(5) $f(x) = x_1^3 - x_1 x_2 + x_2^2 - 2x_1 + 3x_2 - 4$

min? $x^0 = (0;0)^T$

дано: $\varepsilon_1 = 0,1 \quad \varepsilon_2 = 0,15 \quad M = 10$

$\frac{\partial f}{\partial x_1} f(x) = 3x_1^2 - x_2 - 2 \qquad S(x^0) = -4$

$\frac{\partial f}{\partial x_2} f(x) = -x_1 + 2x_2 + 3$

$\nabla f(x) = (3x_1^2 - x_2 - 2;\ -x_1 + 2x_2 + 3)^T$

$k = 0$

$\nabla f(x^0) = (-2;3)^T$

$\|\nabla f(x^0)\| = \sqrt{(-2)^2 + 3^2} = \sqrt{13} = 3,6 > \varepsilon_1$

$k < M \Rightarrow$ шаг $t_0 = 0,5$

$x^1 = (0;0)^T - 0,5(-2;3)^T = (1;-1,5)^T$

$f(x^1) = -5,75 \qquad f(x^0) = -4$

$f(x^1) < f(x^0) \quad t_0 = 0,5$

$\|x^1 - x^0\| = 1,8 > \varepsilon_2$

$|f(x^1) - f(x^0)| = 1,75 > \varepsilon_2$

$k = 1$

$\nabla f(x^1) = (2,5;-1)^T$

$\|\nabla f(x^1)\| = 2,69 > \varepsilon_1 \quad k < M$

$t_1 = 0,5$

$x^2 = (1; -1,5)^T - 0,5(2,5; -1)^T = (-0,25; -1)^T$

$f(x^2) = -5,76 < f(x^1)$

$t_1 = t_2 = 0,5$

$\|x^2 - x^1\| = 1,34 > \varepsilon_2$

$|f(x^2) - f(x^1)| = 0,015 < \varepsilon_2$

k=3

$\nabla f(x^2) = (-0,8125; 1,25)^T$

$\|\nabla f(x^2)\| = 1,49 > \varepsilon_1 \quad k < N$

$t_2 = 0,5$

$x^3 = (-0,25; -1)^T - 0,5(-0,8125; 1,25)^T =$

$= (0,3\,; -4,136)^T$

$f(x^3) = 1,69 > f(x^2)$

$t_2 = \frac{0,5}{2} = 0,25$

(2)

$x^3 = (-0,25; -1)^T - 0,25(-0,8125; 1,25)^T =$

$f(x^3) = -5,04 > f(x^2) = (2,067; -2,578)^T$

$t_2 = 0,125$

$x^3 = (-0,25; -1)^T - 0,125(-0,8125; 1,25)^T = (-0,091; -1,\ldots)^T$

$f(x^3) = -6,14 < f(x^2)$ $\quad t_2 = 0,125$

$x^3 = (-0{,}031; -1{,}789)^T$

$\|x^3 - x^2\| = 0{,}8 > \varepsilon_2$

$|f(x^3) - f(x^2)| = 0{,}38 > \varepsilon_2$

k = 4

$\nabla f(x^3) = (-0{,}186; -0{,}487)^T$

$\|\nabla f(x^3)\| = 0{,}52 > \varepsilon_1 \quad k < M$

$x^4 = x^3 - t_3 \nabla f(x^3) = \underline{(-0{,}068; -1{,}728)^T}$

$f(x^4) = -6{,}17 < f(x^3) \Rightarrow t_3 = t_4 = 0{,}125$

$\|x^4 - x^3\| > 0{,}065 > \varepsilon_2$

$|f(x^4) - f(x^3)| = 0{,}031 > \varepsilon_2$

k = 5

$\nabla f(x^4) = (-0{,}25 \; -0{,}388)^T$

$\|\nabla f(x^4)\| = 0{,}46 > \varepsilon_1$

$x^5 = x^4 - t_4 \nabla f(x^4) = (-0{,}0357; -1{,}6795)^T$

$f(x^5) = -6{,}2 < f(x^4) \Rightarrow t_4 = t_5 = 0{,}125$

$\|x^5 - x^4\| = 0{,}058 < \varepsilon_2$

$|f(x^5) - f(x^4)| = 0{,}02 < \varepsilon_2$

не перепроверял, так как мало времени

$x^* = (-0{,}0357; -1{,}6795)^T$

ответ не совпал с 3/13 ошибка на k=3