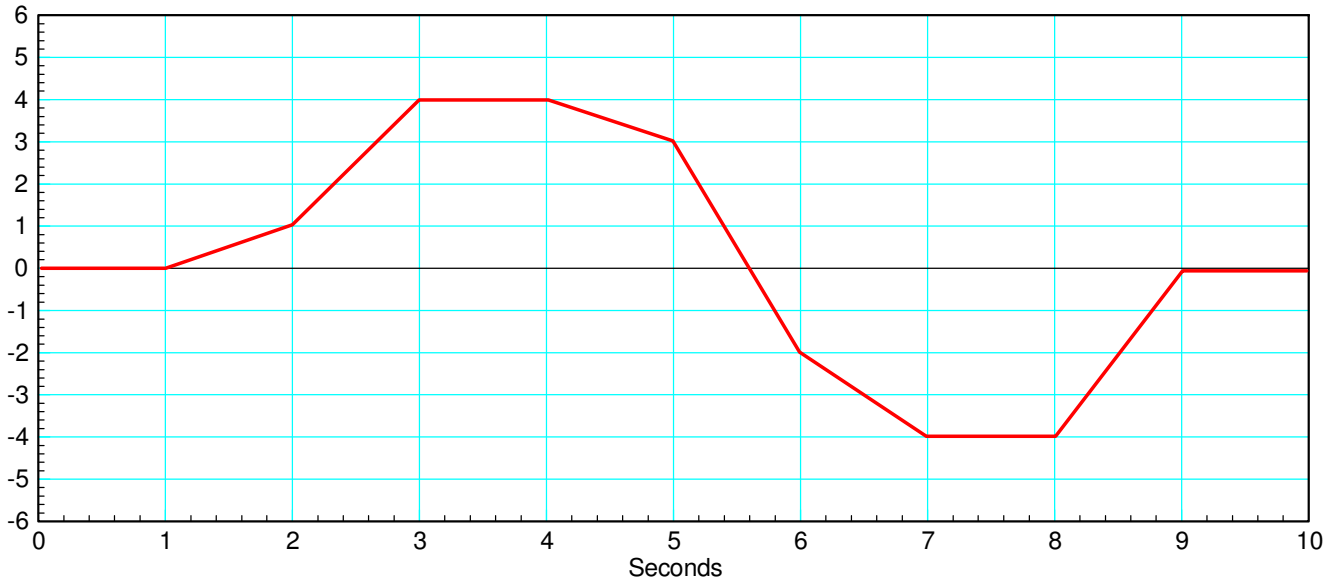


# ECE 111 - Make-Up Homework #6:

Math 165: Differentiation

1) Sketch the derivative of the following function

*If this is the balance of your checking account, how much money are you adding (positive) or withdrawing (negative) for the balance to be as shown?*



## Numerical Differentiation:

2) Use numerical methods to determine the derivative of  $y$ :

$$y = \left( \frac{\cos(3x)}{1+x^2} \right)$$

$$z = \frac{d}{dx}(y)$$

for  $-10 < x < 10$ . ( a plot is sufficient ).

3) Use numerical methods to determine the derivative of  $y$ :

$$y = \cos(x) + 0.1 \sin(20x)$$

$$z = \frac{d}{dx}(y)$$

for  $-10 < x < 10$ . ( a plot is sufficient ).

## Path Planning

4) Assume a motor's angle is as follows:

$$\theta = \begin{cases} 0 & t < 0 \\ t/4 & 0 < t < 4 \\ 1 & t > 4 \end{cases}$$

Calculate and plot using Matlab and numerical differentiation:

- The velocity vs. time (i.e. the voltage to the motor), and
- The acceleration vs. time (i.e. the current to the motor).

5) Assume a motor's angle is as follows:

$$\theta = \begin{cases} 0 & t < 0 \\ \frac{1}{2} - \frac{1}{2} \cos\left(\frac{1}{4}\pi t\right) & 0 < t < 4 \\ 1 & t > 4 \end{cases}$$

Calculate and plot using Matlab and numerical differentiation:

- The velocity vs. time (i.e. the voltage to the motor), and
- The acceleration vs. time (i.e. the current to the motor).

6) Assume a motor's angle is as follows:

$$\theta = \begin{cases} 0 & t < 0 \\ \frac{1}{8}t^2 & 0 < t < 2 \\ -\frac{1}{8}t^2 + t - 1 & 2 < t < 4 \\ 1 & t > 4 \end{cases}$$

Calculate using Matlab and numerical differentiation:

- The velocity vs. time (i.e. the voltage to the motor), and
- The acceleration vs. time (i.e. the current to the motor).