1. The autocorrelation function of a random signal is $R(\tau) = rect\left(\frac{\tau}{T_s}\right) \otimes rect\left(\frac{\tau}{T_s}\right)$.
    a. Find the power spectral density of the signal.
    b. Plot the amplitude of the power spectral density with Matlab (Let Ts = 2).
    c. Find the null-to-null bandpass bandwidth, and the 0-to-null baseband bandwidth (in terms of Ts).

2. Find the variance of a random variable uniformly distributed in [0, 1].

3. Consider a random process formed by a sequence of discrete symbols. The duration of each symbol is T, and the symbol can take the value from {-3, -1, 1, 3} with equal probability.
    a. Find the mean of the random process. Does it depend on time?
    b. Find the average power of the random process.

4. Consider an ideal low pass filter with baseband bandwidth 10.
    a. Find the impulse response of the filter via inverse Fourier transform.
    b. Plot the impulse response with Matlab.

Sample Matlab code for plotting a function:

```
% Any line starting with "%" is the comment line
% Matlab cannot represent continuous-time functions
% (e.g. sin(t)). To solve this problem, we use discrete-time
% variables with very small time interval to approximate
% continuous-time function. The small time interval
% is called time domain resolution.
% the time domain resolution we are going to use is 0.01 second.

t_res = 0.01;

% create vector starting from 0 and ending at 2 second,
% the distance between consecutive samples is t_res
% the discrete-time vector is used to approximate
% continuous time from -2 sec to 2 sec
t = [0:t_res:2];

% the freqeuncy is 2 Hz
f0 = 2;

% the initial phase is 0
theta_0 = pi/3;

% define the function
y = sin(2*pi*f0*t+theta_0);

% draw the function with t on the x-axis and y on the y-axis.
plot(t, y);
```