VIT
Vellore Institute of Technology

Continuous Assessment Test – II

Programme Name & Branch: B.Tech ECE (IoT)

Course Name & Code: Signal Analysis and Processing & ECE1018

Class Number: VL2019201001100

Exam Duration: 90 Minutes

Slot: A2

Maximum Marks: 50

Answer ALL Questions and in Blue/Black ink only.

1. A. Find the Fourier series of a rectangular pulse

$$x(t) = rect\left(\frac{t}{\tau}\right)$$

where

$$rect(t) = \begin{cases} 1 & \text{for } \frac{-1}{2} \le t \le \frac{1}{2} \\ 0 & \text{elsewhere} \end{cases}$$ [4]

and τ is a constant integer.

B. Using the Parseval's theorem, find the average signal power $x(t) = \text{sinc}(t/5) * \delta_4(t)$ [6]

2. A. The Fourier transform of a continuous signal $x(t)$ is $X(\omega) = (2\cos\omega)(\sin 2\omega)/\omega$. Determine the value $x(0)$. [7]

B. Determine the Fourier transform of the function $x(t) = \text{sinc}\, 5t$. [3]

3. A. Determine the discrete Fourier series representation for the sequence

$$x[n] = \cos\left(\frac{\pi}{3}n\right) + \sin\left(\frac{\pi}{4}n\right)$$ [6]

Plot the magnitude spectra for at least one period.

B. A real signal using discrete-time Fourier series is represented as

$$x[n] = \sum_{k=0}^{7} a_k e^{jk\omega_0 n}$$

where ω_0 is the frequency in rad/s. The first four discrete Fourier series coefficients are 5, −j3, 2+j7, and 3−j5. Determine the rest of the coefficients, and then plot the magnitude spectrum. [4]

4. A. An LTI system has impulse response $h[n] = \left(\frac{1}{3}\right)^n u[n]$. Determine the response of the system when it is excited by $x[n] = e^{-0.5n}u[n]$. [5]

B. Consider a causal LTI system that is characterized by the difference equation

$$y[n] - \frac{1}{3}y[n-1] = x[n]$$

where $x[n]$ and $y[n]$ are input to and output of the system, respectively. Determine the impulse response of the system. [5]

5. A. Find the autocorrelation and power of the signal [6]

$$x(t) = 4\sin(2\pi t + \frac{\pi}{3}) + 2\cos(4\pi t + \frac{\pi}{3})$$

B. Consider the power signal $x(t)$ with autocorrelation function $R(\tau) = 200\sin(2\pi\tau)$. Find the power spectral density $S_x(f)$. [4]

*******END OF THE QUESTION PAPER*******