\pi}{2}$

(l) 3

(m) None of these

Problem 34:

If the impulse response of a linear, time-invariant system is $\delta(t-1)+\delta(t+1)$, then what is the output of this system when the input is $\delta(t-2)+\delta(t+2)$?

(a) $\delta(t-3)+\delta(t+3)+\delta(t+1)+\delta(t-1)$

(b) $\delta(t-2)+\delta(t+2)+\delta(t+1)+\delta(t-1)$

(c) $2\delta(t)+\delta(t+1)+\delta(t-1)$

(d) $2\delta(t-3)+2\delta(t-1)$

(e) $2\delta(t+3)+2\delta(t+3)$

(f) $2\delta(t-3)+2\delta(t+1)$

(g) $2\delta(t+3)+2\delta(t-1)$

(h) $2\delta(t)$

(i) $2\delta(t-3)$

(j) $2\delta(t-1)$

(k) $2\delta(t+1)$

(l) $2\delta(t+3)$

(m) None of these

Problem 35:

What is the inverse bilateral Laplace transform of $\frac{1}{(s-1)(s+2)}$ if the bilateral Laplace transform exists when $s = e^{j3\pi/2}$?

(a) $-\frac{1}{3}\left(u(-t)e^{t} + u(t)e^{-2t}\right)$

(b) $\frac{1}{3}\left(u(-t)e^{t} + u(t)e^{-2t}\right)$

(c) $-\frac{1}{3}\left(u(t)e^{t} + u(t)e^{-2t}\right)$

(d) $-\frac{1}{3}\left(-u(-t)e^{t} + u(t)e^{-2t}\right)$

(e) $-\frac{1}{3}\left(-u(t)e^{t} + u(t)e^{-2t}\right)$

(f) $-\frac{1}{3}\left(-u(t)e^{-t} + u(t)e^{-2t}\right)$

(g) $\frac{1}{3}\left(u(-t)e^{-t} + u(t)e^{-2t}\right)$

(h) $-\frac{1}{3}\left(u(-t)e^{t} - u(t)e^{-2t}\right)$

(i) $-\frac{1}{3}\left(u(t)e^{t} + u(-t)e^{2t}\right)$

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

(k) $u(-t)e^{t} - u(t)e^{-2t}$

(l) $e^{t} + e^{-2t}$

(m) None of these

Problem 36:

What is the convolution of $\cos(20t)$ and $\cos(30t)$?

(a) 0

(b) $\cos(50t)$

(c) $\cos(10t)$

(d) $\sin(50t)$

(e) $\sin(10t)$

(f) $\frac{\cos(50t)+\cos(10t)}{2}$

(g) $\frac{\cos(50t)-\cos(10t)}{2}$

(h) $\frac{\sin(50t)+\sin(10t)}{2}$

(i) $\frac{\sin(50t)-\sin(10t)}{2}$

(j) $\delta(t)$

(k) $u(t)$

(l) $\cos(25t)$

(m) None of these