Princess Sumaya University for Technology
King Abdullah II School of Engineering

EE27355
Communication Principles

Quiz #2
Sunday 8/3/2026

Name:…… ☐ **Section 1**

Q.1) Evaluate the following integral:

$$\int_{-\infty}^{\infty} 2\delta(\tau)\, g(t-\tau)\; d\tau$$

Solution: [1-Point]

$$\int_{-\infty}^{\infty} 2\delta(\tau)\, g(t-\tau)\; d\tau = 2g(t)$$

Q.2) Evaluate the following:

$$3\left(\frac{1}{j\omega+2}\right)\delta(\omega+3)$$

Solution: [1-Point]

$$3\left(\frac{1}{2-j3}\right)\delta(\omega+3)$$

Q.3) If the energy of a signal g(t) is E_g, then use that to determine the energy of g(*a*t-*b*) if *a* is equal 3 and *b*=10.

Hint:

$$E_g = \int_{-\infty}^{\infty} |g(t)|^2\, dt$$

Solution: [2-Points]

a=3….. Answer=E_g/3

$$E_{g(at-b)} = \int_{-\infty}^{\infty} [g(at-b)]^2\,dt = \frac{1}{a}\int_{-\infty}^{\infty} g^2(\tau)\,d\tau = E_g/a$$

Q.4) In Figure Q.4, express signal $g_2(t)$ in terms of signal $g_1(t)$.

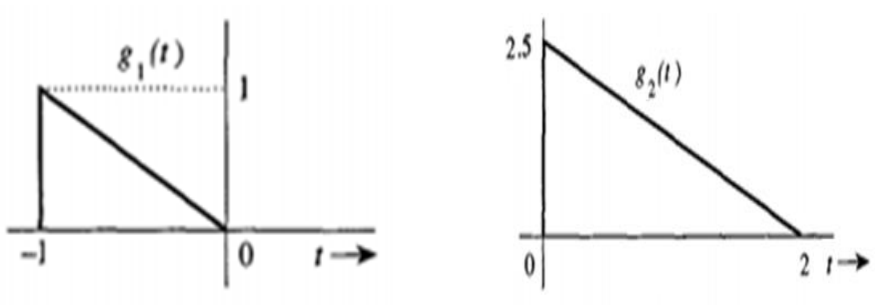


Figure Q.4

<u>Solution:</u> [2-Points]

$$g_3(t)=2.5g_1(0.5t-1)$$

Q.5) Find and sketch the Fourier Transform of the function shown in Figure Q.5 using the integral:

$$G(\omega) = \int_{-\infty}^{\infty} g(t)e^{-j\omega t}\,dt \qquad \sin\theta = \frac{e^{i\theta} - e^{-i\theta}}{2i}$$

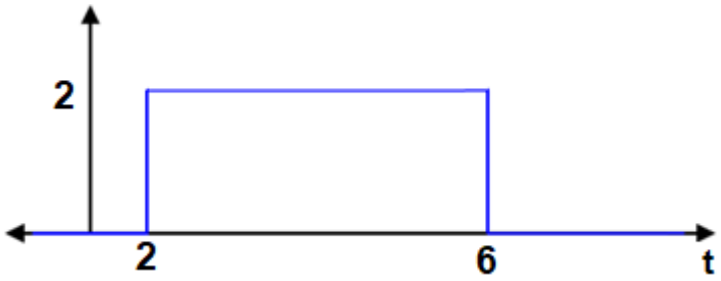


Figure Q.5

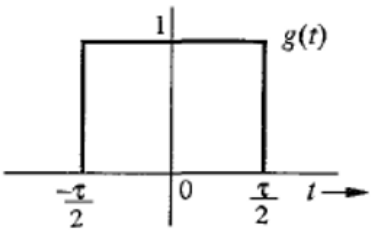
Hint:

