Bahria University,

Karachi Campus



LAB EXPERIMENT NO.

**11**

LIST OF TASKS

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| TASK NO | OBJECTIVE |
| 1 | Write a Python program that implements range – kutta methods of the orders mentioned against each part to approximate the 1st order derivative of the following:   * approximate y(0.2) for 𝒚 ′ = (𝒙−𝒚)/ 𝟐 , having x0 = 0, y0 = 1, and h = 0.1. (2nd order) * approximate y(0.3) for 𝒚 ′ = (𝟏 – 𝒚)𝟑 , having x0 = 0, y0 = 0, and h = 0.1. (3 rd order)   approximate y(0.1) for 𝒚 ′ = −𝟐𝒚 + 𝒙𝟑𝒆−𝟐𝒙 , having x0 = 0, y0 = 1, & h = 0.1. (4th order) |

Submitted On:

**Date: 5/1/2024**

**Task No. 01:**

**Write a Python program that implements range – kutta methods of the orders mentioned against each part to approximate the 1st order derivative of the following:**

* **approximate y(0.2) for 𝒚 ′ = (𝒙−𝒚)/ 𝟐 , having x0 = 0, y0 = 1, and h = 0.1. (2nd order)**
* **approximate y(0.3) for 𝒚 ′ = (𝟏 – 𝒚)𝟑 , having x0 = 0, y0 = 0, and h = 0.1. (3 rd order)**
* **approximate y(0.1) for 𝒚 ′ = −𝟐𝒚 + 𝒙𝟑𝒆−𝟐𝒙 , having x0 = 0, y0 = 1, & h = 0.1. (4th order)**

**Solution:**

**Part A:**

def function(x,y):

return (x-y)/2

def rk\_2nd\_order(x0,y0,x,h):

n=int((x-x0)/h)

y=y0

for i in range(1,n+1):

k1=h\*function(x0,y)

k2=h\*function(x0+h,y0+k1)

y=y+(1/2)\*(k1+k2)

return y

x0=0

y0=1

x=0.2

h=0.1

print('Result: ',rk\_2nd\_order(x0,y0,x,h))

**Part B:**

def function(x,y):

return 1-y\*y\*y

def rk\_3rd\_order(x0,y0,x,h):

n=int((x-x0)/h)

y=y0

for i in range(1,n+1):

k1=h\*function(x0,y)

k2=h\*function(x0+(h/2),y+(k1/2))

k3=h\*function(x0+h,y0+2\*k2-k1)

y=y+(1/6)\*(k1+4\*k2+k3)

return y

x0=0

y0=0

x=0.3

h=0.1

print('Result: ',rk\_3rd\_order(x0,y0,x,h))

**Part C:**

import math

def function(x,y):

return -2\*y+x\*\*3\*math.exp(-2\*x)

def rk\_4rth\_order(x0,y0,x,h):

n=int((x-x0)/h)

y=y0

for i in range(1,n+1):

k1=h\*function(x0,y)

k2=h\*function(x0+(h/2),y+(k1/2))

k3=h\*function(x0+(h/2),y+(k2/2))

k4=h\*function(x0+h,y+k2)

y=y+(1/6)\*(k1+2\*k2+2\*k3+k4)

return y

x0=0

y0=1

x=0.1

h=0.1

print('Result: ',rk\_4rth\_order(x0,y0,x,h))

**Output:**

