> restart;

> $de := x = \frac{d^2}{d x^2}(y(x)) \cdot e^{\left(\frac{d^2}{d x^2}(y(x))\right)}$

$$de := x = \left(\frac{d^2}{dx^2}\, y(x)\right) e^{\frac{d^2}{dx^2}\, y(x)} \quad (1)$$

> dsolve(de)

$$y(x) = \frac{x^2}{8\,\mathrm{LambertW}(x)^2} + \frac{3\,x^2}{4\,\mathrm{LambertW}(x)} - \frac{3\,x^2}{4} + \frac{\mathrm{LambertW}(x)\,x^2}{2} + \_C1\,x + \_C2 \quad (2)$$

> **#Subs y'' with z, x=z-cos(z)**

> $x := z \cdot \exp(z);$

$$x := z\,e^z \quad (3)$$

> $dx := diff(x, z)$

$$dx := e^z + z\,e^z \quad (4)$$

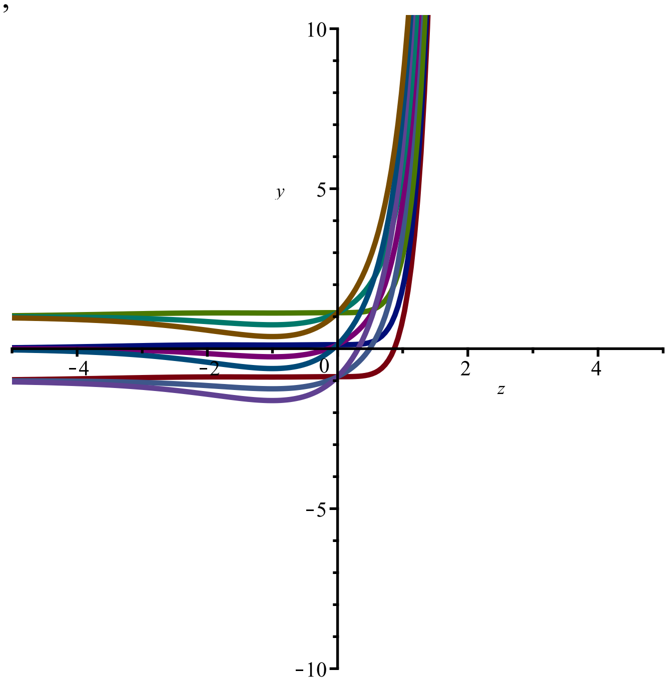
> $y1 := diff(y(z), z) = int(z \cdot dx, z)$

$$y1 := \frac{d}{dz}\, y(z) = e^z\left(z^2 - z + 1\right) \quad (5)$$

> $sol := y = int((rhs(y1) + C1) \cdot dx, z) + C2$

$$sol := y = \frac{\left(e^z\right)^2}{8} + C1\,e^z + \frac{z^3\left(e^z\right)^2}{2} - \frac{3\,z^2\left(e^z\right)^2}{4} + \frac{3\left(e^z\right)^2 z}{4} + C1\left(z\,e^z - e^z\right) + C2 \quad (6)$$

> dpl := plot([seq(seq(rhs(sol), C2 =-1 ..1), C1 =-1 ..1)], z =-5 ..5 , y =-10 ..10, thickness = 2) :
plots[display](dpl);



> #part 2

> restart;

