Questions and Answers for Lecture 4

1. Why can't white noise be defined for non-stationary noise?

   "White" is used to describe the shape of the power spectrum density (pdf) of random noise. Only a WSS (wide-sense stationary) noise/random process can have a definition of a pdf. For a non-stationary noise, there is no definition on pdf (we have to use other way to study it), there is no way to describe whether it is "white" or not.

2. So white noise always has infinite bandwidth or not? Also, does it have infinite variance?

   "Ideal" white noise is flat and with infinite bandwidth and therefore has infinite variance. But, after passing it through a bandpass filter, the variance of noise turns into finite.

3. How can white noise be Gaussian? Will the PSD spectrum still be flat?

   Gaussian is used to describe the probability distribution of a random process while flat or white describes the PSD of a WSS random process. So a Gaussian process may have a flat pdf as in white noise.

4. I don't really understand why Rn(τ) gives that result in sl.7, or where the since function comes from?

   $R_n(\tau)$, the correlation function of a WSS random process, can be obtained from the inverse Fourier transform of its power spectrum density, $S(f)$. When you perform the integral to a rectangular window in the inverse Fourier transform, you will get a sinc function.

5. For bandpass noise, the I, Q components have the same variance (power) with n(t). Could you please explain what exactly is the relationship between power and variance? So is power identical to variance for all signals?

   The power of a random process/signal is $E|X(t)|^2$ and its variance is $E|X(t) - \mu(t)|^2 = E|X(t)|^2 - |\mu(t)|^2$, where $\mu(t) = E(X(t))$. Since $\mu(t) = 0$ for almost all signals in communication systems, it is **almost** true that power=variance.

6. We haven't covered the Rice distribution or the Bessel functions, will we need to evaluate them analytically or just know what they are?

   Rice distribution is often used in digital communication systems and Bessel functions are often used in analysing the performance of a communication system. But, for this module, it is enough just to know it.

7. Do the I and Q components have the same PSD with n(t)?

   Yes.