1. Consider a sequence of observations on a random variable $X_t$, where $t=1,...,T$.

(a) Suppose you are given the power spectral density function for $X$, $f_X(\omega)$, for $\omega \in [0,\pi]$. What can you say about $\{X_t\}$ from an examination of $f_X(\omega)$? What does it mean for $X_t$ to be nonstationary and how can you use $f_X(\omega)$ to detect this? How does this method relate to detecting nonstationarity using the time domain approach?

(b) Carefully explain the concept of aliasing. Describe how the Nyquist (or folding) frequency is determined.

(c) Suppose that you had to estimate $f_X(\omega)$. How would you construct your estimator? What problems would arise if $X_t$ is nonstationary?

2. Give the definition of a periodic function and its period. For the trigonometric function $A \sin \omega x$ carefully define: its period, angular frequency, amplitude, and phase.

3. Write down a Fourier series representation of the function $f(x)$ which has period $p$. Please describe the influence of each of the first four terms and intuitively explain why your representation defines a function with period $p$. 