Lab Worksheet (Week-5)

Plotting and Visualization

1. Plot a function $x^5 + 4x^3 + 3x^2 + x + 1$, together with its first, second, third, and fourth derivatives. Give the title *Plotting of 5-degree polynomial and its derivatives*, with the following properties:

   (i) Use the 100 points over a range -5 to 2.

   (ii) Use different colors for each function.

   (iii) Label the axes and use a legend in the lower right corner.

   (iv) Use different line styles.

Solution:

```
x= np.linspace(-5,2,100)
y1= x**5+4*x**3+3*x**2+x+1
y2= 5*x**4+12*x**2+6*x+1
y3= 20*x**3+24*x+6
y4=60*x**2+24
y5= 120*x
fig, ax= plt.subplots()
ax.plot(x,y1, color="blue",label="y(x)",ls="--" )
ax.plot(x,y2, color="red",label="y'(x)",marker= "+")
ax.plot(x,y3, color="green",label="y''(x)",lw=5,ls="-.")
ax.plot(x,y4, color="yellow",label="y'''(x)",lw=5,ls=":")
ax.plot(x,y5, color="lightgreen",label="y''''(x)",lw=5,ls='-')
ax.set_xlabel("x")
ax.set_ylabel("y")
ax.set_title('Plotting of 5 degree polynomial and its Derivatives')
ax.legend(loc=4)
plt.show()
```

2. Write a Python program to draw a scatter plot for comparing Mathematics and Science subject marks. Use marks of 10 students.
   Sample data:
   Test Data:
   math marks = $[88, 92, 80, 89, 100, 80, 60, 100, 80, 34]$
   science marks = $[35, 79, 79, 48, 100, 88, 32, 45, 20, 30]$
   marks range = $[10, 20, 30, 40, 50, 60, 70, 80, 90, 100]$

Solution:

```
math_marks = [88, 92, 80, 89, 100, 80, 60, 100, 80, 34]
science_marks = [35, 79, 79, 48, 100, 88, 32, 45, 20, 30]
marks_range = [10, 20, 30, 40, 50, 60, 70, 80, 90, 100]
plt.scatter(marks_range, math_marks, label='Math marks', color='r')
plt.scatter(marks_range, science_marks, label='Science marks', color='g')
plt.title('Scatter Plot')
plt.xlabel('Marks Range')
plt.ylabel('Marks Scored')
plt.legend()
plt.show()
```

3. Write a Python program to draw a graph of $e^{-x^2}\cos(40x)$ bounded by $-e^{-x^2}$ and e^{-x^2}. Use 1000 points over a range -2 to 2 and the same color for both the bounds. Save it by the name *Graph*.

Solution:

```
fig,ax=plt.subplots(figsize=(8,2.5))
x=np.linspace(-2,2,1000)
y1=np.cos(40*x)
y2=np.exp(-x**2)
ax.plot(x,y1*y2,'b',lw=2)
ax.plot(x,y2,'g')
ax.plot(x,-y2,'g')
ax.set_xlabel("x")
ax.set_ylabel("y")
plt.suptitle("Graph")
plt.show()
fig.savefig("graph.png",dpi=100)
```

4. Write a Python program to plot the vectors $[1,1,1], [2,-1,5]$, and $[4,1,-2]$ in $3D$.

Solution:

```
u=[1,1,1]
v=[2,-1,5]
h=[4,1,-2]
fig,axes=plt.subplots(subplot_kw={'projection':'3d'})
axes.set_xlim(0,7)
axes.set_ylim(-8,5)
axes.set_zlim(1,10)
```

```
sp= [0,0,0]
axes.quiver(sp[0],sp[1],sp[2],u[0],u[1],u[2])
axes.quiver(sp[0],sp[1],sp[2],v[0],v[1],v[2])
axes.quiver(sp[0],sp[1],sp[2],h[0],h[1],h[2])
plt.show()
```