VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

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

Course Name & Code: Signal Analysis and Processing & ECE1018

Class Number: VL2019201001099/06827.

Exam Duration: 90 Minutes

Slot: A1

Maximum Marks: 50

Answer ALL Questions.

1. A. Calculate the Fourier transform of a continuous-time signal $x(t) = t$, for $|t| \le 1$ using integration property of Fourier transform. **[6]**

   B. Determine the Fourier transform of the function $x(t) = \text{sinc}^2 5t$. **[4]**

2. A. If C_k is the harmonic function over one fundamental period of a unit-amplitude, 50%-duty-cycle square wave with an average value of zero and a fundamental period of 1 µs, find the expression consisting of only real-valued functions for the signal whose harmonic function is $C_{k-10} + C_{k+10}$. **[6]**

   B. Consider the train of rectangular pulses shown in Figure 1. The signal can be represented using complex Fourier series coefficients, C_k as

   $$x(t) = \sum_{k=-N}^{N} C_k e^{-jk\omega_0 t}.$$

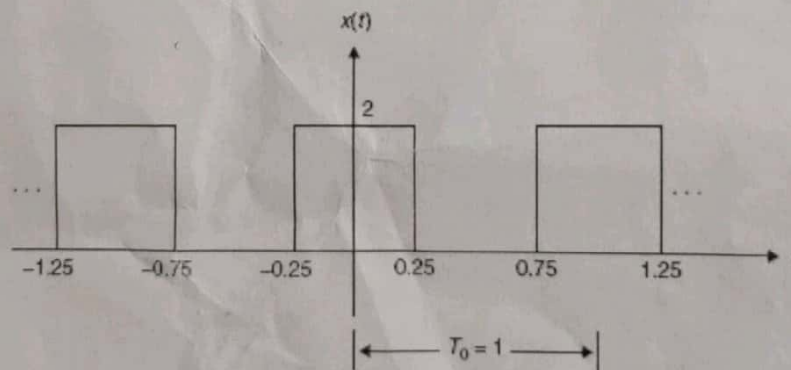   Determine the power of the periodic signal if $N = 5$. **[4]**

Figure 1

3. A. Determine the discrete Fourier series representation for the sequence
   $$x[n] = \cos^2\left(\frac{\pi}{8}n\right)$$ **[6]**

   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, 1–j3, 0, and 3–j4. Determine the rest of the coefficients, and then plot the magnitude spectrum. [4]

4. A. Let $x[n] = n2^{-|n-3|}$ for all integer n. Find the discrete-time Fourier transform of $x[n]$. [5]

B. An LTI system with impulse response $h_1[n] = \left(\frac{1}{3}\right)^n u[n]$ is connected in parallel with another causal LTI system with impulse response $h_2[n]$. The resulting parallel interconnection has the frequency response

$$H(e^{j\omega}) = \frac{-12 + 5e^{-j\omega}}{12 - 7e^{-j\omega} + e^{-2j\omega}}$$

Determine $h_2[n]$. [5]

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

$$x(t) = 6\cos\left(6\pi t + \frac{\pi}{3}\right)$$

B. Consider the power signal $x(t)$ with autocorrelation function $R(\tau) = 200\sin(2\pi\tau)$. Find the power spectral density $S_x(f)$ and plot it. [5]

******* END OF THR QUESTION PAPER*******