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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

Sub : Mathematics

Remark
Demonstrator's
Signature
Date:- / /20

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Title of the expt:-__Slip no 7_____ Page.no:-_____Class:-_______BCS______

Q1) Attempt any TWO of the following

A) Plot the graph of f(x)=x^4 in [0,5] with red dashed line with circle marked

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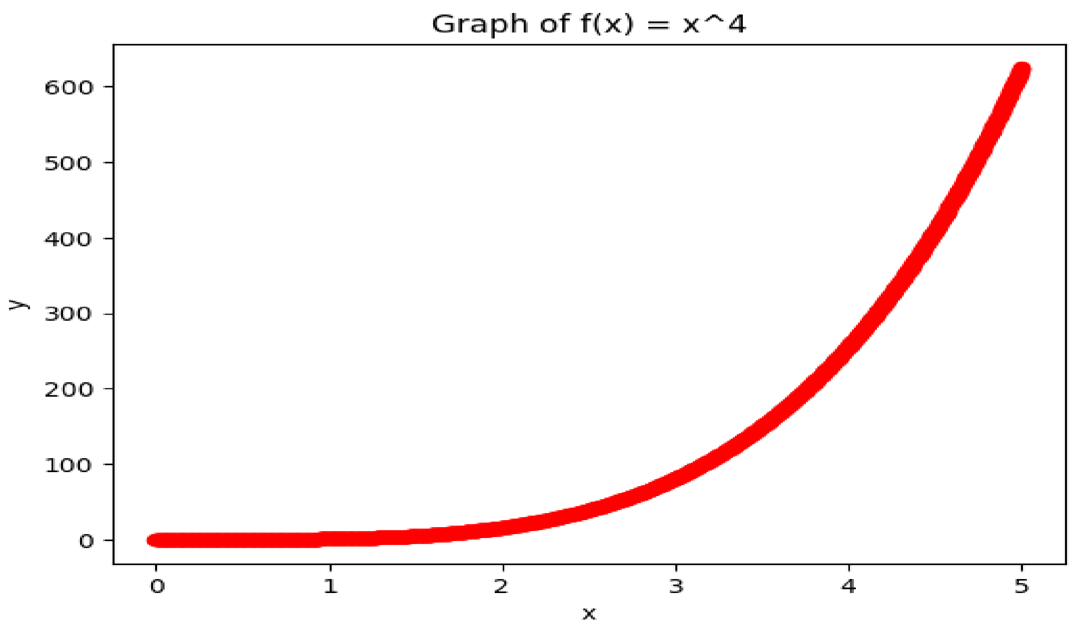
```
import numpy as np

import matplotlib.pyplot as plt
def f(x):
    return x**4

x_values = np.linspace(0, 5, num=1000)
y_values = f(x_values)
plt.plot(x_values, y_values, 'r--', marker='o')
plt.title('Graph of f(x) = x^4')
plt.xlabel('x')
plt.ylabel('y')
plt.show()
```



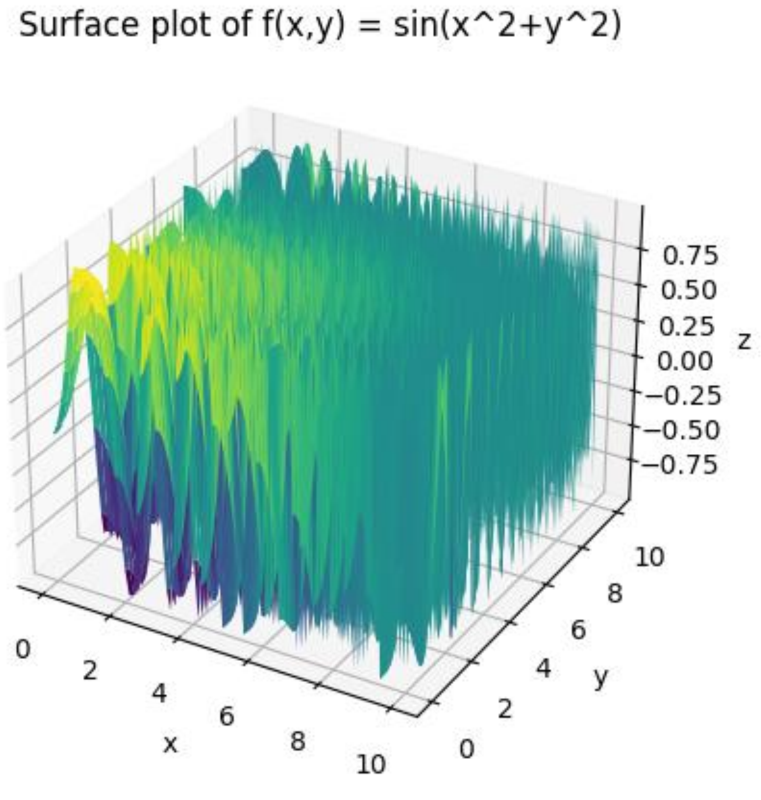
B) Using Python program generate 3D surface plot for the function $f(x)=\sin(x^2+y^2)$ in the interval [0,10]

