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> #Lab 3.2 Completed by Bahdanau Aliaksandr 153502
> #Variant 5
> #Task 1. Solve the equations and compare with the results obtained in maple. Plot several integral curves in the same coordinate system.
> #1.1
> restart;
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$> de := x = \frac{d^2}{dx^2}(y(x)) - \cos(x)\cdot\frac{d^2}{dx^2}(y(x))$

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

$> dsolve(de)$

$$y(x) = \int \left( -\frac{x}{\tan\left(\frac{1}{2}\, x\right)} + 2\ln\left(\tan\left(\frac{1}{2}\, x\right)\right) - \ln\left(1 + \tan\left(\frac{1}{2}\, x\right)^2\right)\right) dx + \_C1\, x + \_C2 \quad \textbf{(2)}$$

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> #Subs y'' with z, x=z-cos(z)
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$> x\_ := z - \cos(z)$

$$x\_ := z - \cos(z) \quad \textbf{(3)}$$

$> dx := diff(z - \cos(z), z)$

$$dx := 1 + \sin(z) \quad \textbf{(4)}$$

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> #dy1 = zdx
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$> y1 := int(z\cdot dx, z)$

$$y1 := \frac{1}{2}\, z^2 + \sin(z) - z\cos(z) \quad \textbf{(5)}$$

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> #dy=y1dx
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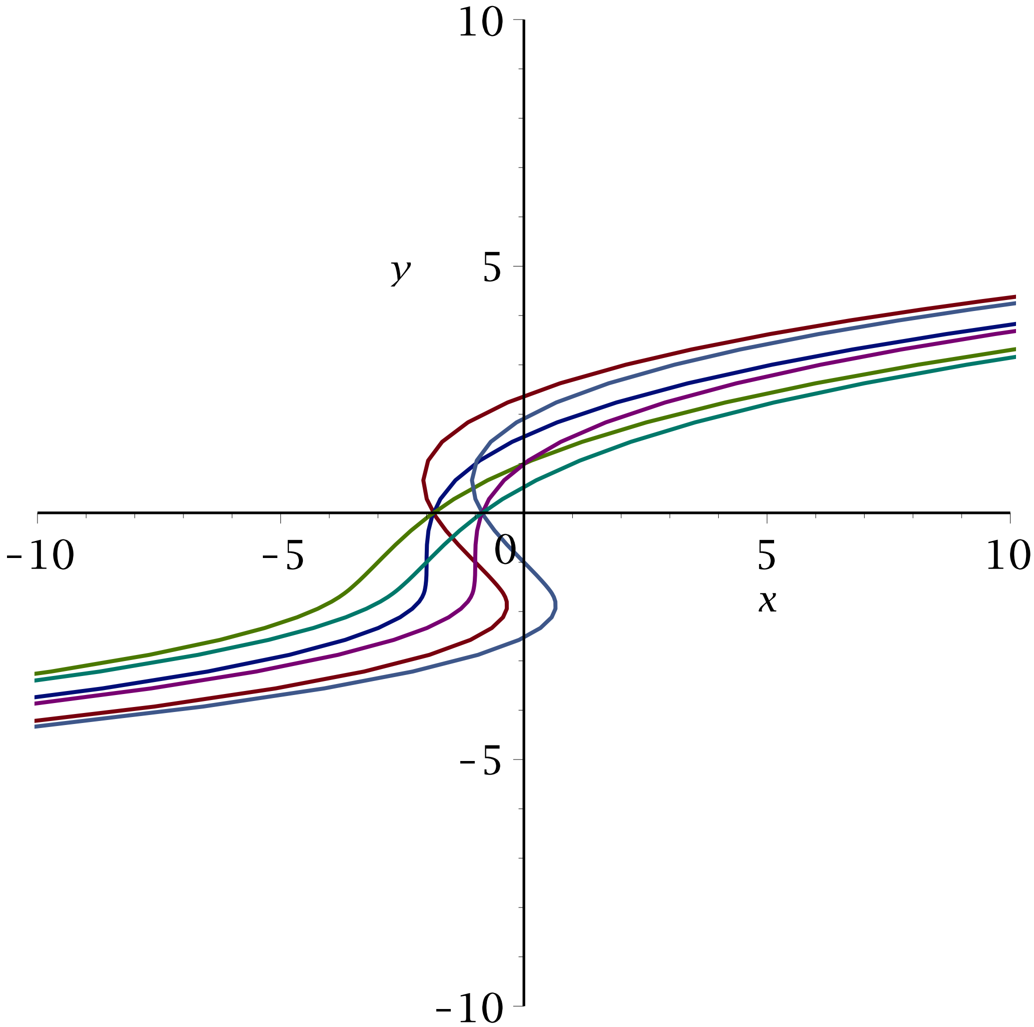
$> y\_ := int((y1 + C1)\cdot dx, z) + C2$

