

Signals and Systems Quiz #6 (Sec. 4.1–4.6)

Name: _____

ID No.: _____

93/12/22

1. (10%) For an aperiodic signal $x(t)$, please give its Fourier transform pair as follows:

$$x(t) = \underline{\hspace{2cm}}, \quad X(j\omega) = \underline{\hspace{2cm}}.$$

2. (10%) The transform $X(j\omega)$ of an aperiodic signal $x(t)$ is commonly referred to as the _____ of $x(t)$, as it provides us with the information needed for describing $x(t)$ as a linear combination of sinusoidal signals at different frequencies.
3. (10%) The unit _____ has a Fourier transform consisting of equal contributions at all frequencies. That is $X(j\omega) = 1$, if $x(t) = \underline{\hspace{2cm}}$.
4. (20%) Let $x(t) = e^{-a|t|}$, $a > 0$. Please determine the Fourier transform of the signal $x(t)$.

5. (20%) The definition of a sinc function is

$$\text{sinc}(\theta) = \frac{\sin \pi\theta}{\pi\theta}.$$

Please rewrite the following two signals in terms of the sinc functions :

$$(1) \frac{2 \sin \omega T_1}{\omega} = \underline{\hspace{2cm}}; \quad (2) \frac{\sin Wt}{\pi t} = \underline{\hspace{2cm}}.$$

6. (10%) The Fourier transform of a periodic signal consists of a train of impulses in the frequency domain, with the area of the impulses proportional to the Fourier _____.

7. (10%) A periodic signal $x(t)$ can be represented as

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}.$$

Then the Fourier transform of $x(t)$ can be expressed as

$$X(j\omega) = \underline{\hspace{10cm}}.$$

8. (10%) Let $x(t) = \cos \omega_0 t$. Please depict the Fourier transform of this signal.

9. (10%) The convolution and multiplication properties:

$$y(t) = x(t) * h(t) \xrightarrow{\mathcal{F}} Y(j\omega) = \underline{\hspace{10cm}}$$

$$r(t) = s(t)p(t) \xrightarrow{\mathcal{F}} R(j\omega) = \frac{1}{2\pi} \underline{\hspace{10cm}}.$$

10. (20%) If the Fourier transform of a signal $x(t)$ is

$$X(j\omega) = \frac{1 + (a + j\omega) + (a + j\omega)^2}{(a + j\omega)^3}, \quad a > 0,$$

please determine the signal $x(t)$.