**5th ORDER**

***#RK Method (5th order )***

**import matplotlib.pyplot as plt**

**[xo,xn,yo,h]=[0,4,1,0.5]**

**n=(xn-xo)/h**

***#f(x.y)=dy/dx (i.e derivative/slope of original; function)***

**print("RK-METHOD 5th ORDER")**

**def f1(x,y):**

**return -2\*(x)\*\*3+12\*(x)\*\*2-20\*(x)+8.5**

***#f(x,y)=y(i.e integral of f1 which is original function)***

**def f2(x,y):**

**return (-0.5\*x\*\*4+4\*x\*\*3-10\*x\*\*2+8.5\*x+1)**

**print("xi \t yi \t k1 \t xi+h \t yi+1 \t y(true)")**

**print("==================================================================")**

**a=[]**

**b=[]**

**c=[]**

**for i in range(0,int(n)+1):**

**yi\_rk5=yo+((1/90)\*(7\*(f1(xo,yo))+32\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))+12\*(f1(xo+h/2,yo-(h/2)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))+h\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))))+32\*(f1(xo+(3/4)\*h,yo+(3/16)\*h\*(f1(xo,yo))+(9/16)\*h\*(f1(xo+h/2,yo-(h/2)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))+h\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))))))+7\*(f1(xo+h,yo-(3/7)\*h\*f1(xo,yo)+(2/7)\*h\*f1(xo+h/4,yo+(h/4)\*f1(xo,yo))+(12/9)\*h\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))-(12/7)\*h\*(f1(xo+h/2,yo-(h/2)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))+h\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))))+(8/7)\*h\*(f1(xo+(3/4)\*h,yo+(3/16)\*h\*(f1(xo,yo))+(9/16)\*h\*(f1(xo+h/2,yo-(h/2)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))+h\*(f1(xo+h/4,yo+(h/8)\*(f1(xo,yo))+(h/8)\*(f1(xo+h/4,yo+(h/4)\*(f1(xo,yo))))))))))))))\*h**

**print(round(xo,4), ' \t', round(yo,4), '\t',round(f1(xo,yo),4), '\t', round(xo+h,4), '\t',round(yi\_rk5,4), '\t',round(f2(xo,yo),4))**

**a.append(round(xo,2))**

**b.append(round(yo,2))**

**c.append(f2(xo,yo))**

**xo=xo+h**

**yo=yi\_rk5**

**print("\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_")**

**print("x=",a,"\ny(5th)=",b,"\ny(true)=",c)**

**plt.plot(a,b,label = "y(5th)=dy/dx")**

**plt.plot(a,c,label = "y(true)=y")**

**plt.title('5th order')**

**plt.xlabel('x')**

**plt.ylabel('f(x,y)')**

**plt.legend()**

**OUTPUT:**

**RK-METHOD 5th ORDER**

**xi yi k1 xi+h yi+1 y(true)**

**0 1 8.5 0.5 3.2188 1.0**

**0.5 3.2188 1.25 1.0 3.0 3.2188**

**1.0 3.0 -1.5 1.5 2.2188 3.0**

**1.5 2.2188 -1.25 2.0 2.0 2.2188**

**2.0 2.0 0.5 2.5 2.7188 2.0**

**2.5 2.7188 2.25 3.0 4.0 2.7188**

**3.0 4.0 2.5 3.5 4.7188 4.0**

**3.5 4.7188 -0.25 4.0 3.0 4.7188**

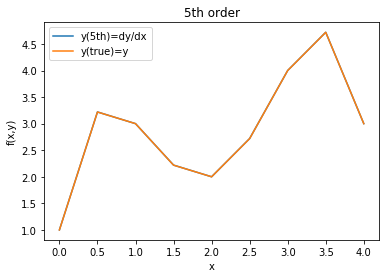
**4.0 3.0 -7.5 4.5 -3.7812 3.0**

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**x= [0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0]**

**y(5th)= [1, 3.22, 3.0, 2.22, 2.0, 2.72, 4.0, 4.72, 3.0]**

**y(true)= [1.0, 3.21875, 3.0, 2.21875, 2.0, 2.71875, 4.0, 4.71875, 3.0]**

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