$$y\_ := \frac{1}{2}\, z\cos(z)^2 - \frac{3}{4}\cos(z)\sin(z) + \frac{1}{4}\, z - \frac{1}{2}\cos(z)\, z^2 - \cos(z)\, C1 + \frac{1}{6}\, z^3 + C1\, z - \cos(z) + C2 \quad \textbf{(6)}$$

$> a, b, c := seq(subs(C2 = i, y\_), i = -1..1):$

$> a1, a2, a3 := seq(subs(C1 = i, a), i = -1..1):$
$b1, b2, b3 := seq(subs(C1 = i, b), i = -1..1):$
$c1, c2, c3 := seq(subs(C1 = i, c), i = -1..1):$
$len := z = -20..20:$

> plot([[a1, x_, len], [a2, x_, len], [a3, x_, len], [b1, x_, len], [b2, x_, len], [b3, x_, len]], x = -10..10, y = -10..10)




> #Task 1.2

> *restart*;

> $de := diff(diff(y(x), x), x) \cdot y(x) - diff(y(x), x)^2 = y(x) \cdot diff(y(x), x) \cdot \tanh(x)$

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

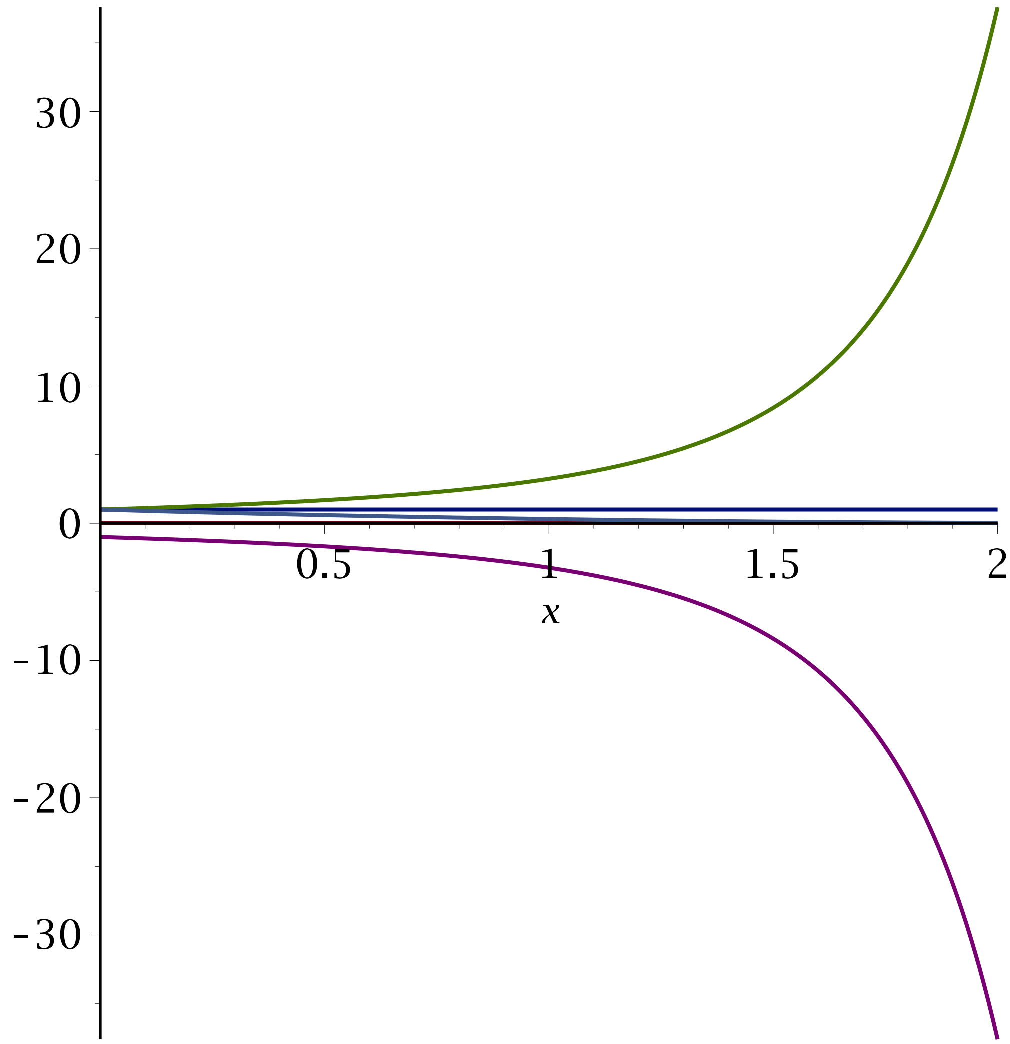
> $y\_ := dsolve(de)$

$$y\_ := y(x) = e^{\frac{1}{2}\, e^{x}\, \_C1}\, \_C2\, e^{-\frac{1}{2}\, \frac{\_C1}{e^{x}}} \tag{8}$$

> $a, b, c := seq(subs(\_C2 = i, y\_), i = -1..1):$

> $a1, a2, a3 := seq(subs(\_C1 = i, a), i = -1..1):$
> $b1, b2, b3 := seq(subs(\_C1 = i, b), i = -1..1):$
> $c1, c2, c3 := seq(subs(\_C1 = i, c), i = -1..1):$

> $plot([rhs(b2), rhs(c2), rhs(c3), rhs(c1), rhs(a3)], x = 0..2)$




