EE 521: Homework 7

1. Prove that

$$\begin{aligned} P_{XX}(F) &= \int_{-T_0}^{T_0} R_{XX}(\tau) e^{-j2\pi F\tau} d\tau \\ &= \frac{1}{2T_0} \left| \int_{-T_0}^{T_0} x(t) e^{-j2\pi Ft} dt \right|^2 \end{aligned} \tag{1}$$

2. Can you use FFT based approaches to build a high speed spectrum analyzer instrument, why or why not?

3. Explain the operation of a high speed spectrum analyzer.

4. Generating real-time noise sequence with a specific power spectral density if of importance while simulating the behavior of a variety of systems and sensors. One approach of doing that is to shape white noise using the proper filter. Use MATLAB/SIMULINK to shape white noise using the filter shown below.

$$H(s) = \frac{\Omega_c}{s + \Omega_c} \tag{2}$$

   (a) Compute and plot the power spectral density of the white noise.

   (b) Compute and plot the power spectral density of the output of the filter.