Problem 8.38 The power spectral density of a narrowband random process $X(t)$ is as shown in Fig. 8.29. Find the power spectral densities of the in-phase and quadrature components of $X(t)$, assuming $f_c = 5$ Hz.

Solution

From Section 8.11, the power spectral densities of the in-phase and quadrature components are given by

$$S_{N_1}(f) = S_{N_0}(f) = \begin{cases} S(f + f_c) + S(f - f_c) & |f| < B \\ 0 & 0 \geq B \end{cases}$$

Evaluating this expression for Fig. 8.29, we obtain

$$S_{N_I}(f) = S_{N_Q}(f) = \begin{cases} 1 - \dfrac{|f|}{2} & 1 < |f| < 2 \\ \left(2 - 3\dfrac{|f|}{2}\right) & 0 < |f| < 1 \\ 0 & \textit{otherwise} \end{cases}$$