In [1]:
```
# Question1 Reversing List entity

# By using in-built function

Input1  = [12, 35, 9, 56, 24]

Input1.reverse()

print ("output1 Reversing:", Input1)

# Just to get output as per the assignment
Input  = [12, 35, 9, 56, 24]
list=[]
list.append(Input[4])
list.append(Input[1])
list.append(Input[2])
list.append(Input[3])
list.append(Input[0])

print("output2 Swapping:",list)
```

```
output1 Reversing: [24, 56, 9, 35, 12]
output2 Swapping: [24, 35, 9, 56, 12]
```

In [2]:
```
# By slicing technique
Input = [1,2,3]

print("output Reversing:",Input [::-1])
```

```
output Reversing: [3, 2, 1]
```

In [3]:
```
# Question2 Swapping List entity
Input = [12,35,9,56, 24]

list=[]
list.append(Input[0])
list.append(Input[2])
list.append(Input[1])
list.append(Input[3])
list.append(Input[4])

print("output:",list)
```

```
output: [12, 9, 35, 56, 24]
```

In [4]:
```
# Question3 Reversing of string
input_str  = 'This is CVL757'
input_str[::-1]
```

Out[4]:
```
'757LVC si sihT'
```

In [5]:
```
# Question4 Reversing the order of words in a string

input_str  = 'This is CVL757'
# Split the string
a = input_str.split()
#Reverse the word
a.reverse()
#join
```

```
output_str = " ".join(a)
print(output_str)
```

```
CVL757 is This
```

In [6]:
```
# Que 5 Random Matrix

import numpy as np
seed_values = 20
np.random.seed(seed_values)
a = np.random.rand(3,3)
print(a)
```

```
[[0.5881308  0.89771373 0.89153073]
 [0.81583748 0.03588959 0.69175758]
 [0.37868094 0.51851095 0.65795147]]
```

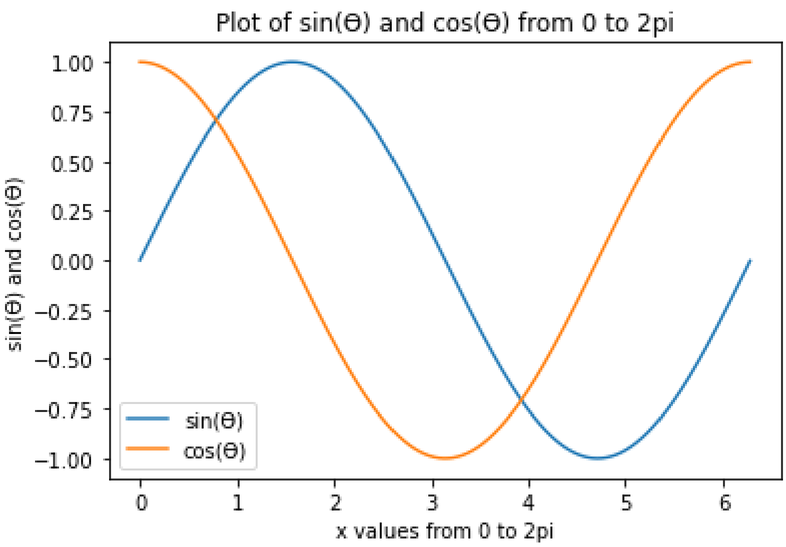
In [7]:
```
#Que6 Swap the columns of random_matrix

a[:,[0,2]] = a[:,[2,0]]
print(a)
```

```
[[0.89153073 0.89771373 0.5881308 ]
 [0.69175758 0.03588959 0.81583748]
 [0.65795147 0.51851095 0.37868094]]
```

In [8]:
```
#Que7 Swap the row of random_matrix
a[[0,2],:] = a[[2,0],:]
print(a)
```

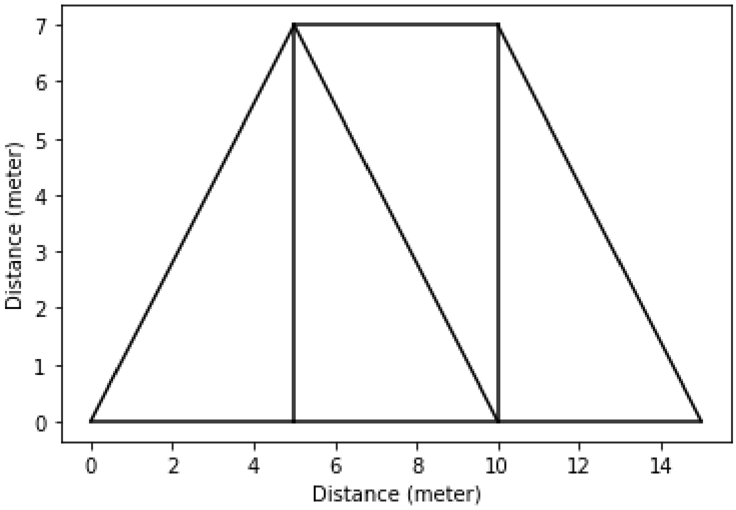
```
[[0.65795147 0.51851095 0.37868094]
 [0.69175758 0.03588959 0.81583748]
 [0.89153073 0.89771373 0.5881308 ]]
```

