Q. Find global minimum point and the value for function $f(x) = x^4 + 3x^2 + 10$.

Sol: Manual calculations for two iterations:-

given $f(x) = x^4 + 3x^2 + 10$

step ①: initialize variables.

$$x = 1$$
$$\eta = 0.1$$
$$epoches = 2$$
$$itr = 1$$

step ②:
$$\left(\frac{\partial f}{\partial x}\right)_{x=1} = \left(4x^3 + 6x\right)$$
$$= 4(1)^3 + 6(1) = 10.$$

step ③: calculate change in x,
$$\Delta x = -\eta\left(\frac{\partial f}{\partial x}\right) = (-0.1)(10)$$
$$= -1$$

step ④: update variable x
$$x = x + \Delta x$$
$$= 1 + (-1) \Rightarrow x = 0.$$

step ⑤: Increment iterations
$$itr = itr + 1.$$

Step - ⑥: if (itr > epoches) then

goto step ⑦

else, goto step ②

here, itr = 2, epoches = ②

$2 > 2 \rightarrow$ false.

hence, goto step ②.

Step - ②: calculate first order deriative of $f(x)$ at $x = 0$.

$$\left(\frac{\partial f}{\partial x}\right)_{x=0} = (4x^3 + 6x)_0$$

$$= 4(0)^3 + 6(0)$$

$$= 0.$$

Step - ③: Calculate change in x.

$$\Delta x = -\eta \left(\frac{\partial f}{\partial x}\right) = -(0.1)(0)$$

$$= 0.$$

Step - ④: Update variable x.

$$x = x + \Delta x$$

$$= 0 + 4(0)$$

$$= 0.$$

step-⑤ : Increment iterations

$$itr = itr + 1$$

step-⑥ : if (itr > epoches) goto step ⑦

else, go to step ②

here, $itr = 3$, $epoches = 2$

$3 > 2 \rightarrow$ true.

hence, go to step ⑦

step-⑦ : print variable x.

$$\Rightarrow x = 0.$$

at $x = 0$.

we find min. value of function $f(x)$, that min. value.

$$f(0) = 10.$$