-→

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
def f(x, y):
    return np.sin(x**2 + y**2)

x_values = np.linspace(0, 10, 100)
y_values = np.linspace(0, 10, 100)

x_mesh, y_mesh = np.meshgrid(x_values, y_values)
z_values = f(x_mesh, y_mesh)
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(x_mesh, y_mesh, z_values, cmap='viridis')
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
ax.set_title('Surface plot of f(x,y) = sin(x^2+y^2)')
plt.show()
```

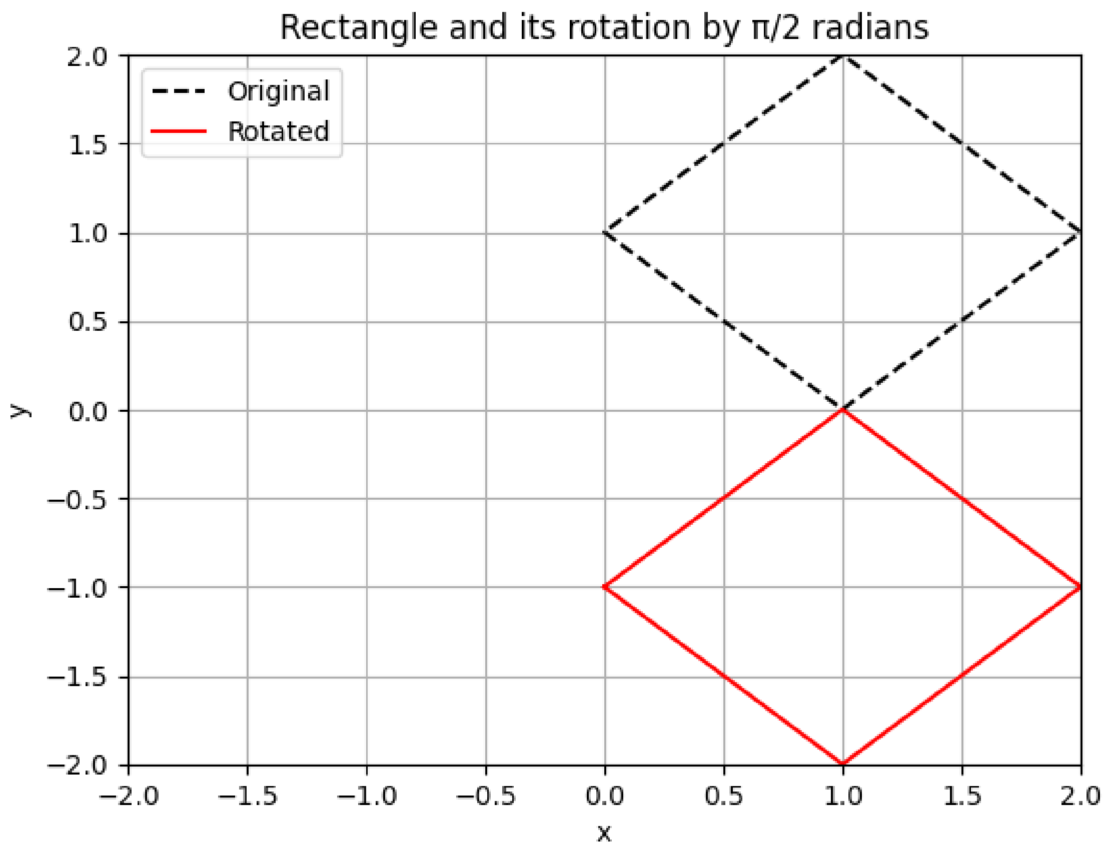


C) Write a python program to draw rectangle with vertices [1,0],[2,1],[1,2] and [0,1] its rotation about the origin by $\frac{\pi}{2}$ radians

-→

