

**Instruction:** Hand in your work in the mail box labeled INC691 by 4 pm. or submit it via email. DO NOT copy homework from your classmates or lend it to others. Anyone who violates this regulation will be given zero for the homework.

1. A moving average (MA) random process defined as

$$y(k) = \frac{1}{2}(x(k) + x(k-1)), \quad -\infty < k < \infty,$$

where  $x(k)$  is a IID white gaussian noise with variance  $\sigma^2$ .

- (a) plot  $y(k)$  using Matlab,
- (b) determine the covariance function  $C_y(k, l)$ .

2. A random phased sinusoid signal defined by

$$x(k) = \cos(2\pi(0.1)k + \Phi), \quad -\infty < k < \infty,$$

where  $\Phi \in [0, 2\pi]$ .

- (a) Find the mean of  $x(k)$ .
- (b) Find the auto-correlation and auto-covariance of  $x(k)$ .
- (c) Find power spectral density of  $x(k)$ .

The mean of  $x(k)$  is found using Find the probability density function of  $x(k)$ .

3. The mean sequence is defined as

$$\mu_x(k) = E[y(k)] = E\left[\frac{1}{2}(x(k) + x(k-1))\right] = 0, \quad -\infty < k < \infty,$$

where  $x(k)$  is a white Gaussian noise, which has a zero mean for all  $k$ .

- (a) Find the covariance sequence  $C_x(k, l)$  of  $y(k)$ .
- (b) Plot  $C_x(k, l)$ .

4. An auto-regressive (AR) random process  $x(k)$  defined to be a WSS random process with zero mean as follow:

$$x(k) = ax(k-1) + e(k),$$

where  $|a| < 1$  and  $e(k)$  is white Gaussian noise, with zero mean and variance  $\sigma_e^2$  for all  $k$ .

- (a) Plot  $x(k)$  for  $a = 0.3$  and  $a = 0.9$  with Matlab.
- (b) Determine  $R_x(k)$
- (c) Determine the power spectrum of the system.
- (d) Plot the power spectrum of the system for  $a = 0.3$  and  $a = 0.9$ .