Time Series Analysis – Assignment I

1. A discrete-time signal $x[n] = cos^2\left(\frac{2\pi}{3}n\right)$ is obtained by sampling a continuous-time signal x(t) at a sampling rate of 60 Hz. What is the fundamental period of x[n]. Identify x(t).

2. Answer the following:

Let $X = Cos\theta$ and $Y = Sin\theta$ be two random variables. Let mean value of each be zero. Let θ be a random variable in the interval $[0\ 2\pi]$.
(a) Find the value of $\sigma_{xy} = E(XY) - E(X)E(Y)$ (Hint: Do not get confused with covariance function which is a function of τ. Use the formula for mean and E(XY) to find the value).
(b) Are X & Y variables independent. Support your answers. (Hint: No covariance between two random variables does not mean they are independent).

3. Answer the following:

An electroencephalographic (EEG) signal has a maximum frequency of 300 Hz. The signal is sampled and quantized into a binary sequence by an A/D converter.
(a) Determine the sampling rate if the signal is sampled at a rate 50 percent higher than the Nyquist rate.
(b) The samples are quantized into 2,048 levels. How many binary bits are required for each sample?

4. Answer the following:

We toss two fair coins simultaneously and independently. If the outcomes of the two coins are the same, we win; otherwise, we lose. Let A be the event that the first coin comes up heads, B be the event that the second coin comes up heads, and C be the event that we win. Which of the following statements is false?
(i) Events A and B are independent.
(ii) Events A and C are not independent.
(iii) Events A and B are not conditionally independent given C.
(iv) The probability of winning is 1/2.