```
> # lab4: научиться раскладывать функцию в ряд Фурье по тригонометрической системе
      функций и по ортогональным полиномам, определять область сходимости
      полученного ряда к порождающей его функции, контролировать результаты с
      помощью средств системы Maple.
```

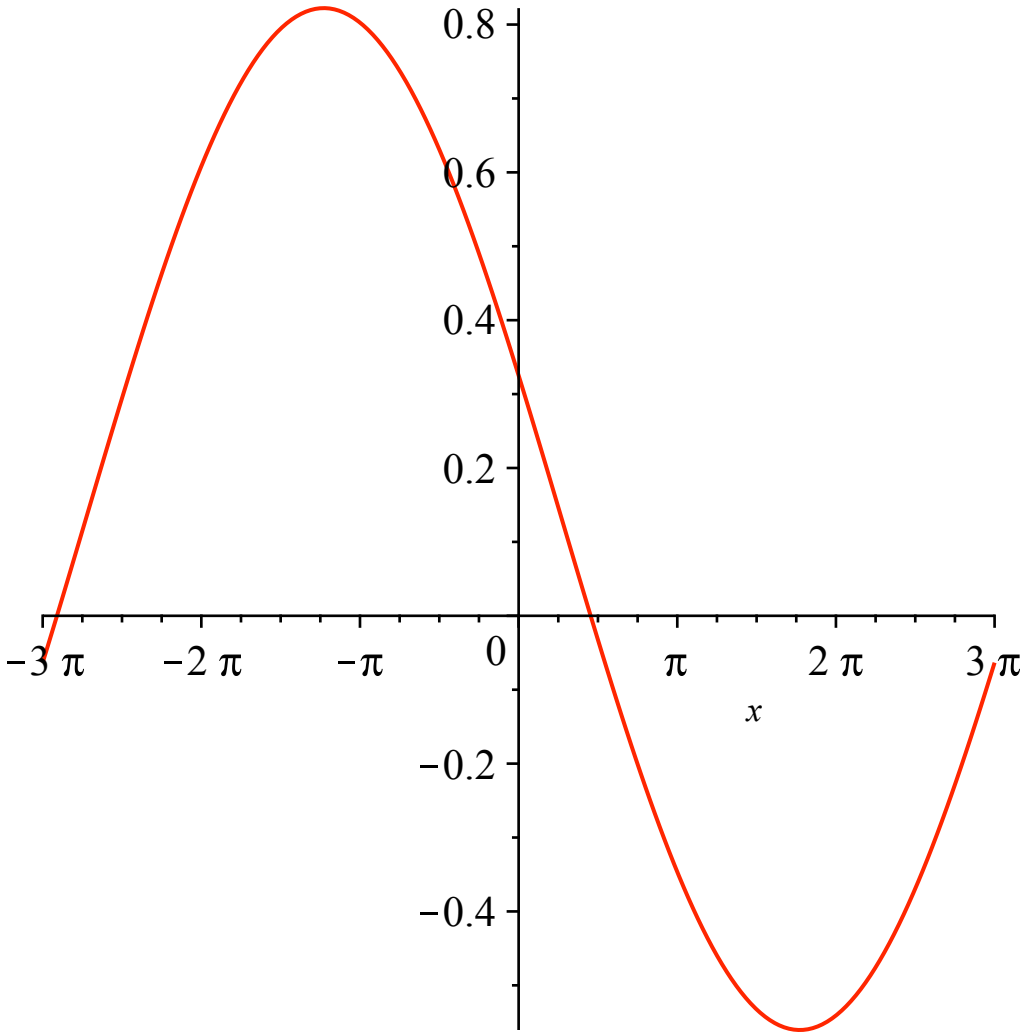
```
> f := piecewise(-π ≤ x < 0, (π - x)/2, 0 ≤ x < π, -π/2)
```

$$f := \begin{cases} \frac{\pi}{2} - \frac{x}{2} & -\pi \le x < 0 \\ -\frac{\pi}{2} & 0 \le x < \pi \end{cases} \tag{1}$$