> #Task 1.3

> *restart*;

> $solutions := dsolve\left(diff(y(x), x) = x \cdot diff(diff(y(x), x), x) - \frac{1}{10} \cdot diff(diff(y(x), x), x)^{10}\right)$

$$solutions := y(x) = \frac{81}{190} x^{19/9} + \_C1, y(x) = \frac{81}{380} \mathrm{I}\, x^{19/9} \left(-\sqrt{3} + \mathrm{I}\right) + \_C1, y(x) = \frac{81}{380} \mathrm{I}\, x^{19/9} \left(\sqrt{3} + \mathrm{I}\right) + \_C1, y(x) = -\frac{81}{190} x^{19/9} \left(-\mathrm{I} \cos\left(\frac{7}{18}\pi\right) + \cos\left(\frac{1}{9}\pi\right)\right) + \_C1, y(x) = -\frac{81}{190} x^{19/9} \left(\mathrm{I} \cos\left(\frac{7}{18}\pi\right) + \cos\left(\frac{1}{9}\pi\right)\right) + \_C1, y(x) = \frac{81}{190} x^{19/9} \left(\cos\left(\frac{2}{9}\pi\right) - \mathrm{I} \cos\left(\frac{5}{18}\pi\right)\right) + \_C1, y(x) = \frac{81}{190} x^{19/9} \left(\cos\left(\frac{2}{9}\pi\right) + \mathrm{I} \cos\left(\frac{5}{18}\pi\right)\right) + \_C1, y(x) = \frac{81}{190} x^{19/9} \left(\cos\left(\frac{4}{9}\pi\right)\right. \tag{9}$$

$- \mathrm{I}\cos\left(\frac{1}{18}\pi\right)\Big) + \_C1,\ y(x) = \frac{81}{190}x^{19/9}\left(\cos\left(\frac{4}{9}\pi\right) + \mathrm{I}\cos\left(\frac{1}{18}\pi\right)\right) + \_C1,$

