Chapter 9: 2nd Order Linear Homogeneous ODEs with Constant Coefficients

Discussing a procedure for solving these 2nd order equations using a "characteristic equation" built specifically for the problem at hand. Wolfram Alpha does not need to refer to these characteristic equations and therefore that aspect of the solving process is completely lost in this version of the solutions.

Cutting and pasting and Wolfram Alpha. Wolfram Alpha is amenable to accepting pasted entries. In this chapter pastable expressions are given a distinctive boundary fence, exemplified by the sample: !| abcdef |!

In the above pseudo-entry, only the alpha characters would be copied for transfer to Wolfram Alpha.

9.1 Solve $y'' - y' - 2y = 0$

The entry is made into Wolfram Alpha:

!| y" - y' -2 * y = 0 |!

and the answer is received:

$$y = c_1 e^{-x} + c_2 e^{2x}$$

In this case the solution was arrived at without generating, factoring, or finding roots of the characteristic equation. Which probably defeats the purpose of the question.

9.2 Solve $y'' - 7y' = 0$

The entry is made into Wolfram Alpha:

!| y" - 7 * y' = 0 |!

and the answer is received:

$$y = c_1 e^{7x} + c_2$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.3 Solve $y'' - 5y = 0$

The entry is made into Wolfram Alpha:

!| y" - 5 * y = 0 |!

and the answer is received:

$$y(x) = c_1 e^{\sqrt{5}x} + c_2 e^{-\sqrt{5}x}$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.5 Solve $\ddot{y} + 10\dot{y} + 21y = 0$

The entry is made into Wolfram Alpha, meanwhile giving it a clue as to the independent variable:

!| y" + 10 * dy/dt + 21 * y = 0 |!

and the answer is received:

$$y(t) = c_1 e^{-7t} + c_2 e^{-3t}$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.6 Solve $\ddot{x} - 0.01x = 0$

The entry is made into Wolfram Alpha, meanwhile giving it a clue as to the independent variable:

!| d^2 x/dt^2 - 0.01 * x = 0 |!

and the answer is received:

$$x(t) = c_1 e^{0.1t} + c_2 e^{-0.1t}$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.7 Solve $y'' + 4y' + 5y = 0$

The entry is made into Wolfram Alpha.

!| y" + 4 * y' + 5 * y = 0 |!

and the answer is received:

$$y(x) = c_1 e^{-2x} \sin x + c_2 e^{-2x} \cos x$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.8 Solve $y'' + 4y = 0$

The entry is made into Wolfram Alpha.

!| y" + 4 * y = 0 |!

and the answer is received:

$$y(x) = c_2 \sin 2x + c_1 \cos 2x$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.9 Solve $y'' + 4y = 0$

The entry is made into Wolfram Alpha.

!| y" - 3 * y ' + 4 * y = 0 |!

and the answer is received:

$$y(x) = c_1 e^{3x/2} \sin\left(\frac{\sqrt{7}x}{2}\right) + c_2 e^{3x/2} \cos\left(\frac{\sqrt{7}x}{2}\right)$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.10 Solve $\ddot{y} - 6\dot{y} + 25y = 0$

The entry is made into Wolfram Alpha, including the clue about independent variable.

!| y" - 6 * dy/dt + 25 * y = 0 |!

and the answer is received:

$$y(t) = c_1 e^{3t} \sin(4t) + c_2 e^{3t} \cos(4t)$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.11 Solve $\frac{d^2 I}{dt^2} + 20 \frac{dI}{dt} + 200I = 0,$

The entry is made into Wolfram Alpha, (including the necessary temporary substitution for the troublesome character 'I').

!| d^2C/dt^2 + 20 * dC/dt + 200 * C = 0 |!

and the answer is received:

$$I(t) = c_1 e^{-10t} \sin(10t) + c_2 e^{-10t} \cos(10t)$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.12 Solve $y'' - 8y' + 16y = 0t$

The entry is made into Wolfram Alpha:

!| y" - 8 * y' + 16 * y = 0 |!

and the answer is received:

$$y(x) = c_1 e^{4x} + c_2 e^{4x} x$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.13 Solve $y'' = 0$

The entry is made into Wolfram Alpha:

!| y'' = 0 |!

and the answer is received:

$$y(x) = c_1 + c_2 x$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.14 Solve $\ddot{x} + 4\dot{x} + 4x = 0$

The entry is made into Wolfram Alpha, (including the hint about the identity of the independent variable):

!| x'' + 4 * dx/dt + 4 * x = 0 |!

and the answer is received:

$$x(t) = c_1 e^{-2t} + c_2 e^{-2t} t$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

9.15 Solve $100 \frac{d^2 N}{dt^2} - 20 \frac{dN}{dt} + N = 0$

The entry is made into Wolfram Alpha:

!| 100 * d^2N/dt^2 - 20 * dN/dt + N = 0 |!

and the answer is received:

$$N(t) = c_1 e^{t/10} + c_2 e^{t/10} t$$

Yet again the solution was arrived at without generating, factoring, or finding roots of the characteristic equation.

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