

# Signals and Systems ECE 202

## Assignment 10

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. Using the frequency-shifting property, find the inverse Fourier transform of

$$X(f) = \text{rect}\left(\frac{f-20}{2}\right) + \text{rect}\left(\frac{f+20}{2}\right)$$

Use MATLAB to plot your answer as a function of time for  $-2 \leq t \leq 2$ .

2. Using the multiplication-convolution duality of the Fourier transform, find an expression for  $y(t)$  which does not use the convolution operator  $*$ .

- (a)  $y(t) = \text{rect}(t) * \cos(\pi t)$
- (b)  $y(t) = \text{rect}(t) * \cos(2\pi t)$
- (c)  $y(t) = \text{sinc}(t) * \text{sinc}\left(\frac{t}{2}\right)$
- (d)  $y(t) = \text{sinc}(t) * \text{sinc}^2\left(\frac{t}{2}\right)$
- (e)  $y(t) = e^{-t}u(t) * \sin(2\pi t)$

3. Use Parseval's theorem to find the signal energy of these signals.

- (a)  $x(t) = 4\text{sinc}\left(\frac{t}{5}\right)$
- (b)  $x(t) = 2\text{sinc}^2(3t)$

4. Find the total area under the function  $g(t) = 100\text{sinc}((t-8)/30)$ .

5. Find the following Fourier transforms and use MATLAB to plot the magnitude and phase of the result

- (a)  $x(t) = \delta(t-2)$
- (b)  $x(t) = 5\text{rect}\left(\frac{t+2}{4}\right)$
- (c)  $x(t) = \text{rect}(t+1) + \text{rect}(t-1)$
- (d)  $x(t) = \text{rect}(t+2) + \text{rect}(t) + \text{rect}(t-2)$
- (e)  $x(t) = 6\sin(200\pi t)$
- (f)  $x(t) = 2e^{-3t}u(3t)$
- (g)  $x(t) = 4e^{-3t^2}$