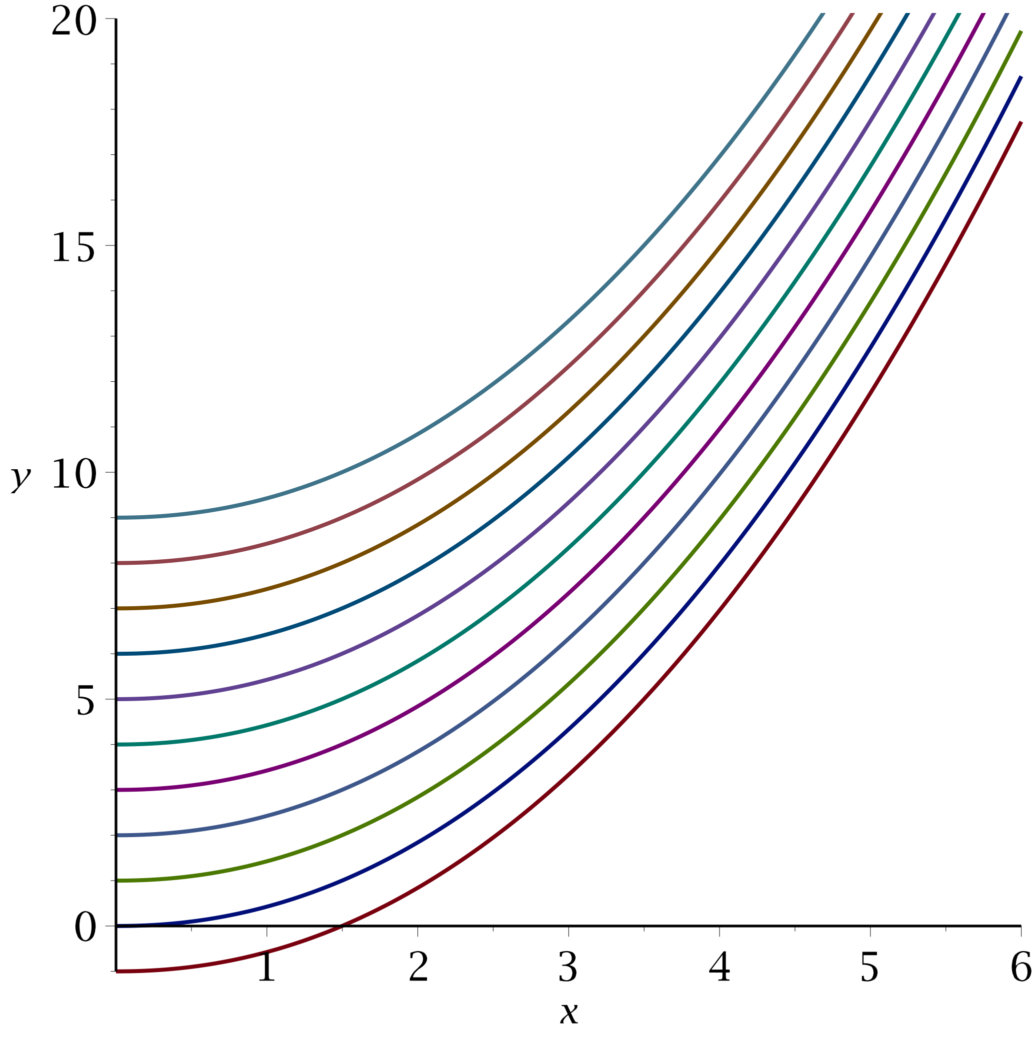
$y(x) = \frac{1}{2}\,RootOf(\_Z^{10} + 10\,\_C1)\,x^2 + \_C1\,x + \_C2$

> # All solitions, exept of first are not real

> $y\_ := rhs(solutions[1])$

$$y\_ := \frac{81}{190}x^{19/9} + \_C1 \tag{10}$$

> $plot([seq(subs(\_C1 = i, y\_), i = -1..9)], x = 0..6, y = -1..20)$




> #Task 1.4

> $restart;$

> $de := diff(diff(y(x), x), x) = 2\cdot\left(\frac{diff(y(x), x)}{x} - \frac{y(x)}{x^2}\right) + \frac{1}{x^2}\cdot\cos\left(\frac{1}{x}\right)$

$$de := \frac{d^2}{dx^2}y(x) = \frac{2\left(\frac{d}{dx}y(x)\right)}{x} - \frac{2\,y(x)}{x^2} + \frac{\cos\left(\frac{1}{x}\right)}{x^2} \tag{11}$$