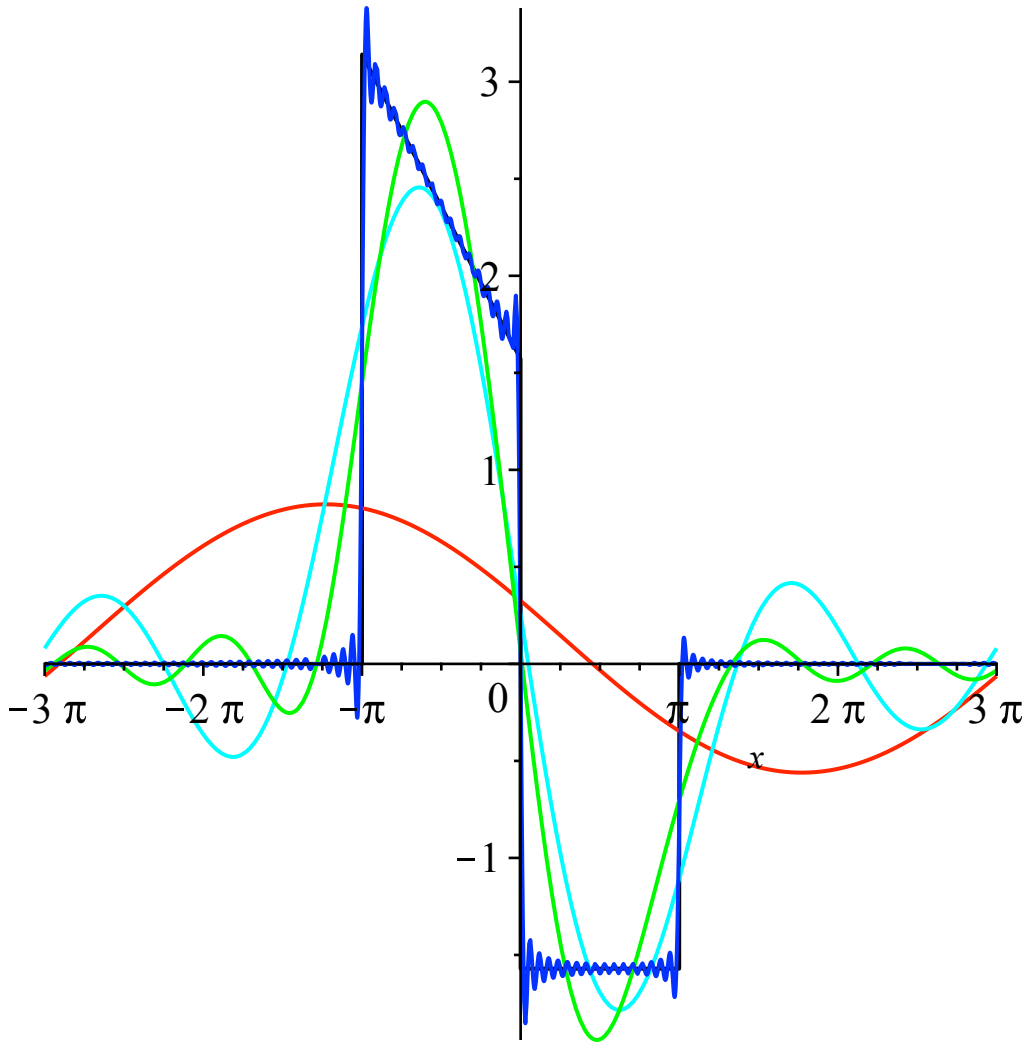
```
> fourierseries := proc(f, x, x1, x2, n)
  local a, b, s, l, k;
  l := (x2 - x1)/2;
  a[0] := int(f, x = x1 .. x2)/l;
  a[k] := int(f·cos(k·π·x/l), x = x1 .. x2)/l;
  b[k] := int(f·sin(k·π·x/l), x = x1 .. x2)/l;
  s := a[0]/2 + sum(a[k]·cos(k·π·x/l) + b[k]·sin(k·π·x/l), k = 1 .. n);
  end proc:
```

```
> g := t→fourierseries(f, x, -3·π, 3·π, t):
```

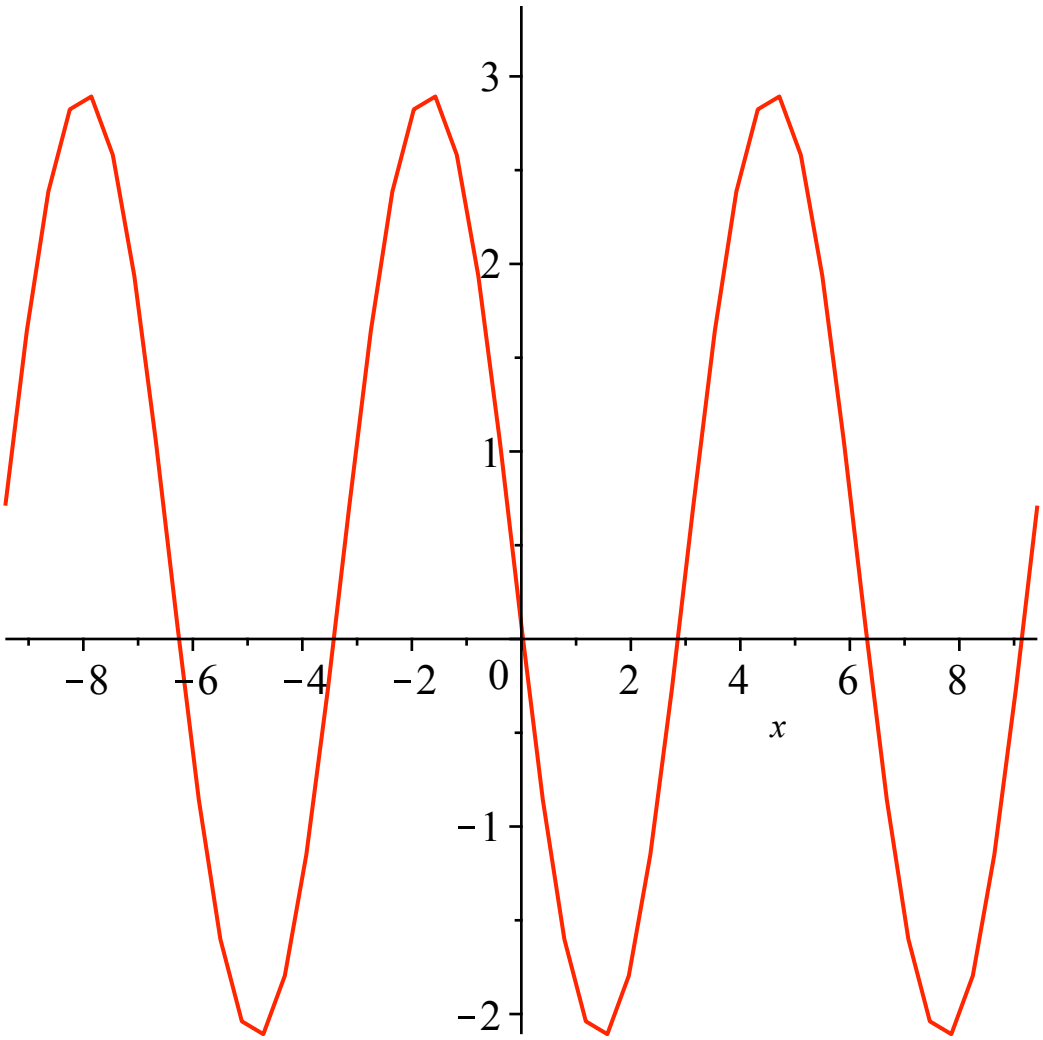
```
> plot(g(1), x = -3·π .. 3·π, color = red)
```




```
> plot( [f, g(1), g(3), g(7), g(100)], x = -3·π .. 3·π, color = [black, red, cyan, green, blue])
```



