

Q.1 Consider the signals, $x(t) = 4\text{tri}\left(\frac{t}{2}\right)$.

- (a) Sketch the signal, $y(t) = \sum_{k=-\infty}^{\infty} x(t - 4k)$. Label your sketch appropriately.
 - (b) Find $X(f)$ and $Y(f)$.
 - (c) Sketch $Y(f)$. Label your sketch appropriately.
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Q.2 (a) Find the Fourier transform of $x(t) = 4\cos(2\pi f_c t)u(t)$, where $u(t)$ denotes the unit step function.

- (b) Suppose that the Fourier transform of $x_1(t)$ is $X_1(f) = \text{rect}(\pi f)$.
 - i. Find the energy of $y(t)$ if $y(t) = \frac{dx_1(t)}{dt}$.
 - ii. What are the bandwidths of $x_1(t)$ and $y(t)$?
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Q.3 Consider the trigonometric form of the Fourier series of a periodic signal, $x(t) = \sum_{k=0}^{\infty} \frac{1}{2^k} \cos(8\pi k t)$.

- (a) What is the fundamental frequency of $x(t)$?
 - (b) Is $x(t)$ an even or odd function? Justify your answer.
 - (c) What is the average value of $x(t)$?
 - (d) Compute the average power of $x(t)$.
 - (e) Sketch the discrete frequency spectrum of $x(t)$.
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Q.4 Consider the signal $x(t) = 2\sin(4\pi t)\sin(10\pi t) + 4\cos^2(8\pi t)$.

- (a) What are the frequency components of $x(t)$?
- (b) Determine the minimum sampling frequency of $x(t)$.
- (c) $x(t)$ is sampled at 20 Hz. Derive and sketch the spectrum of the sampled signal. Label your sketch.