> *#Лабораторная работа 3, часть 2*

> *#Вариант 1*

> *#Задание 1.1*
> *#Решите уравнения и сравните с результатами, полученными в Maple. Постройте в одной системе координат несколько интегральных кривых.*
> *restart*

> $diffE := x = diff(diff(y(x), x), x) + \exp(-diff(diff(y(x), x), x))$

$$diffE := x = \frac{d^2}{dx^2}\, y(x) + e^{-\frac{d^2}{dx^2}\, y(x)} \qquad (1)$$

> $diffsolution := dsolve(diffE)$

$$diffsolution := y(x) = \frac{x^3}{6} + \frac{\mathrm{LambertW}(-e^{-x})^3}{6} + \frac{3\,\mathrm{LambertW}(-e^{-x})^2}{4} + \mathrm{LambertW}(-e^{-x}) + \_C1\, x + \_C2 \qquad (2)$$

> *#решим параметрически. Введем замену y''=t*

> $parX := t + \exp(-t)$

$$parX := t + e^{-t} \qquad (3)$$

> $dx := diff(t + \exp(-t), t)$

$$dx := 1 - e^{-t} \qquad (4)$$

> **#y' = tdx**

> $y1 := int(t \cdot dx, t)$

$$y1 := \frac{t^2}{2} + t\, e^{-t} + e^{-t} \qquad (5)$$

> **#y = y1dx**

> $parY := int((y1 + C1) \cdot dx, t) + C2$

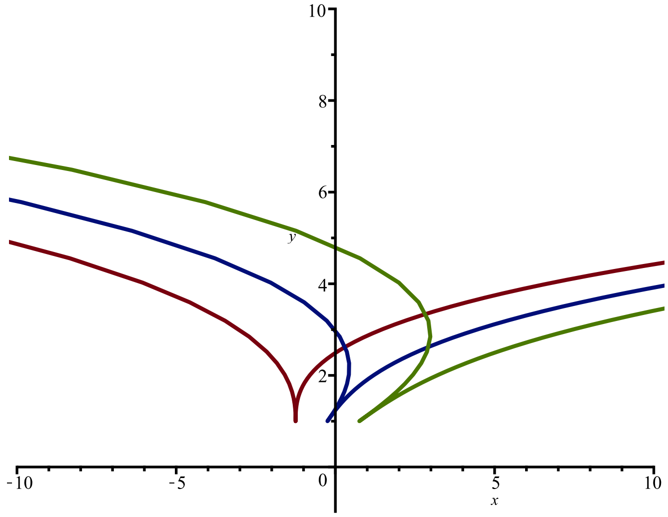
$$parY := \frac{t^3}{6} + C1\, t + \frac{3\,(e^{-t})^2}{4} + e^{-t}\, C1 + \frac{t\,(e^{-t})^2}{2} + \frac{e^{-t}\, t^2}{2} - e^{-t} + C2 \qquad (6)$$

> $diferentC2 := subs(C2 = 0, parY)$:

> $differentC12\_1, differentC12\_2, differentC12\_3 := seq(subs(C1 = k, diferentC2), k = -1..1)$:

> $lengthOf := t = -10..10$:

> plot([[differentC12_1, *parX*, *lengthOf*], [differentC12_2, *parX*, *lengthOf*], [differentC12_3, *parX*, *lengthOf*]], $x = -10..10, y = -1..10$)



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\> *#Задание 1.2*
restart

\> $diffur := y(x) \cdot diff(diff(y(x), x), x) - (diff(y(x), x))^2 - y(x) \cdot diff(y(x), x) \cdot \cot(x) = 0$

$$diffur := y(x) \left(\frac{d^2}{dx^2} y(x)\right) - \left(\frac{d}{dx} y(x)\right)^2 - y(x) \left(\frac{d}{dx} y(x)\right) \cot(x) = 0 \quad \textbf{(7)}$$

\>

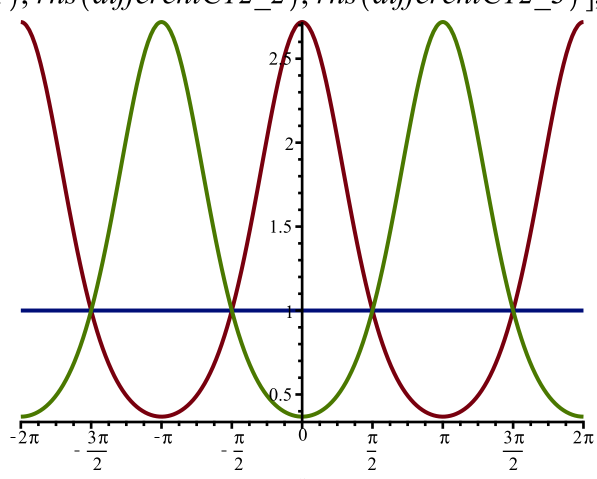
\> $diffSolution := dsolve(diffur)$

$$diffSolution := y(x) = \frac{\_C2}{e^{-\_C1 \cos(x)}} \quad \textbf{(8)}$$

\> $diferentC2 := subs(\_C2 = 1, diffSolution) :$

\> $differentC12\_1, differentC12\_2, differentC12\_3 := seq(subs(\_C1 = k, diferentC2), k = -1 ..1) :$