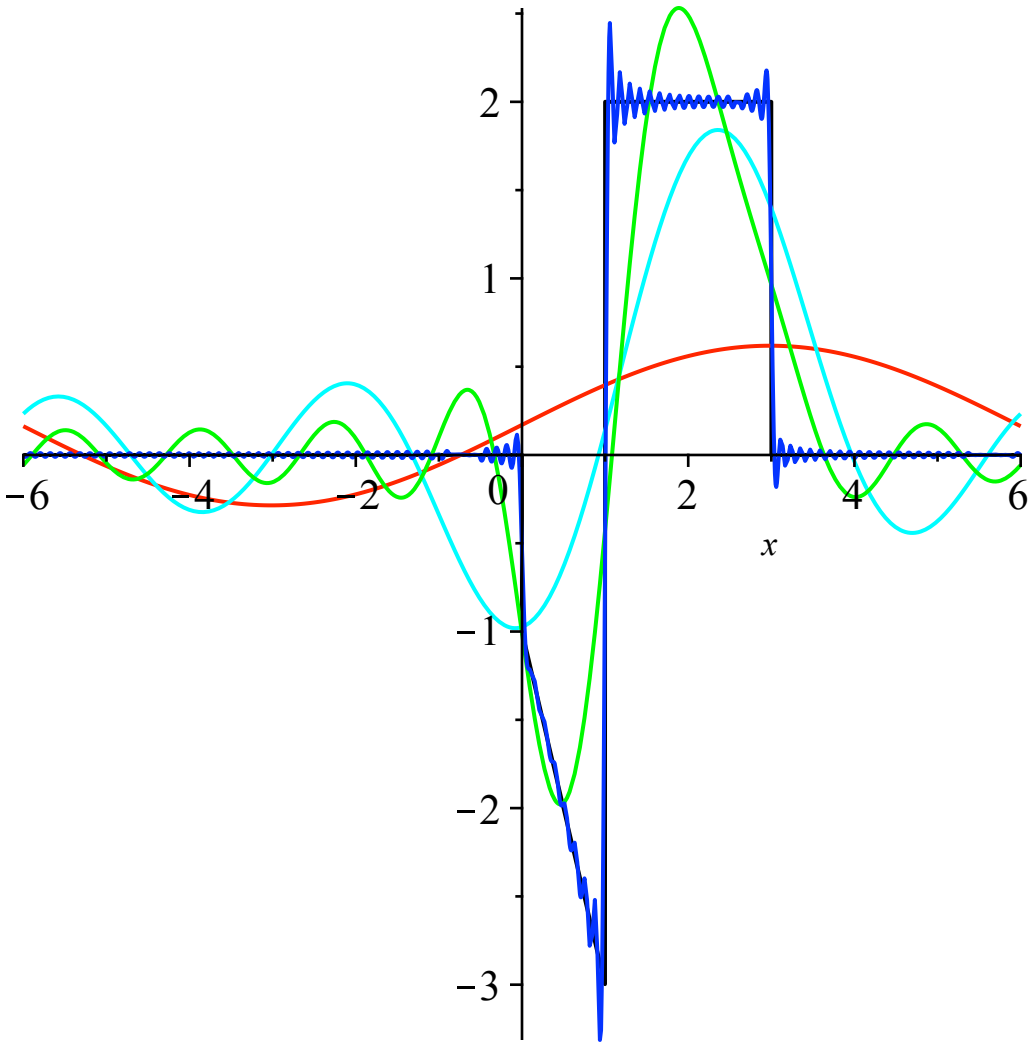

```
> with(plots):
  animate(fourierseries(f, x, -π, π, t), x = -3·π .. 3·π, t = 1 ..10)
```




```
> # Task2
> f2 := piecewise(0 < x < 1, -2·x - 1, 1 ≤ x < 3, 2)
```

$$f2 := \begin{cases} -2\,x - 1 & 0 < x < 1 \\ 2 & 1 \le x < 3 \end{cases} \quad \textbf{(2)}$$

```
> g2 := t→fourierseries(f2, x, -6, 6, t) :
> plot([f2, g2(1), g2(3), g2(7), g2(100)], x = -6..6, color = [black, red, cyan, green, blue])
```




```
> # Task3
```

```
> y1 := x→a·x^2 + b·x + c :
  solve({
     y1(0) = -2.5,
     y1(1) = 0,
     y1(2) = -2.5,
   }, [a, b, c])
```

