

> restart

$$y = C_1 e^x + C_2 x^2 e^x + C_3 e \cos(x) \quad \wedge$$

> SolGral := y(x) = C<sub>1</sub>·exp(x) + C<sub>2</sub>·x·2·exp(x) + C<sub>3</sub>·exp(x)·cos(x)

$$\text{SolGral} := y(x) = C_1 e^x + C_2 x^2 e^x + C_3 e^x \cos(x) \quad (1)$$

> Sistema := diff(SolGral, x), diff(SolGral, x\$2), diff(SolGral, x\$3) : Sistema<sub>1</sub>; Sistema<sub>2</sub>; Sistema<sub>3</sub>

$$\frac{d}{dx} y(x) = C_1 e^x + 2 C_2 x e^x + C_2 x^2 e^x + C_3 e^x \cos(x) - C_3 e^x \sin(x)$$

$$\frac{d^2}{dx^2} y(x) = C_1 e^x + 2 C_2 e^x + 4 C_2 x e^x + C_2 x^2 e^x - 2 C_3 e^x \sin(x)$$

$$\frac{d^3}{dx^3} y(x) = C_1 e^x + 6 C_2 e^x + 6 C_2 x e^x + C_2 x^2 e^x - 2 C_3 e^x \sin(x) - 2 C_3 e^x \cos(x) \quad (2)$$

> Parametro := simplify(solve({Sistema}, {C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>})) : Parametro<sub>1</sub>

$$C_1 = \frac{1}{2} \frac{1}{2 \sin(x) + \sin(x) x - x \cos(x)} \left( \left( 6 \left( \frac{d^2}{dx^2} y(x) \right) \cos(x) + 2 \sin(x) \left( \frac{d^3}{dx^3} y(x) \right) \right. \right. \\ \left. \left. - 6 \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) - 2 \cos(x) \left( \frac{d^3}{dx^3} y(x) \right) - 4 \left( \frac{d}{dx} y(x) \right) \cos(x) \right. \right. \\ \left. \left. + 10 x \left( \frac{d^2}{dx^2} y(x) \right) \cos(x) - 2 x \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) - 4 x \cos(x) \left( \frac{d^3}{dx^3} y(x) \right) \right. \right. \\ \left. \left. - 8 x \left( \frac{d}{dx} y(x) \right) \cos(x) + 3 x^2 \left( \frac{d^2}{dx^2} y(x) \right) \cos(x) - x^2 \sin(x) \left( \frac{d^3}{dx^3} y(x) \right) \right. \right. \\ \left. \left. + x^2 \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) - x^2 \cos(x) \left( \frac{d^3}{dx^3} y(x) \right) - 2 x^2 \left( \frac{d}{dx} y(x) \right) \cos(x) \right. \right. \\ \left. \left. + 8 \sin(x) \left( \frac{d}{dx} y(x) \right) + 4 \sin(x) x \left( \frac{d}{dx} y(x) \right) \right) e^{-x} \right) \quad (3)$$

> Ecuacion := simplify(subs(C<sub>1</sub>=rhs(Parametro<sub>1</sub>), C<sub>2</sub>=rhs(Parametro<sub>2</sub>), C<sub>3</sub>=rhs(Parametro<sub>3</sub>), SolGral))

$$\text{Ecuacion} := y(x) = - \frac{1}{2 \sin(x) + \sin(x) x - x \cos(x)} \left( -\sin(x) \left( \frac{d^3}{dx^3} y(x) \right) \right. \\ \left. + 3 \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) - 3 x \left( \frac{d^2}{dx^2} y(x) \right) \cos(x) + x \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) \right) \quad (4)$$

$$+ x \cos(x) \left( \frac{d^3}{dx^3} y(x) \right) + 3 x \left( \frac{d}{dx} y(x) \right) \cos(x) - 2 \sin(x) x \left( \frac{d}{dx} y(x) \right) - 4 \sin(x) \left( \frac{d}{dx} y(x) \right)$$

> *EcuacionFinal* := simplify(lhs(*Ecuacion*) \* (2 sin(x) + sin(x) x - x cos(x)) - rhs(*Ecuacion*) \* (2 sin(x) + sin(x) x - x cos(x))) = 0

$$\textit{EcuacionFinal} := 2 y(x) \sin(x) + y(x) \sin(x) x - y(x) x \cos(x) - \sin(x) \left( \frac{d^3}{dx^3} y(x) \right) \quad (5)$$

$$+ 3 \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) - 3 x \left( \frac{d^2}{dx^2} y(x) \right) \cos(x) + x \sin(x) \left( \frac{d^2}{dx^2} y(x) \right) + x \cos(x) \left( \frac{d^3}{dx^3} y(x) \right) + 3 x \left( \frac{d}{dx} y(x) \right) \cos(x) - 2 \sin(x) x \left( \frac{d}{dx} y(x) \right) - 4 \sin(x) \left( \frac{d}{dx} y(x) \right) = 0$$

**E.D.O.(3)L.c.v.H.**

> *Solucion* := dsolve(*EcuacionFinal*)

$$\textit{Solucion} := y(x) = e^x (-\_C2 \cos(x) - 2 \_C3 x^2 + \_C1) \quad (6)$$

> restart

$$\frac{d^2 y}{dx^2} - 3 \frac{dy}{dx} + 2y = 8e^{3x} + 36e^{4x}$$

> *Ecuacion* := y'' - 3 y' + 2 y = 8 \* exp(3 x) + 36 \* exp(4 x)

$$\textit{Ecuacion} := \frac{d^2}{dx^2} y(x) - 3 \left( \frac{d}{dx} y(x) \right) + 2 y(x) = 8 e^{3x} + 36 e^{4x} \quad (7)$$