```
import numpy as np
import matplotlib.pyplot as plt
vertices = np.array([[1, 0], [2, 1], [1, 2], [0, 1], [1, 0]])
theta = np.pi/2
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                            [np.sin(theta), np.cos(theta)]])
rotated_vertices = vertices @ rotation_matrix

fig, ax = plt.subplots()
ax.plot(vertices[:,0], vertices[:,1], 'k--', label='Original')
ax.plot(rotated_vertices[:,0], rotated_vertices[:,1], 'r-', label='Rotated')
ax.legend()
ax.set_xlim(-2, 2)
ax.set_ylim(-2, 2)
ax.grid()
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_title('Rectangle and its rotation by π/2 radians')
plt.show()
```



Q 2) Attempt any TWO of the following

A) Write a python program to reflect the line segment joining the points A[5,3] & B[1,4] through the line y=x+1

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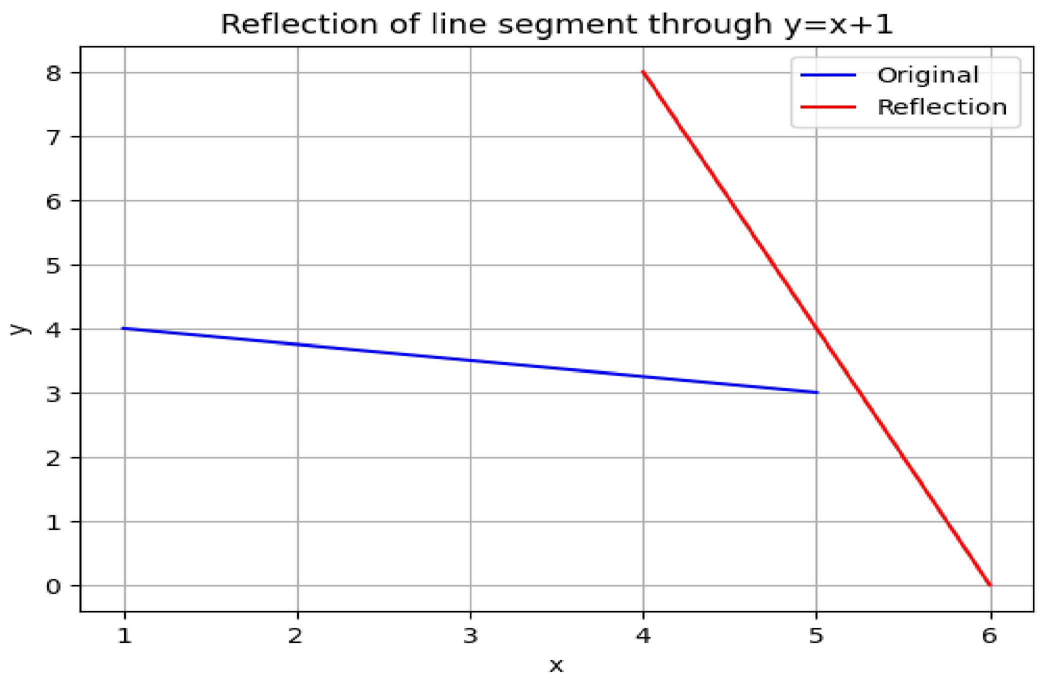
```
import numpy as np
import matplotlib.pyplot as plt
A = np.array([5, 3])
B = np.array([1, 4])
def reflection_line(x):
    return x - 1

m = 1
b = 1
A_image = np.array([(1-m**2)*A[0] + 2*m*A[1] - 2*m*b, (1-m**2)*A[1] + 2*m*A[0] - 2*b])
B_image = np.array([(1-m**2)*B[0] + 2*m*B[1] - 2*m*b, (1-m**2)*B[1] + 2*m*B[0] - 2*b])
fig, ax = plt.subplots()
ax.plot([A[0], B[0]], [A[1], B[1]], 'b-', label='Original')
ax.plot([A_image[0], B_image[0]], [A_image[1], B_image[1]], 'r-', label='Reflection')
ax.legend()
ax.grid()
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_title('Reflection of line segment through y=x+1')
plt.show()
```



B) Using python declare the points P(5,2),Q(5,-2),R(5,0) check whether these points are collinear.Declare the ray passing through the points P and Q find the length of this ray between P and Q. Also find slope of this ray

-→

```
import math

# Define the coordinates of the points P, Q, and R
P = (5, 2)
Q = (5, -2)
R = (5, 0)

# Check if the points P, Q, and R are collinear
if (Q[1]-P[1])*(R[0]-Q[0]) == (R[1]-Q[1])*(Q[0]-P[0]):
    print("The points P, Q, and R are collinear.")
else:
    print("The points P, Q, and R are not collinear.")

