Sample problems for the quiz on 13th Oct.

2.11 Consider the four waveforms shown in Figure P2.11.

a. Determine the dimensionality of the waveforms and a set of basis functions.
b. Use the basis functions to represent the four waveforms by vectors \( s_1, s_2, s_3, \) and \( s_4 \).
c. Determine the minimum distance between any pair of vectors.

2.39 A lowpass Gaussian stochastic process \( X(t) \) has a power spectral density

\[
S(f) = \begin{cases} 
N_0 & |f| < B \\
0 & \text{otherwise}
\end{cases}
\]

Determine the power spectral density and the autocorrelation function of \( Y(t) = X^2(t) \).

Given: \( R_{yy}(t) = R_{xx}(0) + 2R_{xx}^2(t) \)

3.2 Determine the signal space representation of the four signals \( s_k(t), k = 1, 2, 3, 4 \), shown in Figure P3.2, by using as basis functions the orthonormal functions \( \phi_1(t) \) and \( \phi_2(t) \). Plot the signal space diagram, and show that this signal set is equivalent to that for a four-phase PSK signal.

[FIGURE P2.11]

[FIGURE P3.2]
3.6 Consider the two 8-point QAM signal constellations shown in Figure P3.6. The minimum distance between adjacent points is $2A$. Determine the average transmitted power for each constellation, assuming that the signal points are equally probable. Which constellation is more power-efficient?

![Figure P3.6](image-url)