

Assignment 1

This assignment is due on Jan 29, marks will be deducted for late homework. **Remember to include the names of all students in your study group**

1. Show that the sum of two discrete periodic signals is periodic, whereas the sum of two continuous periodic signals is not necessarily periodic. Under what conditions is the sum of two continuous periodic signals periodic
2. Classify these systems into linear and nonlinear (*a simple nonlinear or linear will not suffice, you need show how you arrive at your conclusions*)

(a) $y(t) = x^2(t) + 1$

(b) $y(t) = \frac{1}{x(t)}$

(c) $y(t) = e^{-t^2} x(t)$

(d) $y(t) = x(t) \sin(\omega_c t + \theta)$

(e) $y(t) = e^{2x(t)+1}$

(f) $y(t) = x(t) + y(t-1) + y(t-2)$

3. Determine whether the following signals are energy signals, power signals or neither)

(a) $x(t) = \frac{1}{t}$

(b) $x(t) = e^{-\alpha t} \cos(\beta t) u(t), \alpha, \beta > 0$

(c) $x[n] = 2e^{-jn}$

(d) $x(t) = \text{sgn}(t)$

(e)

$$x(t) = \begin{cases} Kt^{-\frac{1}{8}} & t > 0 \\ 0 & t \leq 0 \end{cases}$$

4. Determine the Fourier Transform of each of the following signals (α is positive)

(a) $x(t) = \frac{1}{1+t^2}$

(b) $x(t) = \Pi(2t-3) + \Lambda(2t+3)$

(c) $x(t) = t^2 \text{sinc}(t)$

(d) $x(t) = \delta(t + \frac{1}{2}) + \delta(t - \frac{1}{2})$

5. Consider the function

$$f(t) = \begin{cases} 1 & 0 \leq x \leq \pi \\ -1 & -\pi \leq x < 0 \end{cases}$$

- (a) Write a function in MATLAB to compute the coefficients of the Discrete Fourier Series
- (b) Plot the Fourier Series representation of $f(t)$, when $N = 10$ (i.e., the number of coefficients)
- (c) Plot the Fourier Series representation of $f(t)$, when $N = 30$
- (d) Plot the Fourier Series representation of $f(t)$, when $N = 100$
- (e) What can you conclude from the plots shown in (b) to (d) ?