PROBLEM:

(a) Evaluate the following integral: $\int_{-\infty}^{\infty} \delta(\omega - 0.2\pi) e^{j\omega t} d\omega$.

Provide some **explanation** or intermediate steps to justify your answer.

(b) Plot $x(t) = \dfrac{\sin(5\pi t)}{t}$ versus t for all t between -1 and 1. Label all important features such as peaks and zero crossings.

(c) Use the **Fourier transform** to find the DC value of the sinc function in part (b). In other words, evaluate the integral $\int_{-\infty}^{\infty} \dfrac{\sin(5\pi t)}{t} dt$. Again, provide some **explanation** or intermediate steps to justify your answer.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

(a) Evaluate the following integral: $\int_{-\infty}^{\infty} \delta(\omega + 0.3\pi) e^{j\omega t} d\omega$.

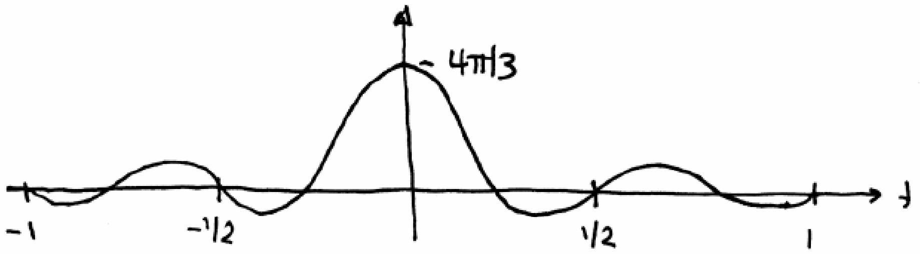
Provide some $\boxed{\textbf{explanation}}$ or intermediate steps to justify your answer.

Use the property $\int_{-\infty}^{\infty} x(t)\delta(t-t_0)dt = x(t_0)$.

Here, we have

$$\int_{-\infty}^{\infty} \delta(\omega + 0.3\pi) e^{j\omega t} d\omega = e^{-j0.3\pi t}$$

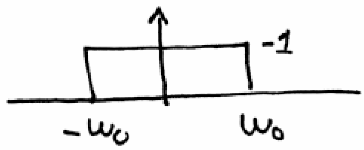
(b) Plot $x(t) = \dfrac{\sin(4\pi t)}{3t}$ versus t for all t between -1 and 1. Label all important features such as peaks and zero crossings.



(c) Use the **Fourier transform** to find the DC value of the sinc function in part (b). In other words, evaluate the integral $\int_{-\infty}^{\infty} \dfrac{\sin(4\pi t)}{3t} dt$. Again, provide some $\boxed{\textbf{explanation}}$ or intermediate steps to justify your answer.

With $X(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt$, note that the DC value at $\omega = 0$ is the integral of $x(t)$. Since we know that

$$\frac{\sin(\omega_0 t)}{\pi t} \Longleftrightarrow$$



with

$$\frac{\sin(4\pi t)}{3t} = \frac{\pi}{3} \frac{\sin(4\pi t)}{\pi t}$$

it follows that $X(j\omega)$ at $\omega = 0$ is $\boxed{\pi/3}$.

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