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> restart
> semana := lunes, martes, miércoles, jueves, viernes, sábado, domingo
      semana := lunes, martes, miércoles, jueves, viernes, sábado, domingo (1)
> dia := [semana]
      dia := [lunes, martes, miércoles, jueves, viernes, sábado, domingo] (2)
> dia1
      lunes (3)
> dia5
      viernes (4)
> DiaHabil := dia[1..5]
      DiaHabil := [lunes, martes, miércoles, jueves, viernes] (5)
> DiaHabil3
      miércoles (6)
> DiaHabil6
Error, invalid subscript selector
> dia6
      sábado (7)
> FinSemana := dia[6..7]
      FinSemana := [sábado, domingo] (8)
> ConjuntoDia := {semana}
      ConjuntoDia := {domingo, jueves, lunes, martes, sábado, viernes, miércoles} (9)
> dia
      [lunes, martes, miércoles, jueves, viernes, sábado, domingo] (10)
> diaOrdenado := sort(dia)
      diaOrdenado := [domingo, jueves, lunes, martes, miércoles, sábado, viernes] (11)
> restart
> AA := array([ [1, 2], [3, 4] ])
      AA :=  $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$  (12)
> BB := array([ [5, 6], [7, 8] ])
      BB :=  $\begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$  (13)
> with(linalg)
[BlockDiagonal, GramSchmidt, JordanBlock, LUdecomp, QRdecomp, Wronskian, addcol, (14)
 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,

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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]

> evalm(AA)

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

(15)

> AA;

$$AA$$

(16)

> CC := evalm(AA &* BB)

$$CC := \begin{bmatrix} 19 & 22 \\ 43 & 50 \end{bmatrix}$$

(17)

> det(AA)

$$-2$$

(18)

> det(BB)

$$-2$$

(19)

> det(CC)

$$4$$

(20)

> InvAA := inverse(AA)

$$InvAA := \begin{bmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}$$

(21)

> II := evalm(AA &* InvAA)

$$II := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(22)

> det(InvAA)

$$-\frac{1}{2}$$

(23)

> det(II)

$$1$$

(24)

> evalm(AA)

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

(25)

> Sistema := diff($x_1(t), t$) = $x_1(t) + 2 \cdot x_2(t)$, diff($x_2(t), t$) = $3 \cdot x_1(t) + 4 \cdot x_2(t)$: Sistema₁;
Sistema₂

$$\frac{d}{dt} x_1(t) = x_1(t) + 2 x_2(t)$$

(26)

$$\frac{d}{dt} x_2(t) = 3 x_1(t) + 4 x_2(t) \quad (26)$$

> *SolGralSist* := *dsolve*({*Sistema*}) : *evalf*(*SolGralSist*₁, 2); *evalf*(*SolGralSist*₂, 2)

$$x_1(t) = _C1 e^{5.5t} + _C2 e^{-0.35t}$$

$$x_2(t) = 2.2 _C1 e^{5.5t} - 0.65 _C2 e^{-0.35t} \quad (27)$$

>

>

> *MatExp* := *exponential*(*AA*, *t*) :

> *evalf*(*MatExp*[1, 1], 2)

$$0.76 e^{-0.35t} + 0.24 e^{5.5t} \quad (28)$$

> *map*(*evalf*, *MatExp*, 2)

$$\begin{bmatrix} 0.76 e^{-0.35t} + 0.24 e^{5.5t} & 0.35 e^{5.5t} - 0.35 e^{-0.35t} \\ 0.52 e^{5.5t} - 0.52 e^{-0.35t} & 0.24 e^{-0.35t} + 0.76 e^{5.5t} \end{bmatrix} \quad (29)$$

> *InvMatExp* := *inverse*(*MatExp*) :

> *map*(*evalf*, *InvMatExp*, 2)

$$\begin{bmatrix} \frac{0.045 (5.3 e^{-0.35t} + 17. e^{5.5t})}{e^{5.5t} e^{-0.35t}} & - \frac{0.35 (e^{5.5t} - 1. e^{-0.35t})}{e^{5.5t} e^{-0.35t}} \\ - \frac{0.52 (e^{5.5t} - 1. e^{-0.35t})}{e^{5.5t} e^{-0.35t}} & - \frac{0.045 (-17. e^{-0.35t} - 5.3 e^{5.5t})}{e^{5.5t} e^{-0.35t}} \end{bmatrix} \quad (30)$$

