

# ECE 111 - Homework #15

Week #11 - ECE 343 Signals - Monday, April 29th

Problem 1-5) Let  $x(t)$  be a function which is periodic in  $2\pi$

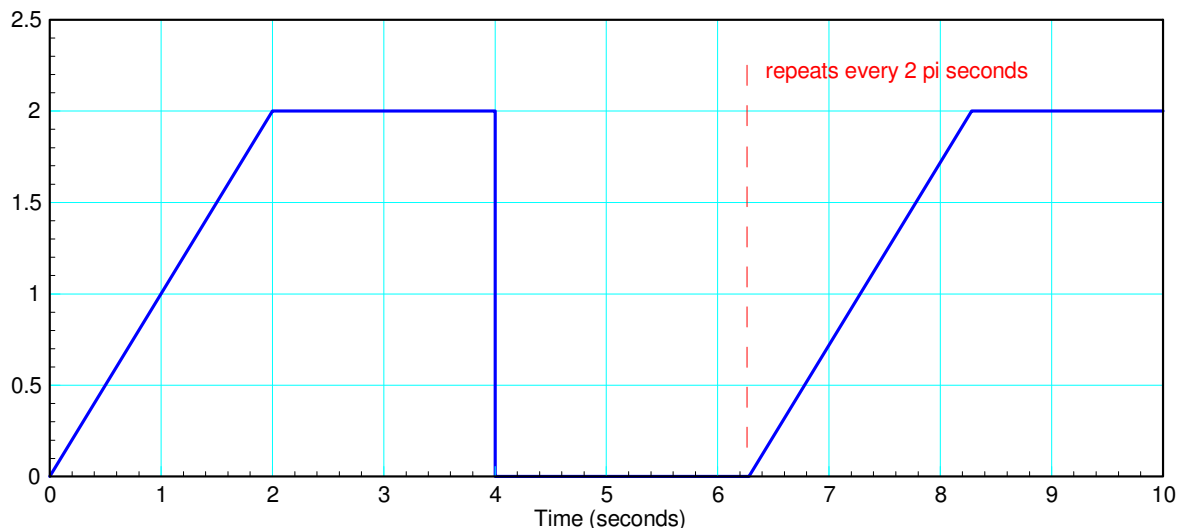
$$x(t) = x(t + 2\pi)$$

Over the interval  $(0, 2\pi)$   $x(t)$  is

$$x(t) = \max(0, 5 \sin(t) - 3)$$

or in Matlab:

```
t = [0:0.001:2*pi]' + 1e-6;  
x = t .* (t<2) + 2*(t>2) .* (t<4);  
plot(t,x)
```



$x(t)$  Note that  $x(t)$  repeats every  $2\pi$  seconds

## Curve Fitting with a power series:

1) Using least squares, approximate  $x(t)$  over the interval  $(0, 2\pi)$  as

$$x(t) \approx a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4 + a_5 t^5$$

Plot  $x(t)$  along with its approximation.

## Curve Fitting using a Fourier Series

2) Using least squares, approximate  $x(t)$  over the interval  $(0, 2\pi)$  as

$$x(t) = a_0 + a_1 \cos(t) + b_1 \sin(t) + a_2 \cos(2t) + b_2 \sin(2t) + a_3 \cos(3t) + b_3 \sin(3t)$$

Plot  $x(t)$  along with its approximation.

## Superposition

3) Assume  $X$  and  $Y$  are related by

$$Y = \left( \frac{0.25}{s^2 + 0.5s + 0.25} \right) X$$

3a) Determine  $x(t)$  in terms of its Fourier Transform out to 3 rad/sec

3b) Plot  $x(t)$  and its Fourier approximation taken out to 3 rad/sec

4) Determine the output,  $y(t)$ , at DC ( $\omega = 0$ )

5) Determine the output,  $y(t)$ , at 1 rad/sec

6) Determine the output,  $y(t)$ , at 2 rad/sec

7) Determine the output,  $y(t)$ , at 3 rad/sec

8) Determine the total answer,  $y(t)$

- Plot  $x(t)$  and  $y(t)$