HW2A: 2.5-4, 2.6-1, 2.6-3
HW2B: 2.8-2 (a, c)
HW 2C: 2.9-2, 2.9-4

2.5-4)
\[ c = -\frac{1}{\pi} = -0.31831, \quad E_c = \frac{2\pi^2 - 3}{6 \pi^2} = 0.28267 \]

Octave script that calculates these values numerically: pr02_05_04.m

2.6-1)

a) \( E_x = \frac{1}{2} \)

b) \( E_{g1} = \frac{1}{2}, \quad \rho = 0 \)

c) \( E_{g2} = \frac{1}{2}, \quad \rho = -1 \)

d) \( E_{g3} = \frac{1}{2}, \quad \rho = 0 \)

e) \( E_{g4} = \frac{1}{2}, \quad \rho = \frac{2\sqrt{2}}{\pi} = 0.90032 \)

Octave script that calculates these values numerically: pr02_06_01.m

For binary communication, \( x(t) \) and \( g_2(t) \) would be the best choices.

2.6-3)
\[ \psi_g(\tau) = \frac{1}{4} e^{-2|\tau|} \]

Octave script that computes the xcorr function numerically and compares it to the function above: pr02_06_03.m

2.8-2)

a) \( a_0 = 0, a_n = 2 \text{sinc}(n \pi/2), b_n = 0 \)

\[ c_n = 2 |\text{sinc}(n \pi/2)|, \quad \theta_n = \begin{cases} 180^\circ & \text{if } \text{mod}(n+1,4) = 0 \\ 0^\circ & \text{otherwise} \end{cases} \]
The phase angle is $180^\circ$ when the $a_n$ are negative.

The first figure below is a graph of the Fourier series with $N = 40$ terms (top) and also $N = 400$ terms (bottom). The second figure is a graph of the frequency spectrum.
c) 

\[ a_0 = 0, \quad a_n = 0, \quad b_n = -\frac{1}{n\pi} \]

\[ c_n = \frac{1}{n\pi}, \quad \theta_n = 90^\circ \]

The first figure below is a graph of the fourier series with \( N = 40 \) terms (top) and also \( N = 400 \) terms (bottom). The second figure is a graph of the frequency spectrum.
2.9-2) a)
c) 
\[ g(t) = \left( \frac{3}{2} e^{-\frac{j\pi}{2}} \right) e^{jt} + \left( \frac{3}{2} e^{\frac{j\pi}{2}} \right) e^{-jt} + \left( \frac{1}{2} e^{-j\frac{2\pi}{3}} \right) e^{j3t} + \left( \frac{1}{2} e^{j\frac{2\pi}{3}} \right) e^{-j3t} + \left( e^{j\frac{\pi}{3}} \right) e^{j8t} + \left( e^{-j\frac{\pi}{3}} \right) e^{-j8t} \]
\( D_0 = 0, \quad D_n = j \frac{(-1)^n}{n} \)

\[ b) \quad P_g = 2 \sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{3} \]

\[ P_g = \frac{1}{2\pi} \int_{-\pi}^{\pi} t^2 \, dt = \frac{\pi^2}{3} \]