# Define the ray passing through P and Q
ray_direction = (Q[0]-P[0], Q[1]-P[1])

# Find the length of the ray between P and Q
ray_length = math.sqrt(ray_direction[0]**2 + ray_direction[1]**2)

# Find the slope of the ray
if ray_direction[0] != 0:
    slope = ray_direction[1] / ray_direction[0]
else:
    slope = float('inf')

# Print the length and slope of the ray
print("The length of the ray between P and Q is", ray_length)
print("The slope of the ray is", slope)
```

Output :

```
The points P, Q, and R are collinear.
The length of the ray between P and Q is 4.0
The slope of the ray is inf
```

C) write a python program in 3D to rotate the point (1,0,0) through X plane in anticlock wise direction(rotation through Z axis) by angle of 90◦

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```
import numpy as np
point = np.array([1, 0, 0])
theta = np.radians(90)
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta), 0],
                            [np.sin(theta), np.cos(theta), 0],
                            [0, 0, 1]])
new_point = np.dot(rotation_matrix, point)

print("The original point was:", point)
print("The rotated point is:", new_point)
```

output:

```
The original point was: [1 0 0]
The rotated point is: [6.123234e-17 1.000000e+00 0.000000e+00]
```

Q 3) Attempt the following

A) Attempt any ONE of the following

I) Write a python program to solve the following LPP :

Min $Z=3.5x+2y$

Subject to $x+y\geq5$

$x\geq4$

$y\leq2$

$x,y\geq0$

-→

```
from pulp import *
prob = LpProblem("LP Problem", LpMinimize)
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)

prob += 3.5*x + 2*y
```

```
prob += x + y >= 5
prob += x >= 4
prob += y <= 2
prob.solve()

print("Status: ", LpStatus[prob.status])
print("Optimal values:")
for v in prob.variables():
    print(v.name, "=", v.varValue)
print("Optimal objective value: ", value(prob.objective))
```

II) Write a python program to display the following LPP by using pulp module and simplex method.Find its optimal solution if exist

Max Z=x+2y+z

Subject to x+2y+2z≤1

3x+2y+z≥8

X,y,x≥0

-→

```
from pulp import *
prob = LpProblem("LP Problem", LpMaximize)
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)

prob += x + 2*y + z
prob += x + 2*y + 2*z <= 1
prob += 3*x + 2*y + z >= 8
prob.solve()

print("Status: ", LpStatus[prob.status])
print("Optimal values:")
for v in prob.variables():
    print(v.name, "=", v.varValue)
print("Optimal objective value: ", value(prob.objective))
```

B) Attempt any ONE of the following

I) Apply Python program in each of the following transformation on the point P[4,-2]

A) Reflection through the Y-axis

B) Scaling in X-coordinate by factor 3

C) Rotation about origin through an angle π

D) Shearing in both X and Y direction by -2 and 4 units respectively

-→

```
import numpy as np
P = np.array([4, -2])

P_reflect_y = np.array([-4, 2])
print("Reflection through Y-axis:", P_reflect_y)

P_scale_x = np.array([12, -2])
print("Scaling in X-coordinate by factor 3:", P_scale_x)

theta = np.pi
rot_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                       [np.sin(theta), np.cos(theta)]])
P_rotate = rot_matrix.dot(P)
print("Rotation about origin through an angle π:", P_rotate)

shear_matrix = np.array([[1, -2], [4, 1]])
P_shear = shear_matrix.dot(P)
print("Shearing in both X and Y direction by -2 and 4 units respectively:", P_shear)
```

Output :

```
Reflection through Y-axis: [-4  2]
Scaling in X-coordinate by factor 3: [12 -2]
Rotation about origin through an angle π: [-4.  2.]
Shearing in both X and Y direction by -2 and 4 units respectivel
y: [ 8 14]
```

II) Find the combined transformation of the line segment between the points A[4,-1] & B[3,2] by using python program for the following sequence of transformation

i)Rotation about origin through an angle $\frac{\pi}{4}$

ii) Shering in Y direction by 4 units

iii) Scaling in X-coordinate by 5 units

iv) reflection through Y-axis

-→

```
import numpy as np
A = np.array([4, -1])
B = np.array([3, 2])
theta = np.pi/4
rot_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                [np.sin(theta), np.cos(theta)]])
A_rot = rot_matrix.dot(A)
B_rot = rot_matrix.dot(B)

shear_matrix = np.array([[1, 0], [4, 1]])
A_shear = shear_matrix.dot(A_rot)
B_shear = shear_matrix.dot(B_rot)

scale_matrix = np.array([[5, 0], [0, 1]])
A_scale = scale_matrix.dot(A_shear)
B_scale = scale_matrix.dot(B_shear)
A_reflect_y = np.array([-A_scale[0], A_scale[1]])
B_reflect_y = np.array([-B_scale[0], B_scale[1]])

print("Transformed point A:", A_reflect_y)
print("Transformed point B:", B_reflect_y)
```

output :

```
Transformed point A: [-17.67766953  16.26345597]
Transformed point B: [-3.53553391  6.36396103]
```