COUPLED ODE USING RK4

(WITH GRAPH)

PROBLEM:-

Solve the coupled differential equations $dx/dt=y+x-x^3/3$; $dy/dt= -x$ for four initial conditions : $x(0) = 0$, $y(0) = -1, \quad -2, -3, -4.$ Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$

CODE:-

```
def f1(x,y):
  z=y+x-x**3/3
  return z
def f2(x,y):
  d=-x
  return d
x0=0
y0=-1
h=0.01
t0=0
yax=[]
xax=[]
```

```
tax=[]
xax.append(x0)
yax.append(y0)
tax.append(t0)
for i in range (15):
  k1x=h*f1(x0,y0)
  k1y=h*f2(x0,y0)
  k2x=h*f1((x0+(k1x/2)),(y0+(k1y/2)))
  k2y=h*f2((x0+(k1x/2)),(y0+(k1y/2)))
  k3x=h*f1((x0+(k2x/2)),(y0+(k2y/2)))
  k3y=h*f2((x0+(k2x/2)),(y0+(k2y/2)))
  k4x=h*f1((x0+(k3x)),(y0+(k3y)))
  k4y=h*f2((x0+(k3x)),(y0+(k3y)))
  x1=x0+(k1x+2*k2x+2*k3x+k4x)/6
  y1=y0+(k1y+2*k2y+2*k3y+k4y)/6
  x0=x1
  y0=y1
  t0=t0+h
  xax.append(x0)
  yax.append(y0)
  tax.append(t0)
  print(x1,'\n',y1)
import matplotlib.pyplot as plt
def My_plot(x,t):
  plt.plot(tax,xax,linewidth=2,color='g')
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  plt.plot(tax,yax,linewidth=2,color='b')
  plt.xlabel('<-----X-axis------>')
  plt.ylabel('<-----Y-axis---->')
  plt.grid(True)
  plt.title('GRAPH')
  plt.show()
  plt.clf()
My_plot(xax,tax)
```

OUTPUT:-

x= -0.10498625667228167 y= -0.9948334866310551

x= -0.219756566681802 y= -0.9786758358614678

x= -0.3436455645793173 y= -0.9505771739001069

x= -0.4753214068257669 y= -0.909685873334793

x= -0.6126073802838671 y= -0.855324470802562

x= -0.7523828594267633 y= -0.7870801070231511

x= -0.8906467012763902 y= -0.704897431335255

x= -1.0228081039187924 y= -0.6091541125983784

x= -1.144199477676956 y= -0.500695694892458

x= -1.250701052030589 y= -0.380812249359547

x= -1.339289246761521 y= -0.25115472147298834

x= -1.4083340939291233 y= -0.11360788608709471

x= -1.457577680813948 y= 0.02985048693295353

x= -1.4878556875586004 y= 0.17727453336127727

x= -1.5006982864762521 y= 0.32684011129661056

GRAPH:-