



## DEPARTMENT OF MATHEMATICS

### UNIT-V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

EULER METHOD:

$$y_1 = y_0 + h f(x_0, y_0) \quad \text{for the interval } (x_0, y_0)$$

$$y_2 = y_1 + h f(x_1, y_1) \quad \text{" " } (x_1, y_1)$$

$$y_{n+1} = y_n + h f(x_n, y_n) \quad \text{" " } (x_n, y_n)$$

where  $n = 0, 1, 2, \dots$

This formula is called Euler's algorithm.

① Using Euler's method find  $y(0.2)$  and  $y(0.4)$  from

$$\frac{dy}{dx} = x + y, \quad y(0) = 1 \quad \text{with } h = 0.2.$$

Soln:  $\frac{dy}{dx} = f(x, y) = x + y$

$$\text{Here } x_0 = 0, \quad y_0 = 1, \quad h = 0.2, \quad x_1 = 0.2, \quad y_1 = ?$$

$$x_2 = 0.4, \quad y_2 = ?$$



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$$\begin{aligned}y_1 &= y_0 + h f(x_0, y_0) \\&= 1 + (0.2) [x_0 + y_0] \\&= 1 + (0.2) [0 + 1]\end{aligned}$$

$$y(0.2) = 1.2$$

$$\begin{aligned}y_2 &= y_1 + h f(x_1, y_1) \\&= 1.2 + (0.2) [x_1 + y_1] \\&= 1.2 + 0.2 [0.2 + 1.2]\end{aligned}$$

$$y(0.4) = 1.48$$

② Using Euler's method solve  $y' = x + y + xy$ ,  $y(0) = 1$  Compute  $y$  at  $x = 0.1$  by taking  $h = 0.05$ .

Soln:  $f(x, y) = x + y + xy$   
Gm:  $x_0 = 0, y_0 = 1, h = 0.05$ .

$$\begin{aligned}y_1 &= y_0 + h f(x_0, y_0) \\&= 1 + (0.05) [x_0 + y_0 + x_0 y_0] \\&= 1 + (0.05) [0 + 1 + 0]\end{aligned}$$

$$y(0.05) = 1.05$$



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$$\begin{aligned}y_2 &= y_1 + hf(x_1, y_1) \\&= 1.05 + (0.05) [x_1 + y_1 + x_1 y_1] \\&= 1.05 + (0.05) [0.05 + 1.05 + 0.05 \times 1.05]\end{aligned}$$

$$y(0.1) = 1.0527$$

③ using Euler's method find the soln. of the initial value problem  $\frac{dy}{dx} = \log(x+y)$ ,  $y(0)=2$  at  $x=0.2$  by assuming

$$h=0.2.$$

$$\text{Soln: } y(0.2) = 2.0602.$$