> *Soluciongeneral* := expand(dsolve(*Ecuacion*))

$$\textit{Soluciongeneral} := y(x) = 4 (e^x)^3 + 6 (e^x)^4 + (e^x)^2 \_C1 + e^x \_C2 \quad (8)$$

> restart

**E.D.O.(2)L.cc.NH**

> *Ecuacion* := y'' + y' + y = 8 \* exp(2 x) \* sin(2 x)

$$\textit{Ecuacion} := \frac{d^2}{dx^2} y(x) + \frac{d}{dx} y(x) + y(x) = 8 e^{2x} \sin(2 x) \quad (9)$$

$$\frac{d^2 y}{dx^2} + \frac{dy}{dx} + y = 8e^{2x} \sin(2x)$$

> EcuacionHomogenea := lhs(Ecuacion) = 0

$$\text{EcuacionHomogenea} := \frac{d^2}{dx^2} y(x) + \frac{d}{dx} y(x) + y(x) = 0 \quad (10)$$

> Q := rhs(Ecuacion)

$$Q := 8e^{2x} \sin(2x) \quad (11)$$

> EcuacionCaracteristica := m · 2 + m + 1 = 0

$$\text{EcuacionCaracteristica} := m^2 + m + 1 = 0 \quad (12)$$

> Raiz := solve(EcuacionCaracteristica)

$$\text{Raiz} := -\frac{1}{2} + \frac{1}{2} i\sqrt{3}, -\frac{1}{2} - \frac{1}{2} i\sqrt{3} \quad (13)$$

> SolUno := y(x) = exp(Re(Raiz<sub>1</sub>) · x) · cos(Im(Raiz<sub>1</sub>) · x)

$$\text{SolUno} := y(x) = e^{-\frac{1}{2}x} \cos\left(\frac{1}{2}\sqrt{3}x\right) \quad (14)$$

> SolDos := y(x) = exp(Re(Raiz<sub>1</sub>) · x) · sin(Im(Raiz<sub>1</sub>) · x)

$$\text{SolDos} := y(x) = e^{-\frac{1}{2}x} \sin\left(\frac{1}{2}\sqrt{3}x\right) \quad (15)$$

> with(linalg);

[BlockDiagonal, GramSchmidt, JordanBlock, LUdecomp, QRdecomp, Wronskian, addcol, addrow, adj, adjoint, angle, augment, backsub, band, basis, bezout, blockmatrix, charmat, charpoly, cholesky, col, coldim, colspace, colspan, companion, concat, cond, copyinto, crossprod, curl, definite, delcols, delrows, det, diag, diverge, dotprod, eigenvals, eigenvalues, eigenvectors, eigenvects, entermatrix, equal, exponential, extend, ffgausselim, fibonacci, forwardsub, frobenius, gausselim, gaussjord, geneqns, genmatrix, grad, hadamard, hermite, hessian, hilbert, htranspose, ihermite, indexfunc, innerprod, intbasis, inverse, ismith, issimilar, iszero, jacobian, jordan, kernel, laplacian, leastsqrs, linsolve, matadd, matrix, minor, minpoly, mulcol, mulrow, multiply, norm, normalize, nullspace, orthog, permanent, pivot, potential, randmatrix, randvector, rank, ratform, row, rowdim, rowspace, rowspan, rref, scalarmul, singularvals, smith, stackmatrix, submatrix, subvector, sumbasis, swapcol, swaprow, sylveste, toeplitz, trace, transpose, vandermonde, vecpotent, vectdim, vector, wronskian] (16)

> WW := wronskian([rhs(SolUno), rhs(SolDos)], x)

$$WW := \left[ \left[ e^{-\frac{1}{2}x} \cos\left(\frac{1}{2}\sqrt{3}x\right), e^{-\frac{1}{2}x} \sin\left(\frac{1}{2}\sqrt{3}x\right) \right], \right] \quad (17)$$

$$\left[ -\frac{1}{2} e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) - \frac{1}{2} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3}, -\frac{1}{2} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) + \frac{1}{2} e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3} \right]$$

>  $BB := \text{array}([0, Q])$

$$BB := \begin{bmatrix} 0 & 8 e^{2x} \sin(2x) \end{bmatrix} \quad (18)$$

>  $SOL := \text{simplify}(\text{linsolve}(WW, BB)) : Aprima := SOL_1; Bprima := SOL_2$

$$Aprima := -\frac{16}{3} \sqrt{3} e^{\frac{5}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \sin(2x)$$

$$Bprima := \frac{16}{3} \sqrt{3} e^{\frac{5}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) \sin(2x) \quad (19)$$

>  $A := \text{int}(Aprima, x) + C_1 : B := \text{int}(Bprima, x) + C_2 :$

>  $\text{SolucionNoHomogenea} := y(x) = \text{expand}(\text{simplify}(A \cdot \text{rhs}(\text{SolUno}) + B \cdot \text{rhs}(\text{SolDos})))$

$$\text{SolucionNoHomogenea} := y(x) = \frac{48}{109} e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x} \sin(x) \cos(x) \quad (20)$$

$$+ \frac{48}{109} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x} \sin(x) \cos(x)$$

$$- \frac{160}{109} e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x} \cos(x)^2 - \frac{160}{109} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x} \cos(x)^2$$

$$+ \frac{80}{109} e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x} + \frac{80}{109} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right)^2 e^{\frac{5}{2}x}$$

$$+ e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) C_1 + e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) C_2$$

>  $\text{SolGral} := \text{dsolve}(\text{Ecuacion})$

$$\text{SolGral} := y(x) = e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) - C_2 + e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) - C_1 - \frac{8}{109} (10 \cos(2x) - 3 \sin(2x)) e^{2x} \quad (21)$$

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