Experiment No.: 03

1 Aim

1. To compute and plot the Fourier spectra for the aperiodic signals.

2 Software Used

1. MATLAB

3 Theory

For theory, we can refer the text books:

1. B. P. Lathi, Modern Digital and Analog Communication Systems, Third edition, Oxford (1998).
2. Alan V.Oppenheim and Alan S.Willsky, Signals and Systems, Second edition, Prentice hall (1997).

4 Procedure

Exercise 1 *The Fourier transform (FT) of an aperiodic continuous-time signal $x(t)$ is given by*

$$X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega\, t} dt. \tag{1}$$

In numerical computations, the data must be finite. Let us consider the signal $x(t)$ of finite duration T_0. We approximate the FT of the finite duration signal $x(t)$ as B. P. Lathi

$$\begin{aligned} X(\omega) &= \int_{0}^{T_0} x(t)\, e^{-j\omega\, t} dt \\ &= \lim_{T_s \to 0} \sum_{k=0}^{N_0-1} x(k\, T_s)\, e^{-j\omega\, k\, T_s} T_s; \end{aligned} \tag{2}$$

where T_s denotes the sampling interval of the signal $x(t)$ and $N = \frac{T_0}{T_s}$ is the total number of samples. Let us consider the samples of $X(\omega)$ at regular interval of ω_0. If X_r is the r^{th} sample, then from Eq. (2), we obtain

$$\begin{aligned} X_r &= \sum_{k=0}^{N_0-1} T_s\, x(k\, T_s)\, e^{-j\, r\, \omega_0\, k\, T_s} \\ &= \sum_{k=0}^{N_0-1} x_k\, e^{-j\, r\, \Omega_0\, k}; \end{aligned} \tag{3}$$

where $x_k = T_s\, x(k\, T_s)$, $X_r = X(r\omega_0)$ and $\Omega_0 = \omega_0\, T_s$.

Use MATLAB to compute the FT of the following signal:

$$x_1(t) \quad = \quad e^{-2\,t}u(t) \tag{4}$$

where $u(t)$ denotes the continuous-time unit step function. Plot the magnitude and phase spectra of the $x_1(t)$. Choose $T_0 = 4$ and $T_s = \frac{1}{64}$.

Exercise 2 *Let $T_0 = 8$ and $T_s = \frac{1}{32}$ and plot the magnitude and phase spectra and compare with the previous results. Explain the result.*

5 Observation

Write/ Plot Your Own With Observation Table (If Required).

6 Analysis of Results

Write Your own.

7 Conclusions

Write Your Own.

Precautions

1. Observation should be taken properly.