Q3: code submitted

Q4:

a)

```
Manipulator Jacobian:
[[-1.90016658 -0.90343868]
 [ 2.00499583  0.20986428]
 [ 0.          0.09476195]
 [ 0.          0.0587108 ]
 [ 0.         -0.18979606]
 [ 1.          0.98006658]]
End-Effector Velocity:
[-0.3707044   0.24247244  0.01895239  0.01174216 -0.03795921  0.29601332]

assumed parameters:
 num_links = 2
 theta = [0.1, 0.2]
 d = [0, 2]
 a = [1, 2]
 alpha = [0, .2]
 end_effector_position = np.array([3, 2, 0])
```

b)

```
sample values :
link lengths: 2.0,2.0,2.0
desired coordinates: 1.5,0.5,1.0
Theta1 (in radians): 0.3217505543966422
Theta2 (in radians): -0.5152512025505319
Prismatic Displacement (d3): 1.9855069064904307
End-effector x-coordinate: 1.6510295344219905
End-effector y-coordinate: 0.5503431781406636
End-effector z-coordinate: 0.9999999999999999
```

Q11:

```
Enter the number of joints: 2

 joint_angles_values = [1.1, 1.2, 1.4, 1.5, 1.7, 1.8]
 joint_accelerations_values = [0.3, 0.2, 0.32, 0.25, 0.21, 0.25]
 only first n values will be considered based on number of joints
tau1 =
0.3·d₁₁ + 0.2·d₁₂

tau2 =
0.3·d₂₁ + 0.2·d₂₂
```

Q12:

```
sample values :
link lengths: 2.0,2.0,2.0
desired coordinates: 1.5,0.5,1.0
Theta1 (in radians): 0.3217505543966422
Theta2 (in radians): -0.5152512025505319
Prismatic Displacement (d3): 1.9855069064904307
End-effector x-coordinate: 1.6510295344219905
End-effector y-coordinate: 0.5503431781406636
End-effector z-coordinate: 0.9999999999999999
```

Q13:

```
sample values:
end effector positions: x,y,z
link lengths 5.0,5.0
offest: 1.0

Theta1: -0.40369644240331326 radians
Theta2: 2.0943951023931957 radians
Z3: 1.0 units above the XY plane
End-effector position (x, y, z): (3.9999999999999982, 3.0, 2.0)
```

Q14:

```
Specify the number of links 2

Specify elements of the Jacobian (row x row)
Jacobian[0][0]: -1.2
Jacobian[0][1]: 0.5
Jacobian[1][0]: 1.33
Jacobian[1][1]: .9
Jacobian[2][0]: 0
Jacobian[2][1]: 0
Jacobian[3][0]: 0
Jacobian[3][1]: 0
Jacobian[4][0]: 0
Jacobian[4][1]: 0
Jacobian[5][0]: 1
Jacobian[5][1]: 1

Specify end-effector linear velocities (eg: 1,2,4) (m/s): 0.8,0.9,1
Specify end-effector angular velocities (eg: 1,2,4) (rad/s): 0,0,0

Joint Linear Velocities: [-0.23597511  0.77031663]
Joint Angular Velocities: []
```

Q17:

```
Inverse kinematics of Spherical Wrist manipulator:

Enter angle of Joint 1 (deg): 10
Enter angle of Joint 2 (deg): 20
Enter angle of Joint 3 (deg): 30

Enter the elements of the desired end-effector orientation matrix (row by row):
R_desired[0][0]: 0.9
R_desired[0][1]: -.8
R_desired[0][2]: 0
R_desired[1][0]: 0.9
R_desired[1][1]: 1.2
R_desired[1][2]: 0
R_desired[2][0]: 0
R_desired[2][1]: 0
R_desired[2][2]: 1

Desired Rotation Matrix:
[[ 0.9 -0.8  0. ]
 [ 0.9  1.2  0. ]
 [ 0.   0.   1. ]]

Current Rotation Matrix:
[[-0.63302222 -0.75440651  0.17364818]
 [ 0.1116189  -0.13302222 -0.98480775]
 [ 0.76604444  0.64278761  0.        ]]

Calculated Z-Y-Z Euler Angles:
phi = 40.00000000000001 deg
theta = 90.0 deg
psi = -61.06726652172001 deg
```