Assignment #1

1. Consider the periodic signal $e^{-t/2}$, $0 \le t \le 2$, with period $T = 2$. What is its power?
   a. $\frac{1}{2}\left(e^2 - 1\right)$
   b. $\frac{1}{2}\left(1 - \frac{1}{e^2}\right)$
   c. $\left(1 - \frac{1}{e}\right)$
   d. $\left(e - 1\right)$

   Ans b

2. Consider the impulse train $x(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$. What is its discrete Fourier series representation?
   a. 1
   b. $\sum_{k=-\infty}^{\infty} e^{j2\pi \frac{kt}{T_s}}$
   c. $\frac{1}{T_s} \sum_{k=-\infty}^{\infty} e^{j2\pi \frac{kt}{T_s}}$
   d. $\sum_{k=-\infty}^{\infty} \sin c(kT_s) e^{j2\pi \frac{kt}{T_s}}$

   Ans c

3. Consider the impulse train $x(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$. What is its Fourier transform?
   a. $\frac{1}{T_s} \sum_{k=-\infty}^{\infty} \delta\left(f - \frac{k}{T_s}\right)$
   b. $\delta(f)$
   c. $\sum_{k=-\infty}^{\infty} \delta\left(f - \frac{k}{T_s}\right)$
   d. $\sum_{k=-\infty}^{\infty} \sin c(kT_s) \delta(f - kT_s)$

   Ans a

4. Consider the unit-step function $u(t)$ defined as, $u(t) = 1$ if $t > 0$, ½ at $t = 0$ and 0 if $t \le 0$. What is its Fourier transform?

a. $\frac{1}{j2\pi f}$

b. $\delta(f)$

c. 1

d. $\frac{1}{2}\delta(f)+\frac{1}{j2\pi f}$

Ans d

5. Consider the Gaussian pulse $g(t)=e^{-kt^2}$. Let its Fourier transform be denoted by $G(f)$. Find $G(0)$.

a. 1

b. $\frac{1}{2}$

c. $\sqrt{\frac{\pi}{k}}$

d. $k\sqrt{\pi}$

Ans c

6. Consider the Gaussian pulse $g(t)=e^{-kt^2}$. Let its Fourier transform be denoted by $G(f)$. Demonstrate that $\frac{dG(f)}{df}=-\alpha\times fG(f)$. What is the value of the constant α?

a. $\frac{2\pi^2}{k}$

b. $\sqrt{\frac{\pi}{k}}$

c. $k\sqrt{\pi}$

d. 1

Ans a

7. Consider the Gaussian pulse $g(t)=e^{-kt^2}$. Let its Fourier transform be denoted by $G(f)$. Demonstrate that $\frac{dG(f)}{df}=-\alpha\times fG(f)$. Hence find the Fourier transform $G(f)$.

a. $k\sqrt{\pi}e^{-k\pi^2 f^2}$

b. $\sqrt{\frac{\pi}{k}}e^{-\frac{\pi^2}{k}f^2}$

c. $\sqrt{\frac{k\pi}{2}}e^{-\frac{k}{2\pi^2}f^2}$

d. $\frac{2\pi^2}{k}e^{-2k\pi^2 f^2}$

Ans b

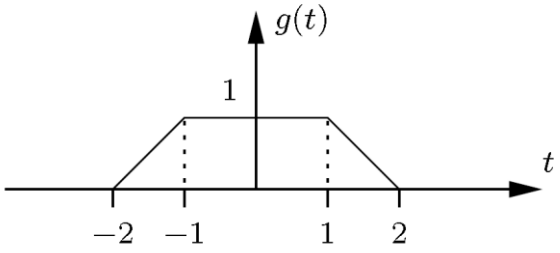
8. If the periodic real signal $g_p(t)$ is even, that is, $g_p(-t) = g_p(t)$, then the Fourier coefficient c_k is a purely real and an even function of k. Is the above statement true or false?

   Ans: True

9. For a general signal $g(t)$ with Fourier transform $G(f)$, $|j2\pi fG(f)| \geq \int_{-\infty}^{\infty} \left|\frac{dg(t)}{dt}\right| dt$. Is the above statement true or false?

   Ans: False

10. Consider the signal g(t) shown below. Find $\int_{-\infty}^{\infty} \left|\frac{d^2 g(t)}{dt^2}\right| dt$.



   a. 1
   b. 2
   c. 3
   d. 4

   Ans d