> *Ident* := *simplify*(*evalm*(*MatExp* &* *InvMatExp*))

$$Ident := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad (31)$$

> *with*(*DEtools*)

[*AreSimilar*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, *DFactorsols*, *Dchangevar*, *FunctionDecomposition*, *GCRD*, *Gosper*, *Heunsols*, *Homomorphisms*, *IVPsol*, *IsHyperexponential*, *LCLM*, *MeijerGsols*, *MultiplicativeDecomposition*, *ODEInvariants*, *PDEchangecoords*, *PolynomialNormalForm*, *RationalCanonicalForm*, *ReduceHyperexp*, *RiemannPsols*, *Xchange*, *Xcommutator*, *Xgauge*, *Zeilberger*, *abelsol*, *adjoint*, *autonomous*, *bernoullisol*, *buildsol*, *buildsym*, *canoni*, *caseplot*, *casesplit*, *checkrank*, *chinisol*, *clairautsol*, *constcoeffsols*, *convertAlg*, *convertsys*, *dalembertsol*, *dcoeffs*, *de2diffop*, *dfieldplot*, *diff_table*, *diffop2de*, *dperiodic_sols*, *dpolyform*, *dsubs*, *eigenring*, *endomorphism_charpoly*, *equinv*, *eta_k*, *eulersols*, *exactsol*, *expols*, *exterior_power*, *firint*, *firtest*, *formal_sol*, *gen_exp*, *generate_ic*, *genhomosol*, *gensys*, *hamilton_eqs*, *hypergeomsols*, *hyperode*, *indiciaeq*, *infgn*, *initialdata*, *integrate_sols*, *intfactor*, *invariants*, *kovacicsols*, *lefdivision*, *liesol*, *line_int*, *linearsol*, *matrixDE*, *matrix_riccati*, *maxdimsystems*, *moser_reduce*, *muchange*, *mult*, *mutest*, *newton_polygon*, *normalG2*, *ode_int_y*, *ode_y1*, *odeadvisor*, *odepde*, *parametricsol*, *particularsol*, *phaseportrait*, *poincare*, *polysols*, *power_equivalent*, *rational_equivalent*, *ratsols*, *redode*, *reduceOrder*, *reduce_order*, *regular_parts*, *regularsp*, *remove_RootOf*, *riccati_system*,

(32)

riccatisol, rifread, rifsimp, rightrightdivision, rtaylor, separablesol, singularities, solve_group, super_reduce, symgen, symmetric_power, symmetric_product, symtest, transinv, translate, untranslate, varparam, zoom]

> *with(PDEtools)*

[*CanonicalCoordinates, ChangeSymmetry, CharacteristicQ, CharacteristicQInvariants, ConservedCurrentTest, ConservedCurrents, ConsistencyTest, D_Dx, DeterminingPDE, Eta_k, Euler, FromJet, InfinitesimalGenerator, Infinitesimals, IntegratingFactorTest, IntegratingFactors, InvariantSolutions, InvariantTransformation, Invariants, Laplace, Library, PDEplot, PolynomialSolutions, ReducedForm, SimilaritySolutions, SimilarityTransformation, SymmetrySolutions, SymmetryTest, SymmetryTransformation, TWSolutions, ToJet, build, casesplit, charstrip, dchange, dcoeffs, declare, diff_table, difforder, dpolyform, dsubs, mapde, separability, splitstrip, splitsys, undeclare*]

(33)

> *with(inttrans)*

[*addtable, fourier, fouriercos, fouriersin, hankel, hilbert, invfourier, invhilbert, invlaplace, invmellin, laplace, mellin, savetable*]

(34)

> *with(plots)*

[*animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, graphplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot*]

(35)

> *restart*

> *SistemaSimultaneo := 2·x + 3·y = 5, -4·x + 6·y = -8 : SistemaSimultaneo₁;*
SistemaSimultaneo₂

$$\begin{aligned} 2x + 3y &= 5 \\ -4x + 6y &= -8 \end{aligned}$$

(36)

> *Solucion := solve({SistemaSimultaneo})*

$$\text{Solucion} := \left\{ x = \frac{9}{4}, y = \frac{1}{6} \right\}$$

(37)

