Signals And Systems Exam#2

1. Determine the Fourier series coefficients a_k corresponding to the following periodic signals:

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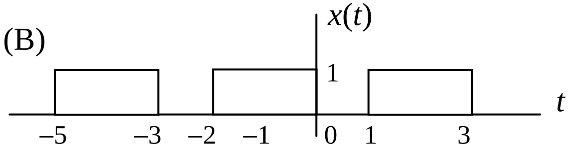
(A) $\left|cos^3 t\right|$ (B)



2. Find the Fourier transform $X(j\omega)$ of the following signals:

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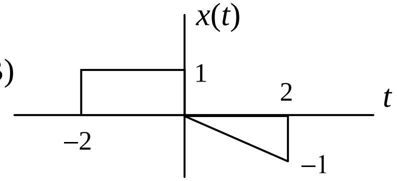
(A) $x(t)=e^{2t}sin(2t)\cdot u(-t)$ (B)



3. Determine $x(t)$ corresponding to the following Fourier transforms:

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(A) $X(j\omega)= j\cdot sin(2\omega)\cdot sinc(\omega)$ (B) $X(j\omega)=u(\omega-3)-u(\omega+3)$

4. Amplitude Modulation (AM) has been used in a broadcasting system to convey a baseband signal $x(t)$ from one location to another with carrier $cos\omega_c t$. The modulated signal is $y(t) = x(t)\, cos\omega_c t$. If $X(j\omega)$ is roughly depicted as a triangle in the right, what is the spectrum $Y(j\omega)$ of the modulated signal? To recover $x(t)$ from $y(t)$ at the receiver, show the required demodulation technique.

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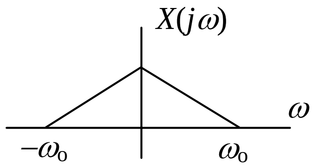

5. Prove the Parseval's relation

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$$\int_{-\infty}^{\infty}|x(t)|^2\, dt = \frac{1}{2\pi}\int_{-\infty}^{\infty}|X(j\omega)|^2\, d\omega$$

6. Sampling is a key operation of analog-to-digital conversion and can be modeled as the multiplication of the input signal $x(t)$ by the uniform impulse train

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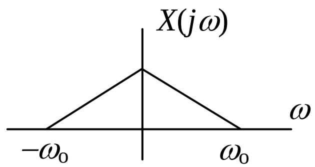
$$p(t)=\sum_{k=-\infty}^{\infty}\delta(t-kT)$$

where T is the sampling period. Please Show that

$$P(j\omega)=\omega_s\sum_{k=-\infty}^{\infty}\delta(\omega-k\,\omega_s)$$

with $\omega_s=\frac{2\pi}{T}$. Let the spectrum $X(j\omega)$ is given in the right. Please recover $x(t)$ from the sampled signal $y(t)=x(t)p(t)$ without aliasing.



7. The Fourier transform of an LTI system is described by

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$$H(j\omega)=\frac{1}{4}\left(\frac{1}{1+j\omega}-\frac{2}{10+j\omega}\right)$$

If the input signal is $x(t)=e^{-t}u(t)$, what is the output $y(t)$?

Please show the Bode plots of $Y(j\omega)$?