5.8 For (a), the 90% correlation coherence bandwidth is

$$B_{c0.9} \doteq \frac{1}{50\sigma_\tau} = \frac{1}{50\times 27(ns)} \doteq \underline{\underline{740\ KHZ}}$$

the 50% correlation coherence bandwidth is

$$B_{c0.5} \doteq \frac{1}{5\sigma_\tau} = \underline{\underline{7.4\ MHZ}}$$

For (b), $B_{c0.9} = \frac{1}{50\sigma_\tau} = \frac{1}{50\times 1.688(\mu s)} \doteq \underline{\underline{11.85\ KHZ}}$

$$B_{c0.5} = \frac{1}{5\sigma_\tau} \doteq \underline{\underline{118.5\ KHz}}$$

5.9 For a binary modulated signal,

Symbol period $T_s = \frac{1}{\text{bit rate}} = \frac{1}{R} \Rightarrow T_s = \frac{1}{25\times 10^3} = 40(\mu s)$

$\Rightarrow \sigma_\tau \leq 0.1\,T_s = 0.1\times 40 = \underline{\underline{4\ (\mu s)}}$

5.9 Cont'd

For an 8-PSK system, Symbol period $T_s = \frac{3}{\text{bit rate}} = \frac{3}{R}$

$\Rightarrow T_s = \frac{3}{75\times 10^3} = 40\ (\mu s)$

$\Rightarrow \sigma \leq 0.1\,T_s = 0.1\times 40 = \underline{\underline{4(\mu s)}}$

5.10

$$\sqrt{2\pi}\, f_m \times e^{-\rho^2} + \left[\sqrt{2\pi}\, f_m \rho\right]\left[-2\rho e^{-\rho^2}\right] = 0$$

$$\sqrt{2\pi}\, f_m \left[e^{-\rho^2} + -2\rho^2 e^{-\rho^2}\right] = 0$$

$$1 = 2\rho^2$$

$$\rho = \sqrt{1/2} = 0.707$$

$\boxed{5.11}$

$$
\begin{aligned}
P(r<R) &= \int_{-\infty}^{R} p(r)\,dr \\
&= \int_0^R \frac{r}{\sigma^2} \exp\left(\frac{-r^2}{2\sigma^2}\right) dr \\
&= \frac{1}{2}\int_0^R \frac{1}{\sigma^2} \exp\left(\frac{-r^2}{2\sigma^2}\right) dr^2 \\
&\overset{t=r^2}{=} \frac{1}{2}\int_0^{R^2} \frac{1}{\sigma^2} \exp\left(\frac{-t}{2\sigma^2}\right) dt \\
&= \frac{1}{2}\cdot\frac{1}{\sigma^2}(-2\sigma^2)\cdot \exp\left(\frac{-t}{2\sigma^2}\right)\Big|_0^{R^2} \\
&= 1-\exp\left(\frac{-R^2}{2\sigma^2}\right)
\end{aligned}
$$

For $P=-10dB=0.316$, the percentage of time that a signal is 10dB or more below the rms value for a Rayleigh fading signal is $P_{0.1} = 1-\exp(-\rho^2) = 1-\exp(-0.316^2) \doteq \underline{\underline{9.5\%}}$