Wireless Communications Technologies

Course No: 16:332:546

Homework 3

1. Attenuation due to large-scale shadow fading is modelled as a lognormal random variable. Specifically, the lognormal random variable Ω_v when measured on a dB scale results in a Gaussian random variable. The transformation is $\Omega_{v(dB)} = 10\log_{10}(\Omega_v)$, where $\Omega_{v(dB)}$ is a Gaussian random variable with pdf given as

$$p(\Omega_{v(dB)}) = \frac{1}{\sqrt{2\pi}\sigma_\Omega}\exp(-\frac{(\Omega_{v(dB)} - \mu_\Omega)^2}{2\sigma_\Omega^2})$$

where $\mu_\Omega = E[\Omega_{v(dB)}]$ and $\sigma_\Omega^2 = Var[\Omega_{v(dB)}]$

Derive the pdf of the lognormal random variable Ω_v from the above.

2. Calculate the mean excess delay and the RMS delay spread for the multipath profile given in Figure 1

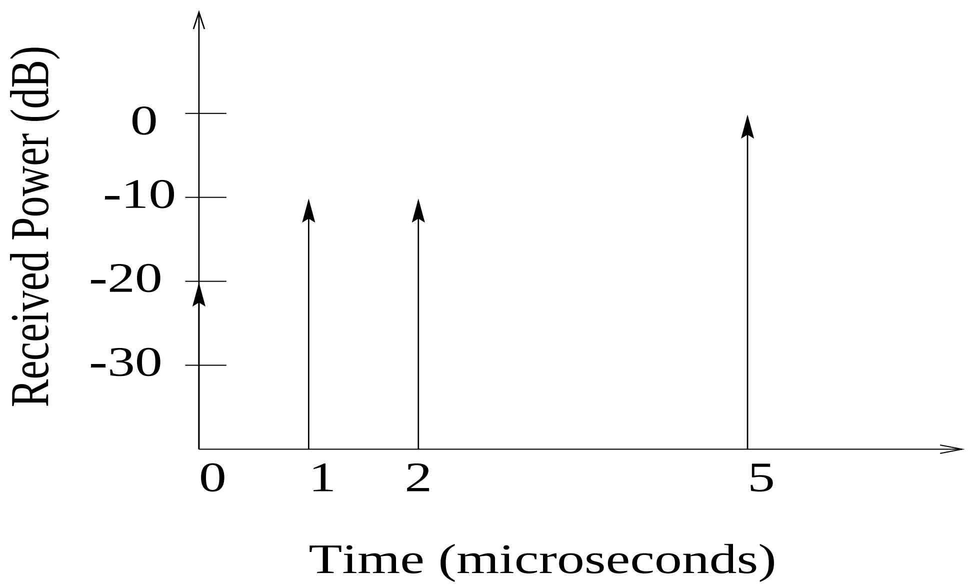

Figure 1: Multipath Profile $P(t)$ *vs.* t

3. Consider M-ary phase shift keying signaling. The psd for such a signal is given as

$$S_{vv}(f) = E_s[\frac{\sin(\pi f T)}{\pi f T}]^2$$

where T is the symbol period and E_s is the energy per symbol. Derive a general expression (as a function of M) for the bandwidth efficiency $\eta_B = \frac{R_b}{B}$ where R_b is the information bit rate and the bandwidth occupied by the signal, B is considered to be the null-to-null bandwidth.