In [9]:
```
 # Question 8 - Plot the sine and cosine curves as shown below
import matplotlib.pyplot as plt
x = np.arange(0,2*np.pi,0.01)
y=np.sin(x)
z=np.cos(x)
plt.plot(x,y,x,z)
plt.xlabel('x values from 0 to 2pi')
plt.ylabel('sin(\u03F4) and cos(\u03F4)')
plt.title('Plot of sin(\u03F4) and cos(\u03F4) from 0 to 2pi')
plt.legend(['sin(\u03F4)', 'cos(\u03F4)'])
plt.show()
```



In [10]:
```
#Question 9 Plot of the truss
```

```
import numpy as np
from matplotlib import pyplot as plt
import pandas as pd
import os

nodes = [[0, 0], [5, 7], [5, 0], [10, 7], [10, 0], [15, 0]]

connections = np.array([[1, 2], [1, 3], [2, 3], [2, 4], [2, 5], [3, 5], [4, 5], [4,

x = []
y = []
plt.figure()
for connection in connections:
    initial, final = connection
    x1, y1 = nodes[initial]
    x2, y2 = nodes[final]
    plt.xlabel("Distance (meter)")
    plt.ylabel("Distance (meter)")
    plt.plot([x1, x2], [y1, y2], color='black')
```