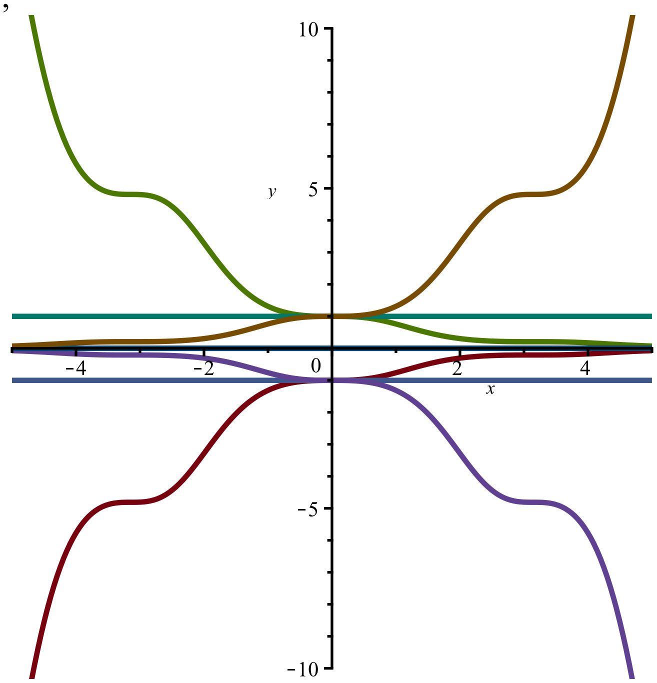
> $de := \sin(x)\cdot\left(y(x)\cdot\frac{d^2}{dx^2}(y(x)) - \left(\frac{d}{dx}(y(x))\right)^2\right) = 2\cdot y(x)\cdot\frac{d}{dx}(y(x))\cdot\cos(x);$

$$de := \sin(x)\left(y(x)\left(\frac{d^2}{dx^2}y(x)\right) - \left(\frac{d}{dx}y(x)\right)^2\right) = 2\,y(x)\left(\frac{d}{dx}y(x)\right)\cos(x) \quad (7)$$

> $slv := dsolve(de);$

$$slv := y(x) = e^{\frac{\_C1\,x}{2}}\, e^{-\frac{\_C1\sin(2x)}{4}}\,\_C2 \quad (8)$$

> $dpl := plot([seq(seq(rhs(slv), \_C2 = -1..1), \_C1 = -1..1)], x = -5..5, y = -10..10, thickness = 2):$
> $plots[display](dpl);$



> #part 3

> restart;

> $de := \frac{d^2}{dx^2}(y(x))\cdot(1+x^2)\cdot\arctan(x) = \frac{d}{dx}(y(x));$

$$de := \left(\frac{d^2}{dx^2}y(x)\right)(x^2+1)\arctan(x) = \frac{d}{dx}y(x) \quad (9)$$

> $de := t(x) = \frac{d}{dx}(t(x))\cdot(1+x^2)\cdot\arctan(x);$

$$de := t(x) = \left(\frac{d}{dx}t(x)\right)(x^2+1)\arctan(x) \quad (10)$$

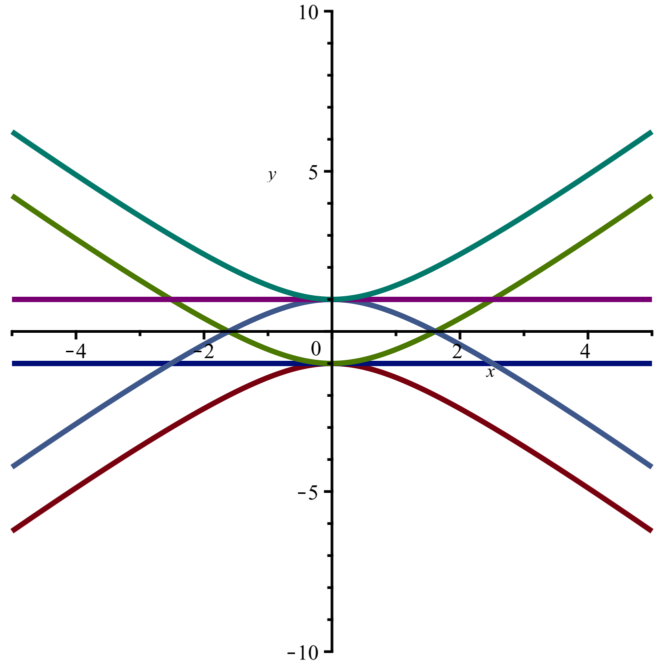
> $dsolve(de);$

$$t(x) = \_C1\arctan(x) \quad (11)$$

> $solution := dsolve(diff(y(x), x) = C\cdot\arctan(x))$

$$solution := y(x) = C\,x\arctan(x) - \frac{C\ln(x^2+1)}{2} + \_C1 \quad (12)$$

> $dpl := plot([seq(seq(rhs(solution), C=-1..1), \_C1=[-1, 1])], x=-5..5, y=-10..10, thickness=2)$