$$[[a = -2.500000000,\ b = 5.,\ c = -2.500000000]] \quad \textbf{(3)}$$

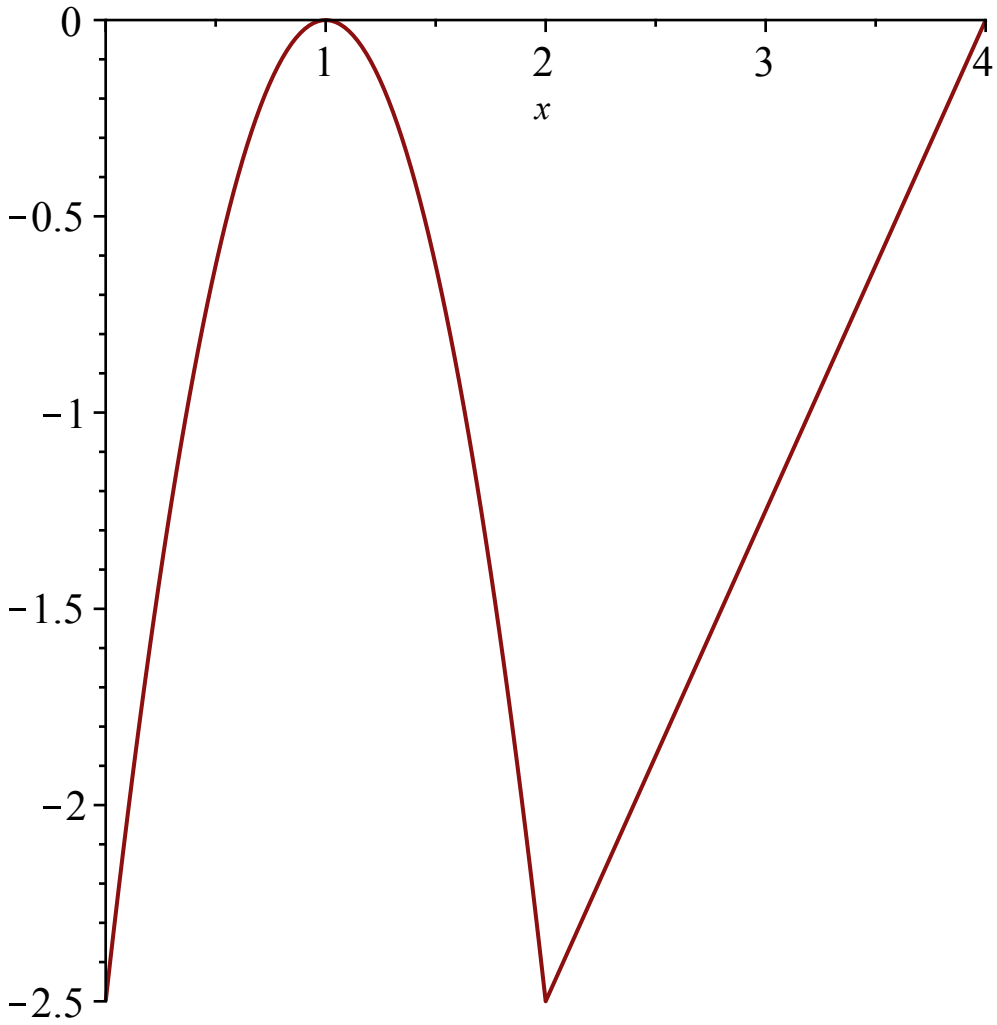
```
> y2 := x→a·x + b :
  solve({
     y2(2) =-2.5,
     y2(4) = 0
   }, [a, b])
```

$$[[a = 1.250000000,\ b = -5.]] \quad \textbf{(4)}$$

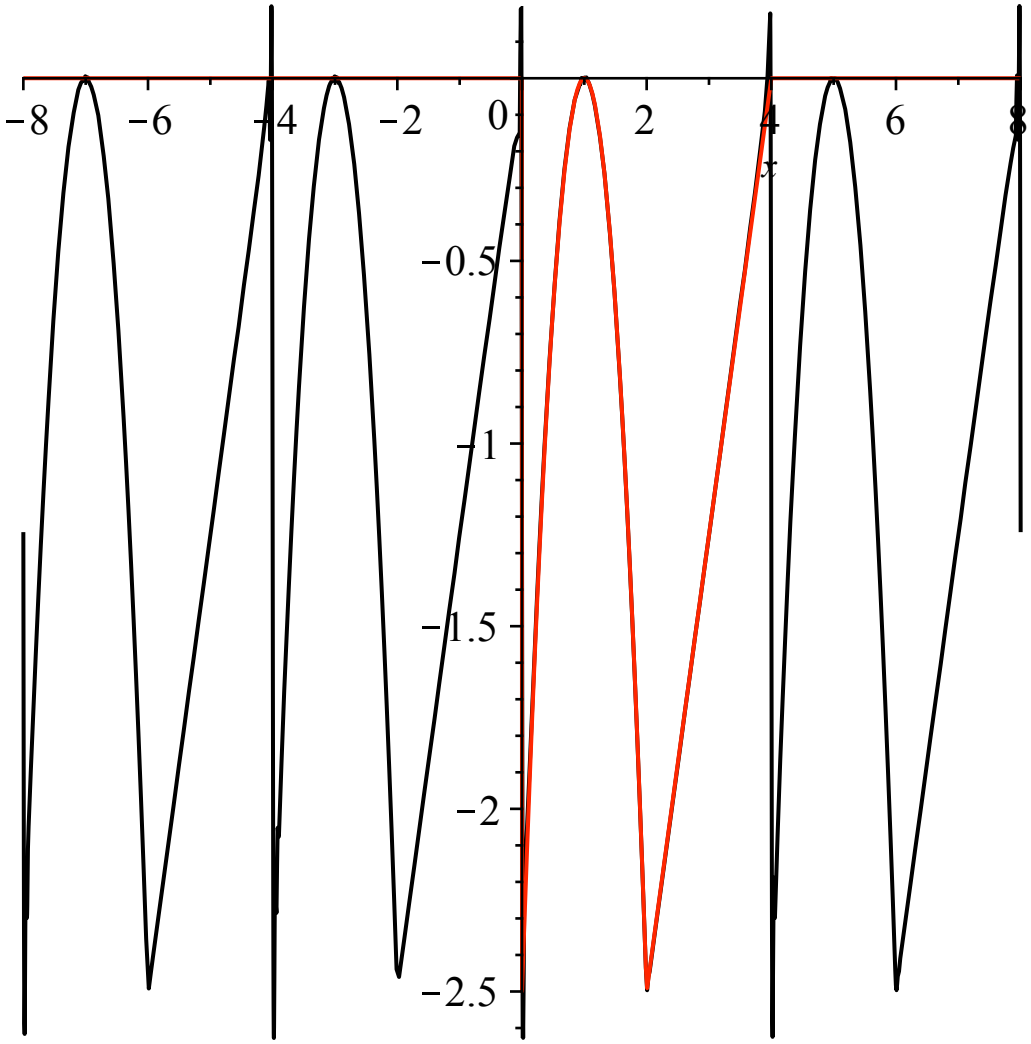
```
> f3 := piecewise(0 ≤ x < 2,-2.5·x^2 + 5·x - 2.5, 2 ≤ x < 4, 1.25 x - 5)
```

$$f3 := \begin{cases} -2.5\,x^2 + 5\,x - 2.5 & 0 \le x < 2 \\ 1.25\,x - 5 & 2 \le x < 4 \end{cases} \quad \textbf{(5)}$$