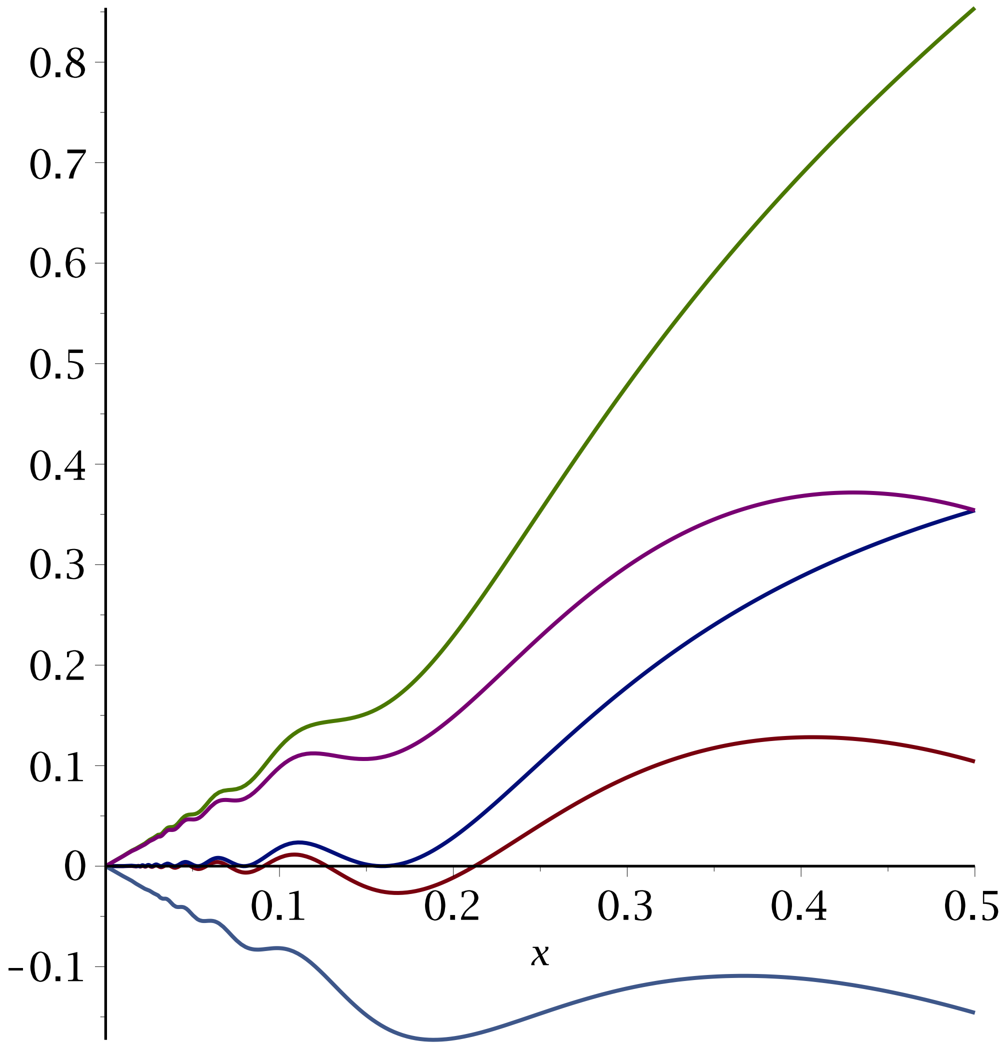
> $y\_ := dsolve(de)$

$$y\_ := y(x) = -x^2\cos\left(\frac{1}{x}\right) + x^2\,\_C2 + x\,\_C1 \tag{12}$$

> $a, b, c := seq(subs(\_C2 = i, y\_), i = -1..1):$

> $a1, a2, a3 := seq(subs(\_C1 = i, a), i = -1..1):$
$b1, b2, b3 := seq(subs(\_C1 = i, b), i = -1..1):$
$c1, c2, c3 := seq(subs(\_C1 = i, c), i = -1..1):$

> $plot([rhs(b2), rhs(c2), rhs(c3), rhs(c1), rhs(a3)], x = 0..0.5)$




> **#Task 2. Find the general solution of the equation and compare with the result obtained in the Maple system.**

> $restart;$

> $de := \tan(x)\cdot diff(diff(y(x), x), x) - diff(y(x), x) + \frac{1}{\sin(x)} = 0$

$$de := \tan(x)\left(\frac{d^2}{dx^2}\,y(x)\right) - \left(\frac{d}{dx}\,y(x)\right) + \frac{1}{\sin(x)} = 0 \tag{13}$$

> $dsolve(de)$

$$y(x) = -\_C1\cos(x) + \frac{1}{2}\ln(\csc(x) - \cot(x)) + \_C2 \tag{14}$$

> #Task 3. Find the general solution of the differential equation.

> $restart;$

> $de := diff(diff(y(x), x), x) + 2 \cdot diff(y(x), x) + 5 \cdot y(x) = -\sin(2 \cdot x)$

$$de := \frac{d^2}{dx^2}\, y(x) + 2 \left( \frac{d}{dx}\, y(x) \right) + 5\, y(x) = -\sin(2\, x) \quad \textbf{(15)}$$

> $dsolve(de)$

$$y(x) = e^{-x} \sin(2\, x)\, \_C2 + e^{-x} \cos(2\, x)\, \_C1 - \frac{1}{17} \sin(2\, x) + \frac{4}{17} \cos(2\, x) \quad \textbf{(16)}$$