Group Member Names:

In [1]:
```
from sympy import *
from sympy.plotting import plot, plot_parametric
```

Lab 4 Template

Each part of each problem should be solved in its own cell.

Question 1

Let $f(x) = xe^{-|x|}$.

a.) Plot f on [-5, 5].

b.) Find the equations of all horizontal tangent lines. (Note: when declaring x, be sure to use **symbols('x', real=True)**)

In [ ]:
```

```

In [ ]:
```

```

Question 2

Let $f(x) = x\sin(x)$.

a.) Find the first 16 derivatives of f.

b.) Given a number n that is divisible by 4, in a separate print statement for each answer, state what $f^{(n)}(x)$, $f^{(n+1)}(x)$, $f^{(n+2)}(x)$, and $f^{(n+3)}$ are.

In [ ]:
```

```

In [2]:
```
print("f^(n)(x)     = ")
print("f^(n + 1)(x) = ")
print("f^(n + 2)(x) = ")
print("f^(n + 3)(x) = ")
```

```
f^(n)(x)     =
f^(n + 1)(x) =
f^(n + 2)(x) =
f^(n + 3)(x) =
```

Question 3

This problem will explore the properties of derivatives in approximating functions with polynomials.

a.) Plot the function $f(x) = e^{-x^2}$ on [-5, 5] with **ylim=[-1, 1]** and print out $f(0)$.

b.) Compute value of the first 8 derivatives of $f(x)$ at $x = 0$. (Only print out the evaluations)

c.) A Taylor polynomial is a polynomial whose coefficients are chosen using the derivatives of another function. The general formula for the $n-th$ Taylor polynomial centered at zero is given by $T_n(x) = f(0) + \frac{f'(0)}{1!}x + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \ldots + \frac{f^{n-1}(0)}{(n-1)!}x^{n-1} + \frac{f^n(0)}{(n)!}x^n$, where ! is the **factorial** function from the previous assignment. Plot $T_2(x)$, $T_4(x)$, $T_6(x)$, and $T_8(x)$ on [-5, 5] on the same axes with **ylim=[-1, 1]**. (Hint: using list comprehension and the python sum command on a list can greatly reduce the amount of typing necessary for this problem)

d.) Evaluate the absolute error given by $|T_n(x) - f(x)|$ for $n = 2, 4, 6, 8$ at $x = 1$ and print the output in four separate print statements, making sure to use **.evalf()** to get a decimal representation.

In [ ]:

In [ ]:

In [ ]:

In [3]:
```
print("Error for T_2 is:", )
print("Error for T_4 is:", )
print("Error for T_6 is:", )
print("Error for T_8 is:", )
```

```
Error for T_2 is:
Error for T_4 is:
Error for T_6 is:
Error for T_8 is:
```