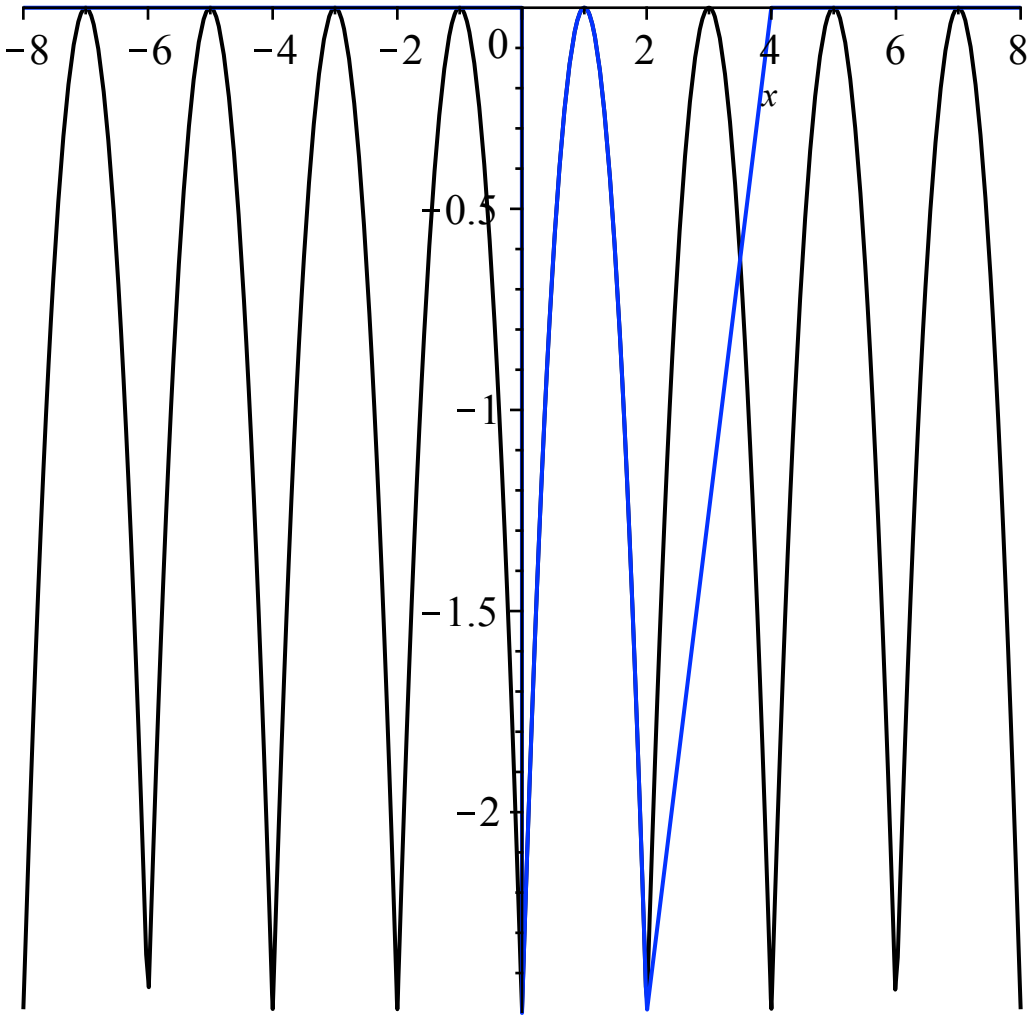
```
> plot(f3, x = 0 ..4)
```



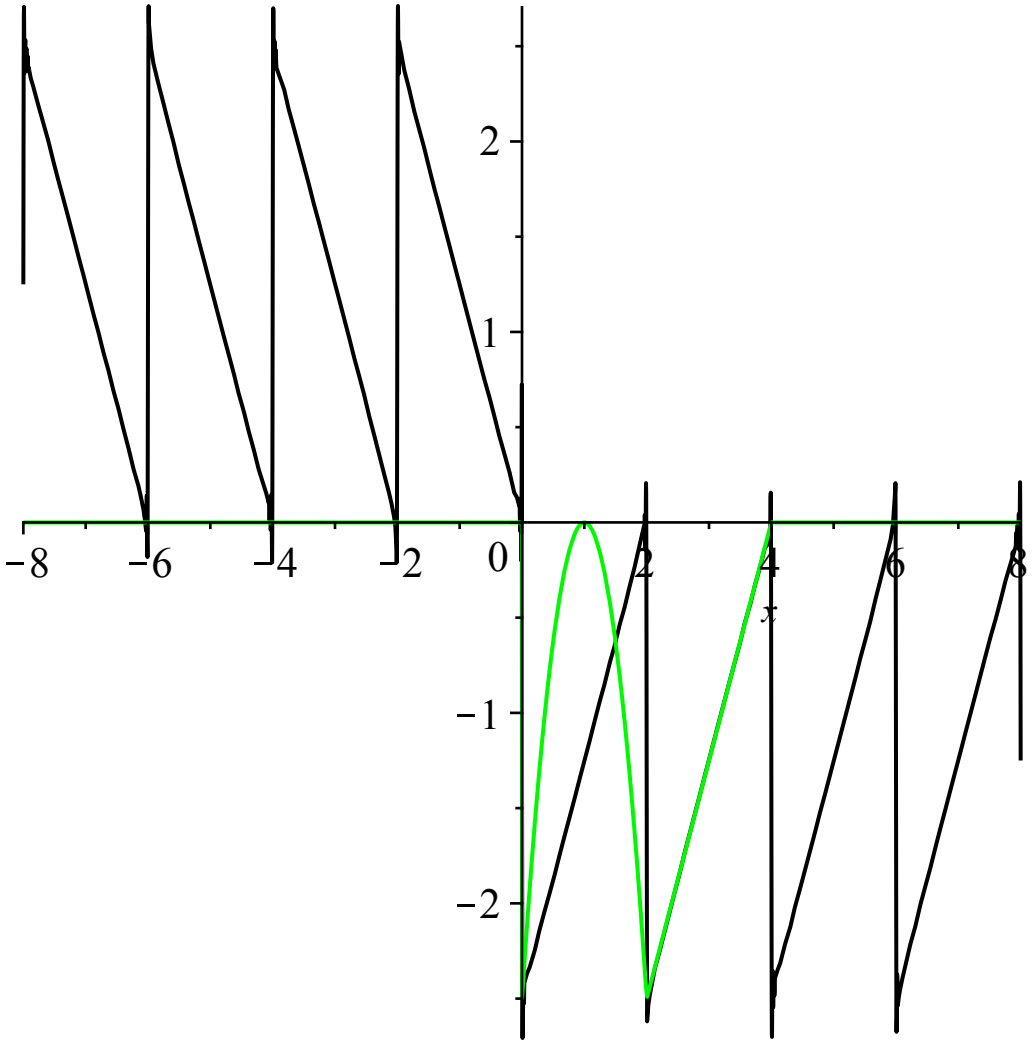

```
> g1 := t→fourierseries(f3, x, 0, 4, t) :
  g2 := t→fourierseries(f3, x, 0, 2, t) :
  g31 := t→fourierseries(f3, x, 2, 4, t) :
  g32 := t→fourierseries(-f3, x, 2, 4, t) :
  g3 := t→piecewise(0 ≤ x, g31(t), x < 0, g32(t)) :
> plot({f3, g1(100)}, x = -8 ..8, color = [black, red])
```




```
> plot({f3, g2(100)}, x=-8..8, color=[black, blue])
```




```
> plot({f3, g3(100)}, x=-8..8, color=[black, green])
```




```
> # Task4
```