\> $\mathrm{plot}([rhs(differentC12\_1), rhs(differentC12\_2), rhs(differentC12\_3)], discont = true)$



\> *#Задание 1.3*
restart

\> $diffur := diff(diff(y(x), x), x) \cdot (1 + y(x)^2) + (diff(y(x), x))^3 = 0$

$$diffur := \left(\frac{d^2}{dx^2} y(x)\right) \left(1 + y(x)^2\right) + \left(\frac{d}{dx} y(x)\right)^3 = 0 \quad \textbf{(9)}$$

>

> $diffSolution := dsolve(diffur)$

$$diffSolution := y(x) = \_C1, y(x) = \tan\left(RootOf\left(2\sin(\_Z)\ \_C1 + 2\sin(\_Z)\ \_Z - \ln\left(\frac{1}{\cos(\_Z)^2}\right)\cos(\_Z) - 2\ \_C2\cos(\_Z) - 2\,x\cos(\_Z)\right)\right) \quad \textbf{(10)}$$

> $diferentC2 := subs(\_C2 = 1, diffSolution)$:

> $differentC12\_1, differentC12\_2, differentC12\_3 := seq(subs(\_C1 = k, diferentC2), k = -1 ..1)$:

> plot([$rhs(differentC12\_1), rhs(differentC12\_2), rhs(differentC12\_3)$], $x = -10 ..10, y = -10 ..10,$ $discont = true$)

>

> #Задание 1.4
restart

> $diffur := diff(diff(y(x), x), x) = 3\cdot\left(\frac{diff(y(x), x)}{x} - \frac{y(x)}{x^2}\right) + \frac{2}{x^3}\cdot\sin\left(\frac{1}{x^2}\right)$

$$diffur := \frac{d^2}{dx^2}\,y(x) = \frac{3\left(\frac{d}{dx}\,y(x)\right)}{x} - \frac{3\,y(x)}{x^2} + \frac{2\sin\left(\frac{1}{x^2}\right)}{x^3} \quad \textbf{(11)}$$

>

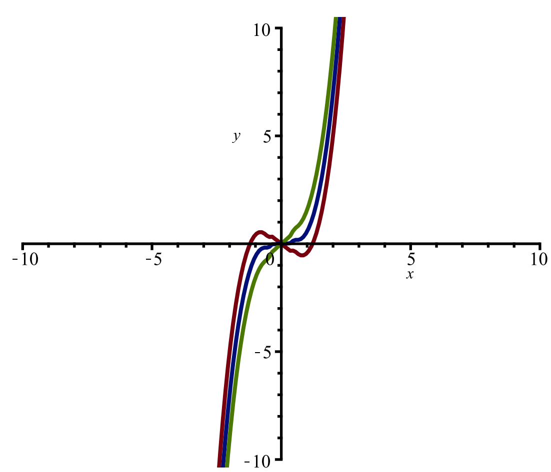
> $diffSolution := dsolve(diffur)$

$$diffSolution := y(x) = x^3\ \_C2 + x\ \_C1 - \frac{x^3\sin\left(\frac{1}{x^2}\right)}{2} \quad \textbf{(12)}$$

> $diferentC2 := subs(\_C2 = 1, diffSolution)$:

> $differentC12\_1, differentC12\_2, differentC12\_3 := seq(subs(\_C1 = k, diferentC2), k = -1 ..1)$:

> plot([$rhs(differentC12\_1), rhs(differentC12\_2), rhs(differentC12\_3)$], $x = -10 ..10, y = -10 ..10,$ $discont = true$)



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> #Задание 2
restart

> #Найдите общее решение уравнения и сравните с результатом, полученным в системе Maple.

> $diffur := diff(diff(diff(y(x), x), x), x)\cdot x\cdot \ln(x) = diff(diff(y(x), x), x)$

$$diffur := \left(\frac{d^3}{dx^3}\, y(x)\right) x \ln(x) = \frac{d^2}{dx^2}\, y(x) \tag{13}$$

>

> $diffSolution := dsolve(diffur)$

$$diffSolution := y(x) = \frac{\_C1 \ln(x)\, x^2}{2} - \frac{3\, \_C1\, x^2}{4} + \_C2\, x + \_C3 \tag{14}$$

> #Задание 3
#Найдите общее решение дифференциального уравнения.

> restart

> $diffur := diff(diff(y(x), x), x) + 2\cdot diff(y(x), x) = 4\cdot \exp(x)(\sin(x) + \cos(x))$

$$diffur := \frac{d^2}{dx^2}\, y(x) + 2\, \frac{d}{dx}\, y(x) = 4\, \left(e^{x}\right)(\sin(x) + \cos(x)) \tag{15}$$

> $diffSolution := dsolve(diffur)$

$$diffSolution := y(x) = \int \left(4 \left(\int \left(e^{x}\right)(\sin(x) + \cos(x))\, e^{2x}\, dx\right) + \_C1\right) e^{-2x}\, dx + \_C2 \tag{16}$$

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