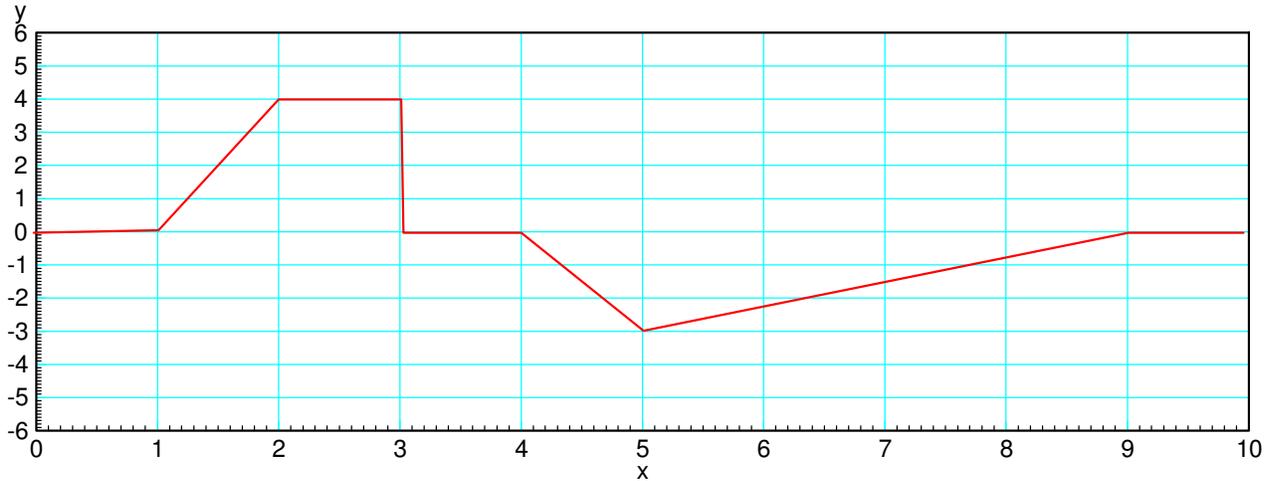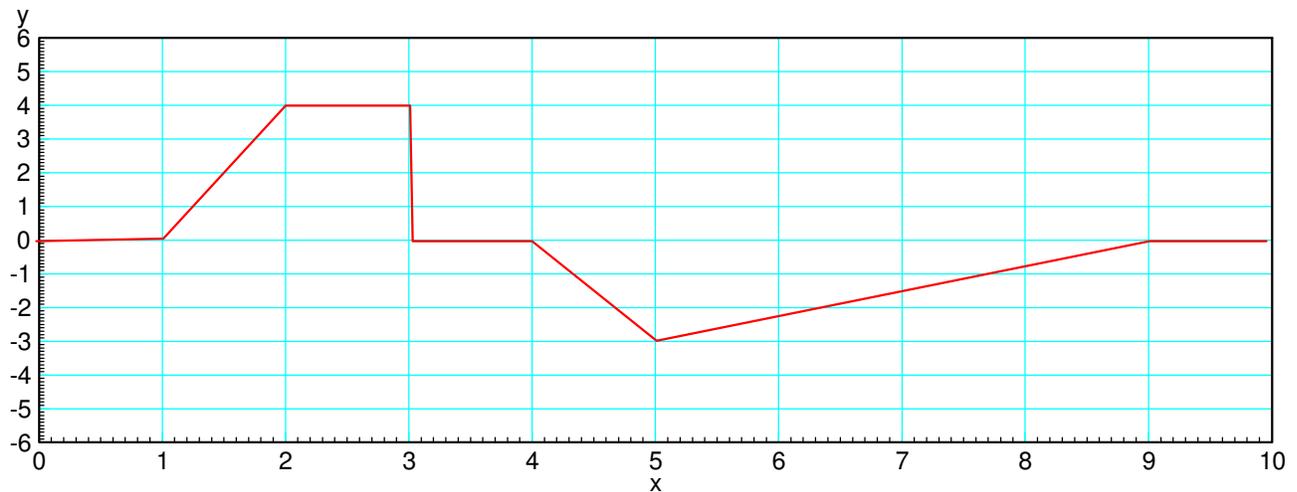# ECE 111 - Homework #4:

Week #4: Math 165 Calculus - Due 11am Tuesday, September 20th

1) Sketch the derivative of the following funciton

*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?*



2) Sketch the integral of the following funciton



*If this is how much money you are depositing (positive) or withdrawing (negative) from your checking account, what is the balance at each instance?*

**Numerical Differentiation:**

3) Use numerical methods to determine y(x)

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

for -10 < x < 10.  ( a plot of y(t) is sufficient ).

4) Use numerical methods to determine y(x)

$$y = \frac{d}{dx}(\sin(x) + 0.2\cos(10x))$$

for -10 < x < 10.  ( a plot of y(t) is sufficient ).

**Numerical Integration**

5) Use numerical methods to determine y(x)

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

for -10 < x < 10.  ( a plot of y(x) is sufficient ).  Assume y(-10) = 0.

6) Use numerical methods to determine y(x)

$$y = \int (\sin(x) + 0.2\cos(10x)) \cdot dx$$

for -10 < x < 10.  ( a plot of y(x) is sufficient ).  Assume y(-10) = 0.

## Wind Energy

7) Load the 4-weeks worth of wind-speed data from NDAWN. (close to your home town if you're from North Dakota). Plot this in MATLAB as wind speed vs hour.

https://ndawn.ndsu.nodak.edu/

8) Write a function in Matlab where you pass the wind speed at 180m (about 2.2x the wind speed at the ground) and it returns the power generated by a Vestas V90-2MW

| Wind Speed (m/s) | 0..3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| kW | 0 | 93 | 211 | 391 | 601 | 884 | 1,247 | 1,594 | 1,861 | 1,993 | 2,000 |

https://en.wind-turbine-models.com/turbines/16-vestas-v90

8a) Determine a function in Matlab to approximate this curve.

8b) Use this function to compute how much power a Vestas V90-2MW wind turbine would produce from the wind data your found in problem 3.

9) It takes 1.78 pounds of North Dakota lignite coal to produce 1kWh of electricity. How many pounds of coal does this wind turbine offset over 4 weeks?

10. Assume
   - This wind turbine costs $2.6 million to build ($1300 / kW), and
   - You get $0.11 / kWh for the energy you produce.

How long will it take for this wind turbine to pay for itself?



Vestas V90-2MW (https://en.wind-turbine-models.com/turbines/16-vestas-v90)