12) find the 2nd differences of the polynomial $f(x) = x^4 - 12x^3 + 42x^2 - 30x + 9$ with $h = 2$.

Ans 2nd Method:

using Synthetic division rule

let $f(x) = x^4 - 12x^3 + 42x^2 - 30x + 9$

$= x^{(4)} + Ax^{(3)} + Bx^{(2)} + Cx^{(1)} + D$

2	1	-12	42	-30	9 = D
		2	-20	44	
4	1	-10	22	14 = C	
		4	-24		
6	1	-6	-2 = B		
		6			
	1	0 = A			

$\therefore f(x) = x^{(4)} - 2x^{(2)} + 14x^{(1)} + 9$

$\Delta f(x) = 1 \times h \times 4x^{(3)} - 2 \times h \times 2x^{(1)} + 14 \times h$

$= 1 \times 2 \times 4x^{(3)} - 2 \times 2 \times 2x^{(1)} + 14 \times 2$

$= 8x^{(3)} - 8x^{(1)} + 28$

$\Delta^2 f(x) = 8 \times h \times 3x^{(2)} - 8 \times h$

$= 8 \times 2 \times 3x^{(2)} - 8 \times 2$

$= 48x^{(2)} - 16$