> #part4

> restart;

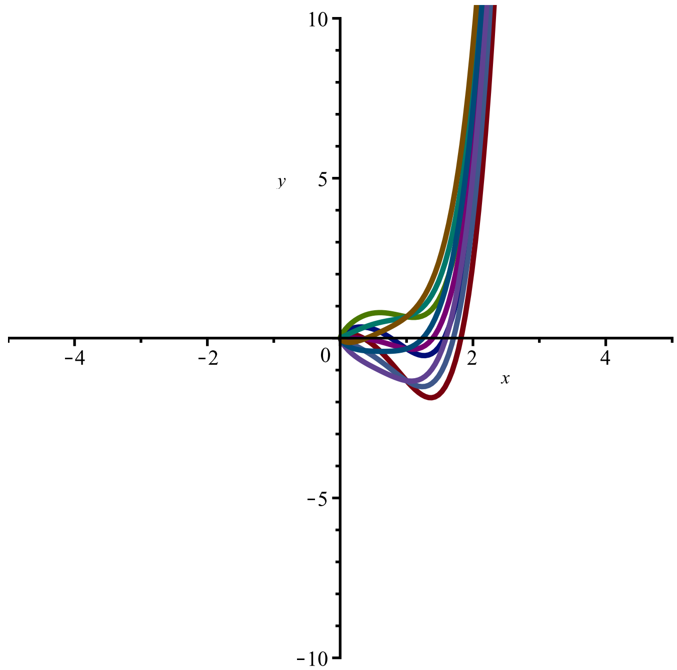
> $de := \frac{d^2}{dx^2}(y(x)) - \frac{\left(\frac{d}{dx}(y(x))\right)}{x} + \frac{y(x)}{x^2} = 9 \cdot x^2 \cdot \ln(x) + 3 \cdot x^2;$

$$de := \frac{d^2}{dx^2} y(x) - \frac{\frac{d}{dx} y(x)}{x} + \frac{y(x)}{x^2} = 9 x^2 \ln(x) + 3 x^2 \tag{13}$$

> $slv := dsolve(de);$

$$slv := y(x) = x \_C1 \ln(x) + x \_C2 + \frac{x^4 (3 \ln(x) - 1)}{3} \tag{14}$$

> $dpl := plot([seq(seq(rhs(slv), \_C2=-1..1), \_C1=-1..1)], x=-5..5, y=-10..10, thickness=2):$
> $plots[display](dpl);$



> #Task 2

> restart;

> $de := \tan(x)\cdot\frac{d^3}{dx^3}(y(x)) = 2\cdot\frac{d^2}{dx^2}(y(x));$

$$de := \tan(x)\left(\frac{d^3}{dx^3}\,y(x)\right) = 2\,\frac{d^2}{dx^2}\,y(x) \tag{15}$$

> dsolve(de);

$$y(x) = -\frac{\_C1\left(-x^2 - \frac{\cos(2\,x)}{2}\right)}{4} + \_C2\,x + \_C3 \tag{16}$$

> #Task 3

> restart;

> $de := \frac{d^2}{dx^2}(y(x)) + 6\cdot\frac{d}{dx}(y(x)) + 13\cdot y(x) = \exp(-3\cdot x)\cdot\cos(4\cdot x);$

$$de := \frac{d^2}{dx^2}\,y(x) + 6\,\frac{d}{dx}\,y(x) + 13\,y(x) = e^{-3\,x}\cos(4\,x) \tag{17}$$

> dsolve(de);

$$y(x) = e^{-3\,x}\sin(2\,x)\,\_C2 + e^{-3\,x}\cos(2\,x)\,\_C1 - \frac{e^{-3\,x}\cos(4\,x)}{12} \tag{18}$$

>