

Signals and Systems ECE 202

Assignment 9

Document and submit your analytic results. Also generate and publish a MATLAB document, where appropriate, for the following exercises. Submit your MATLAB html folder and original MATLAB code (m files).

1. Use MATLAB to define and plot the following function for $0 \leq t \leq 1$ (t in msec)

$$x(t) = \begin{cases} 3 \sin(2\pi t) & 0 < t \leq 0.25 \\ 3 & 0.25 < t \leq 0.5 \\ 9 - 12t & 0.5 < t < 0.75 \end{cases}$$

Use this signal in the following exercises. All times above are in milliseconds.

2. Find the Fourier series coefficients for the given signal. Assume a period $T = 1$ msec ($f_0 = 1/T = 1$ kHz).
3. Given the following truncated Fourier series

$$x(t) = \sum_{k=-M}^M X[k] e^{j2\pi k f_0 t}$$

Plot MSE vs M for the given signal (use MATLAB function `semilogy`) and find M for which MSE is less than 10^{-5} . Use this value of M (or greater) in the following exercises.

4. Calculate the signal energy for the given signal and compare to the signal energy obtained from

$$\sum_{k=-M}^M |X[k]|^2$$

This is a numerical check of Parseval's theorem.

5. Assume that the given signal is the input to an RC circuit, with the output measured across the capacitor. Plot the resulting signal over three periods and find the output signal energy for $\tau = 0.02$ msec.
6. Repeat for $\tau = 0.2$ msec.
7. Repeat for $\tau = 2$ msec.