In [11]:

```
#Question 10 Truss analysis

import numpy as np
from matplotlib import pyplot as plt
import pandas as pd
import os

E = 200e06
A = 0.005
nodes = [[0, 0], [5, 7], [5, 0], [10, 7], [10, 0], [15, 0]]

connections = np.array([[1, 2], [1, 3], [2, 3], [2, 4], [2, 5], [3, 5], [4, 5], [4,

no_nodes = len(nodes)
K_Structure = np.zeros((no_nodes*2, no_nodes*2))
F_Structure = np.zeros((no_nodes*2, 1))

#Developing Global stiffness matrix and Defining Loads for member of Structure

support_nodes = [[0, 0], [15, 0]]

temp_res_dof = []
temp_free_dof = []

for member in connections:
    initial_node_index, final_node_index = member
    x1, y1  = nodes[initial_node_index]
    x2, y2 = nodes[final_node_index]
```

```
    L = ((x2-x1)**2 + (y2-y1)**2)**0.5
    lx, ly = (x2-x1)/L, (y2-y1)/L

    T = np.array([[lx, ly, 0, 0 ],
                  [0, 0, lx, ly]])
    Tt = T.transpose()

    K = np.array([[1, -1],
                  [-1, 1]]) * (A * E / L)

    K_G_local = np.dot(np.dot(Tt, K), T)
    dof = [initial_node_index*2, initial_node_index*2 + 1,
        final_node_index*2, final_node_index*2 + 1]
    K_Structure[np.ix_(dof, dof)] += K_G_local

    if (member[0] == 0) and (member[1] == 1):
        temp_f = np.array([[0], [0], [20], [0]])
        F_Structure[np.ix_(dof)] += temp_f

    if nodes[initial_node_index] in support_nodes:
        temp_res_dof.append(initial_node_index*2)
        temp_res_dof.append(initial_node_index*2 + 1)
    else:
        temp_free_dof.append(initial_node_index*2)
        temp_free_dof.append(initial_node_index*2 + 1)

    if nodes[final_node_index] in support_nodes:
        temp_res_dof.append(final_node_index*2)
        temp_res_dof.append(final_node_index*2 + 1)
    else:
        temp_free_dof.append(final_node_index*2)
        temp_free_dof.append(final_node_index*2 + 1)

res_dof = []
free_dof = []
for item in temp_free_dof:
    if item not in free_dof:
        free_dof.append(item)
for item in temp_res_dof:
    if item not in res_dof:
        res_dof.append(item)

print("\nGlobal stiffness matrix and loads for member of Structure is defined.. \n",

print("\nRes dof number : {}\nfree dof number : {}\n".format(len(res_dof), len(free_

# Displacement and Support Reaction Calculation

K_ff = K_Structure[np.ix_(free_dof, free_dof)]
K_rf = K_Structure[np.ix_(res_dof, free_dof)]
F_ff = F_Structure[np.ix_(free_dof)]
Displacements = np.dot(np.linalg.inv(K_ff), F_ff)
reactions = np.dot(K_rf, Displacements)
print("Support Reactions (kN) \n",reactions)
print("Displacements \n",Displacements)

# Stress calculation in each member
k_temp = K_Structure[2:10, 2:10]
force = k_temp @ Displacements
Stress = force/A
print("Stress in Each Element \n",Stress)
```

```
Global stiffness matrix and loads for member of Structure is defined..
 [[ 239272.85092697   54981.99129775  -39272.85092697  -54981.99129775
```

```
  -200000.              0.                0.                0.
        0.              0.                0.                0.          ]
 [  54981.99129775   76974.78781685  -54981.99129775  -76974.78781685
        0.              0.                0.                0.
        0.              0.                0.                0.          ]
 [ -39272.85092697  -54981.99129775  278545.70185393        0.
        0.              0.           -200000.               0.
   -39272.85092697   54981.99129775       0.                0.          ]
 [ -54981.99129775  -76974.78781685       0.           296806.71849085
        0.          -142857.14285714      0.                0.
    54981.99129775  -76974.78781685       0.                0.          ]
 [-200000.              0.                0.                0.
   400000.              0.                0.                0.
  -200000.              0.                0.                0.          ]
 [      0.              0.                0.          -142857.14285714
        0.          142857.14285714       0.                0.
        0.              0.                0.                0.          ]
 [      0.              0.           -200000.               0.
        0.              0.           239272.85092697  -54981.99129775
        0.              0.           -39272.85092697   54981.99129775]
 [      0.              0.                0.                0.
        0.              0.           -54981.99129775  219831.930674
        0.          -142857.14285714  54981.99129775  -76974.78781685]
 [      0.              0.           -39272.85092697   54981.99129775
  -200000.              0.                0.                0.
   439272.85092697  -54981.99129775 -200000.               0.          ]
 [      0.              0.            54981.99129775  -76974.78781685
        0.              0.                0.          -142857.14285714
   -54981.99129775  219831.930674        0.                0.          ]
 [      0.              0.                0.                0.
        0.              0.           -39272.85092697   54981.99129775
  -200000.              0.           239272.85092697  -54981.99129775]
 [      0.              0.                0.                0.
        0.              0.            54981.99129775  -76974.78781685
        0.              0.           -54981.99129775   76974.78781685]]

Res dof number : 4
free dof number : 8

Support Reactions (kN)
 [[ -8.88888889]
 [ -9.33333333]
 [-11.11111111]
 [  9.33333333]]
Displacements
 [[ 2.18759959e-04]
 [-3.50052910e-05]
 [ 1.11111111e-05]
 [-3.50052910e-05]
 [ 1.85426626e-04]
 [ 1.11957672e-05]
 [ 2.22222222e-05]
 [-5.41375661e-05]]
Stress in Each Element
 [[ 4.00000000e+03]
 [ 3.55271368e-13]
 [-6.07153217e-15]
 [ 0.00000000e+00]
 [-1.26565425e-12]
 [-5.32907052e-13]
 [ 0.00000000e+00]
 [ 1.06581410e-12]]
```

In [12]:

```
#Question 11 Bonous question

import numpy as np
from matplotlib import pyplot as plt
import pandas as pd
import os
```

```
nodes = [[0, 0], [5, 7], [5, 0], [10, 7], [10, 0], [15, 0]]
nodes1 = [[0,0], [5.0+Displacements[0],7.0+Displacements[1]],[5.0+Displacements[2],
connections = np.array([[1, 2], [1, 3], [2, 3], [2, 4], [2, 5], [3, 5], [4, 5], [4,

plt.figure()
for connection in connections:
    initial, final = connection
    X1, Y1 = nodes1[initial]
    X2, Y2 = nodes1[final]
    x1, y1 = nodes[initial]
    x2, y2 = nodes[final]
    plt.xlabel("Distance (meter)")
    plt.ylabel("Distance (meter)")
    plt.plot([x1, x2], [y1, y2], color='black')
    plt.legend(['UnDeformed'])
    plt.plot([x1, x2], [y1, y2] , color='red')
    plt.legend(['UnDeformed','Deformed'])

plt.show()
```