Problem 9.12 Evaluate the autocorrelation function of the in-phase and quadrature components of narrowband noise at the coherent detector input for the DSB-SC system. Assume the band-pass noise spectral density is $S_N(f) = N_0/2$ for $|f-f_c| < B_T$.

Solution

From Eg. (8.98), the in-phase power spectral density is (see Section 8.11)

$$S_{N_I}(f) = S_{N_Q}(f)$$

$$= \begin{cases} S_N(f - f_c) + S_N(f + f_c) & |f| < B_T/2 \\ 0 & \text{otherwise} \end{cases}$$

$$= \begin{cases} N_0 & |f| < B_T/2 \\ 0 & \text{otherwise} \end{cases}$$

From Example 8.13, the autocorrelation function corresponding to this power spectral density is

$$R_{N_Q}(\tau) = R_{N_I}(\tau) = N_0 B_T \operatorname{sinc}(B_T \tau)$$