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

$$S_{N_{1}}(f) = S_{N_{0}}(f) = \begin{cases} S(f + f_{c}) + S(f - f_{c}) & |f| < B \\ 0 & 0 \ge B \end{cases}$$

Evaluating this expression for Fig. 8.29, we obtain

$$S_{N_{I}}(f) = S_{N_{Q}}(f) = \begin{cases} 1 - \frac{|f|}{2} & 1 < |f| < 2\\ \left(2 - 3\frac{|f|}{2}\right) & 0 < |f| < 1\\ 0 & otherwise \end{cases}$$

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