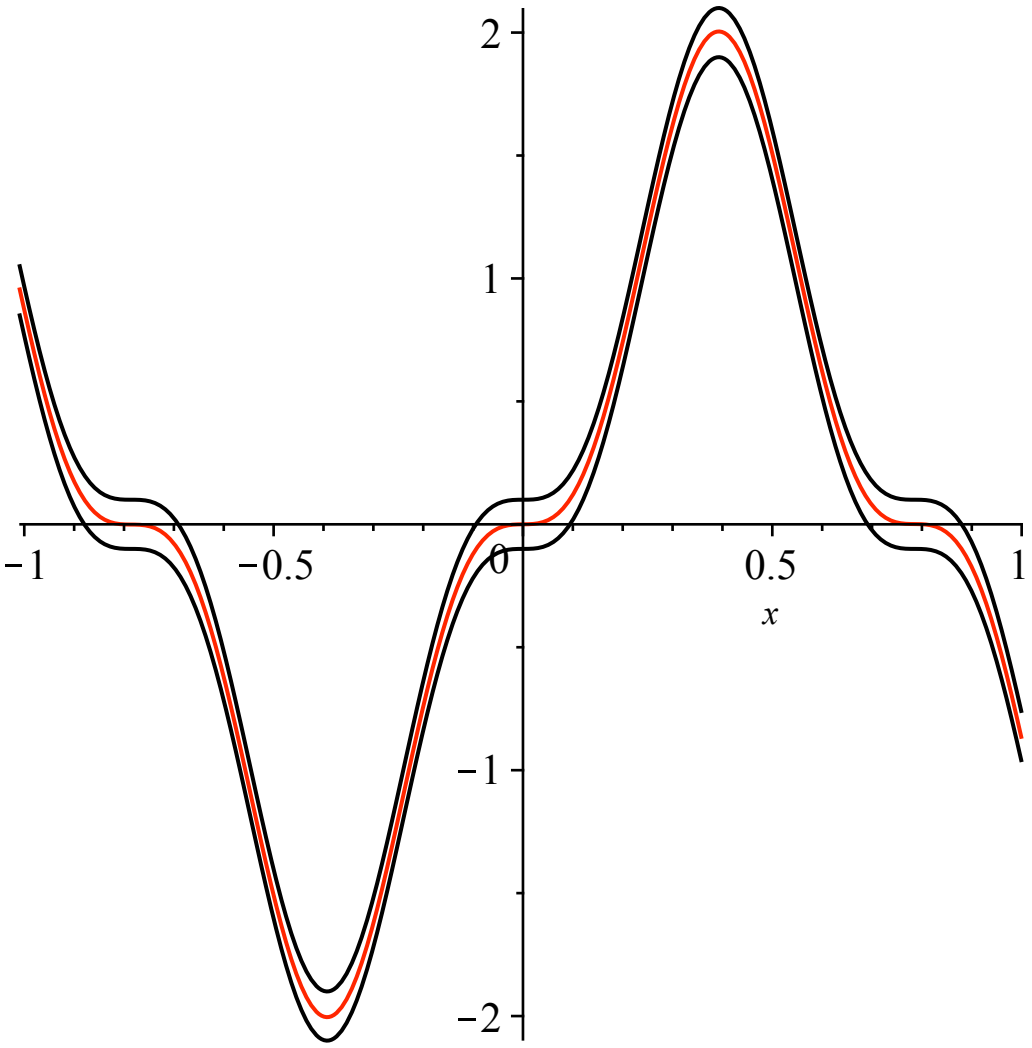
```
> f4_1 := 2·sin^3(4·x)
```

$$f4\_1 := 2\sin(4x)^3 \quad (6)$$

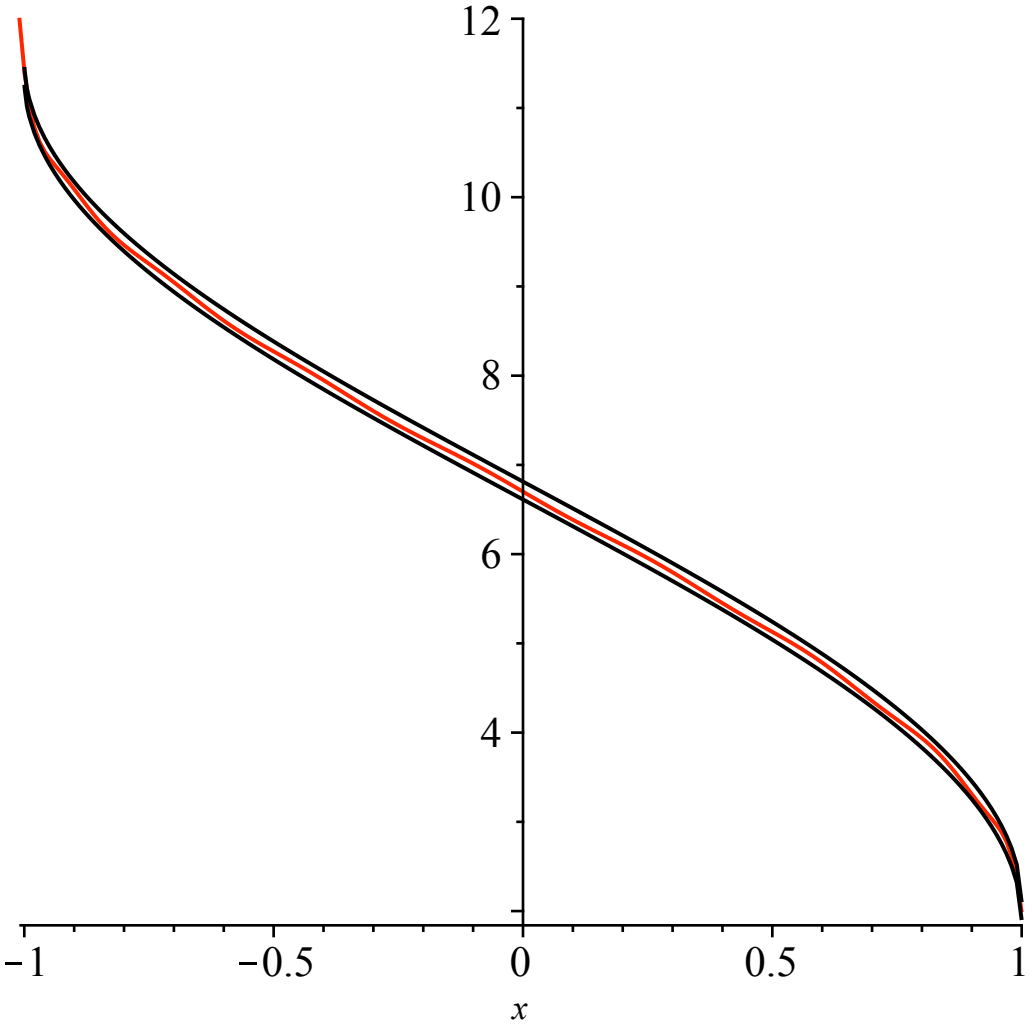
```
> f4_2 := 3·arccos(x) + 2
```

$$f4\_2 := 3\arccos(x) + 2 \quad (7)$$

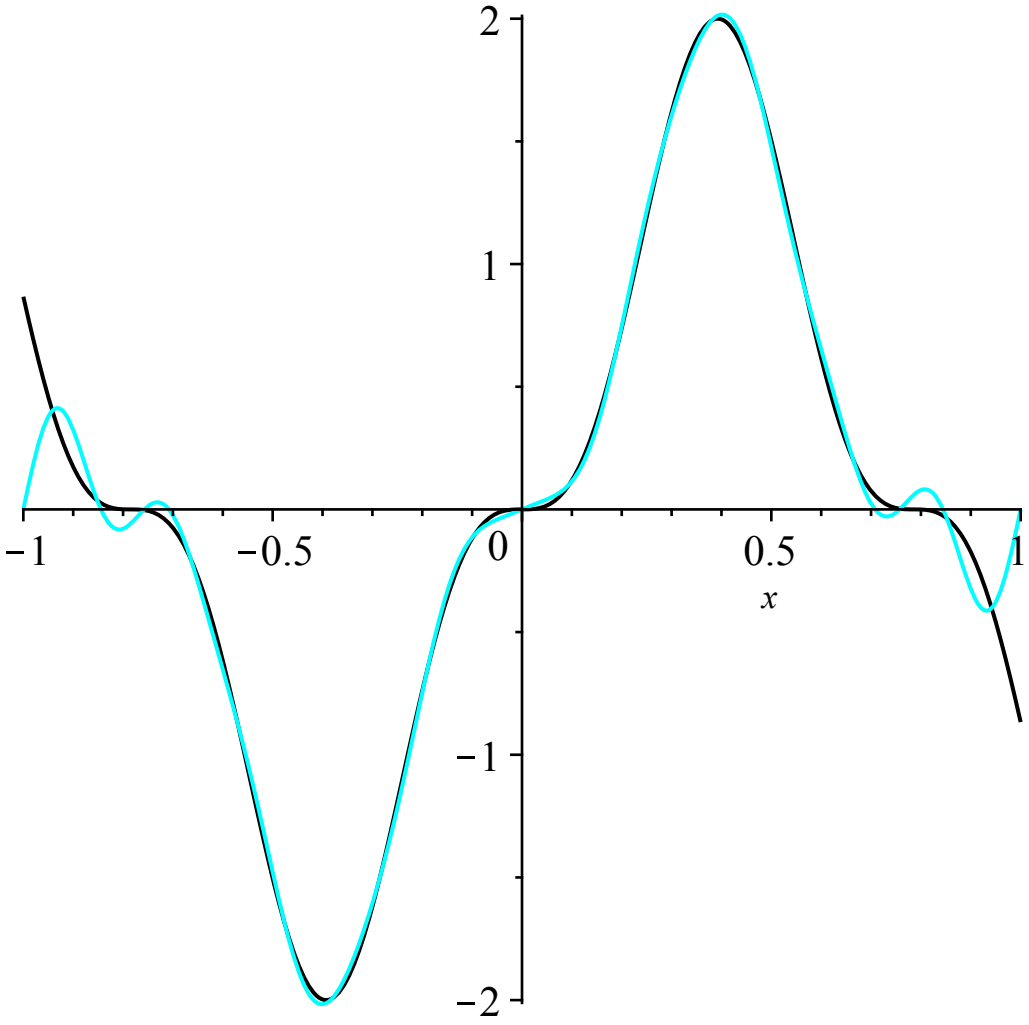
```
> with(orthopoly):
  with(numapprox):
> cheb := proc(f, n)
  local s;
  with(numapprox):
  Digits := n:
  s := chebyshev(f, x = -1..1);
  end proc:
> plot([cheb(f4_1, 3), f4_1 + 0.1, f4_1 − 0.1], x = -1.01..1, color = [red, black, black])
```