Table 3.2
Fourier Transform Operations

Operation	$g(t)$	$G(\omega)$
Addition	$g_1(t) + g_2(t)$	$G_1(\omega) + G_2(\omega)$
Scalar multiplication	$kg(t)$	$kG(\omega)$
Symmetry	$G(t)$	$2\pi g(-\omega)$
Scaling	$g(at)$	$\frac{1}{\lvert a\rvert} G\left(\frac{\omega}{a}\right)$
Time shift	$g(t - t_0)$	$G(\omega)e^{-j\omega t_0}$
Frequency shift	$g(t)e^{j\omega_0 t}$	$G(\omega - \omega_0)$
Time convolution	$g_1(t) * g_2(t)$	$G_1(\omega)G_2(\omega)$
Frequency convolution	$g_1(t)g_2(t)$	$\frac{1}{2\pi} G_1(\omega) * G_2(\omega)$
Time differentiation	$\frac{d^n g}{dt^n}$	$(j\omega)^n G(\omega)$
Time integration	$\int_{-\infty}^{t} g(x)\,dx$	$\frac{G(\omega)}{j\omega} + \pi G(0)\delta(\omega)$

Example 3.2

Find the Fourier transform of $g(t) = \text{rect}\,(t/\tau)$



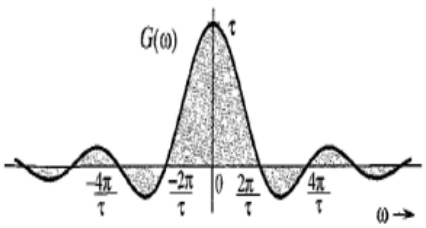
$$G(\omega) = \int_{-\infty}^{\infty} g(t)e^{-j\omega t}\,dt$$

$$G(\omega) = \int_{-\infty}^{\infty} \text{rect}\left(\frac{t}{\tau}\right) e^{-j\omega t}\,dt$$

$$G(\omega) = \int_{-\tau/2}^{\tau/2} e^{-j\omega t}\,dt$$

$$= -\frac{1}{j\omega}(e^{-j\omega\tau/2} - e^{j\omega\tau/2}) = \frac{2\sin(\omega\tau/2)}{\omega}$$

$$= \tau\frac{\sin(\omega\tau/2)}{(\omega\tau/2)} = \tau\,\text{sinc}\left(\frac{\omega\tau}{2}\right)$$



$$\text{rect}\left(\frac{t}{\tau}\right) \Longleftrightarrow \tau\,\text{sinc}\left(\frac{\omega\tau}{2}\right)$$

$\text{sinc}\,(x) = 0$ when $x = \pm n\pi$.

$\text{sinc}\,(\omega\tau/2) = 0$ when $\omega\tau/2 = \pm n\pi$; that is, when $\omega = \pm 2n\pi/\tau$ $(n = 1, 2, 3, \cdots)$

Solution: **[4-Points]**

$$g(t) = \text{rect}\left(\frac{t-4}{4}\right)$$

$$G(w) = \int_{-\infty}^{\infty} \text{rect}\left(\frac{t-4}{4}\right) e^{-jwt}\, dt$$

$$= \int_{2}^{6} 2\, e^{-jwt}\, dt$$

$$= \frac{2}{-jw}\, e^{-jwt}\Big]_{2}^{6}$$

$$= \frac{2}{-jw}\left[e^{-j6w} - e^{-j2w}\right]$$

$$= \frac{2}{-jw}\, e^{-j4w}\left[e^{-j2w} - e^{j2w}\right]$$

$$= \frac{4}{w}\, e^{-j4w}\left[\frac{e^{j2w} - e^{-j2w}}{2j}\right]$$

$$= \frac{4}{w}\, e^{-j4w}\, \sin(2w)$$

$$= 8\, e^{-j4w}\, \frac{\sin(2w)}{2w}$$

$$\boxed{G(w) = 8\, e^{-j4w}\, \text{sinc}(2w)}$$

$2w = \pi$

$w = \pi/2$