> *comprobacion₁ := subs(x = rhs(Solucion₁), y = rhs(Solucion₂), SistemaSimultaneo₁)*
comprobacion₁ := 5 = 5

(38)

> *comprobacion₂ := subs(x = rhs(Solucion₁), y = rhs(Solucion₂), SistemaSimultaneo₂)*
comprobacion₂ := -8 = -8

(39)

> *restart*

> *SolucionGeneral := y(t) = C₁·exp(2·t)·cos(3·t) + C₂·exp(2·t)·sin(3·t)*

$$\text{SolucionGeneral} := y(t) = C_1 e^{2t} \cos(3t) + C_2 e^{2t} \sin(3t)$$

(40)

> *Sistema := diff(SolucionGeneral, t), diff(SolucionGeneral, t\$2) : Sistema₁; Sistema₂*

$$\begin{aligned}\frac{d}{dt} y(t) &= 2 C_1 e^{2t} \cos(3t) - 3 C_1 e^{2t} \sin(3t) + 2 C_2 e^{2t} \sin(3t) + 3 C_2 e^{2t} \cos(3t) \\ \frac{d^2}{dt^2} y(t) &= -5 C_1 e^{2t} \cos(3t) - 12 C_1 e^{2t} \sin(3t) - 5 C_2 e^{2t} \sin(3t) + 12 C_2 e^{2t} \cos(3t)\end{aligned}\quad (41)$$

$$\begin{aligned}&> \text{Parametro} := \text{simplify}(\text{solve}(\{\text{Sistema}\}, \{C_1, C_2\})) : \text{Parametro}_1; \text{Parametro}_2 \\ C_1 &= \frac{1}{39} e^{-2t} \left(-3 \left(\frac{d^2}{dt^2} y(t) \right) \cos(3t) + 12 \left(\frac{d}{dt} y(t) \right) \cos(3t) - 2 \left(\frac{d^2}{dt^2} y(t) \right) \sin(3t) \right. \\ &\quad \left. - 5 \left(\frac{d}{dt} y(t) \right) \sin(3t) \right) \\ C_2 &= \frac{1}{39} e^{-2t} \left(2 \left(\frac{d^2}{dt^2} y(t) \right) \cos(3t) - 3 \left(\frac{d^2}{dt^2} y(t) \right) \sin(3t) + 5 \left(\frac{d}{dt} y(t) \right) \cos(3t) \right. \\ &\quad \left. + 12 \left(\frac{d}{dt} y(t) \right) \sin(3t) \right)\end{aligned}\quad (42)$$

$$\begin{aligned}&> \text{EcuacionUno} := \text{simplify}(\text{subs}(C_1 = \text{rhs}(\text{Parametro}_1), C_2 = \text{rhs}(\text{Parametro}_2), \\ &\quad \text{SolucionGeneral})) \\ \text{EcuacionUno} &:= y(t) = -\frac{1}{13} \frac{d^2}{dt^2} y(t) + \frac{4}{13} \frac{d}{dt} y(t)\end{aligned}\quad (43)$$

$$\begin{aligned}&> \text{EcuacionDos} := \text{lhs}(\text{EcuacionUno}) \cdot 13 - \text{rhs}(\text{EcuacionUno}) \cdot 13 = 0 \\ \text{EcuacionDos} &:= 13 y(t) + \frac{d^2}{dt^2} y(t) - 4 \left(\frac{d}{dt} y(t) \right) = 0\end{aligned}\quad (44)$$

$$\begin{aligned}&> \text{SolGral} := \text{dsolve}(\text{EcuacionDos}) \\ \text{SolGral} &:= y(t) = _C1 e^{2t} \sin(3t) + _C2 e^{2t} \cos(3t)\end{aligned}\quad (45)$$

$$\begin{aligned}&> \text{EcuacionCaract} := m \cdot 2 - 4 \cdot m + 13 = 0 \\ \text{EcuacionCaract} &:= m^2 - 4m + 13 = 0\end{aligned}\quad (46)$$

$$\begin{aligned}&> \text{Raiz} := \text{solve}(\text{EcuacionCaract}) \\ \text{Raiz} &:= 2 + 3I, 2 - 3I\end{aligned}\quad (47)$$

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