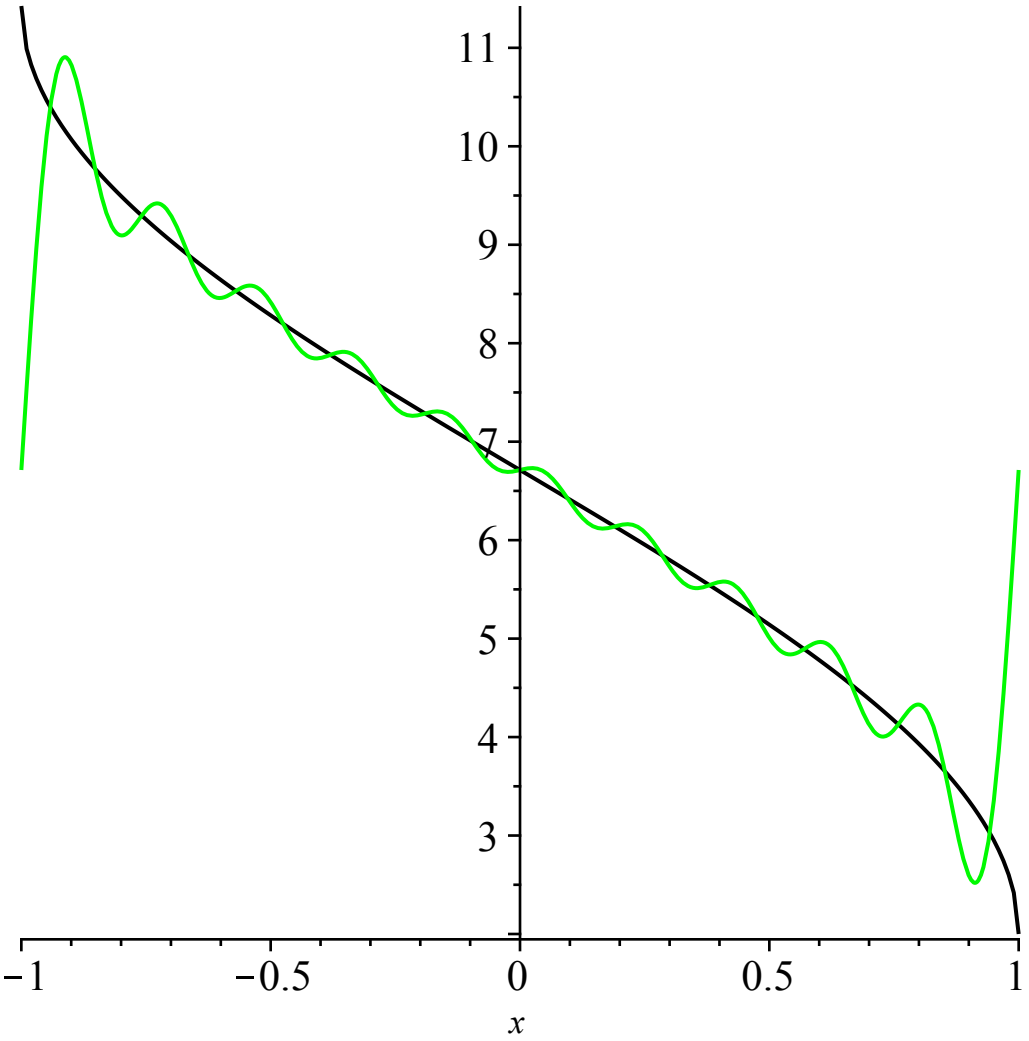

```
> plot([cheb(f4_2, 3), f4_2 + 0.1, f4_2 − 0.1], x = −1.01 ..1, color = [red, black, black])
```




```
> plot([f4_1, fourierseries(f4_1, x, -1, 1, 10)], x = -1..1, color = [black, cyan])
```




```
> plot([f4_2, fourierseries(f4_2, x, -1, 1, 10)], x = -1..1, color = [black, green])
```


11
10
9
8
7
6
5
4
3
−1
−0.5
0
0.5
1
x

>