```
with(DETools) : with(plots) : 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, sylvester, toeplitz, trace, transpose,
  vandermonde, vecpotent, vectdim, vector, wronskian ]
```

(1)

```
f1 := x→6 x^2 − 8 x − x^3;
ec1 := diff(x(t), t) = f1(x(t));
solve(f1(x) = 0);
D(f1)(0); # < 0stabil
D(f1)(4); # < 0stabil
D(f1)(2); # > 0instabil
DEplot(ec1, x(t), t = −2..2, [seq([x(0) = i], i = 1..5)]);
```

$$f1 := x \mapsto 6 \cdot x^2 - 8 \cdot x - x^3$$

$$ec1 := \frac{d}{dt} x(t) = 6\,x(t)^2 - 8\,x(t) - x(t)^3$$

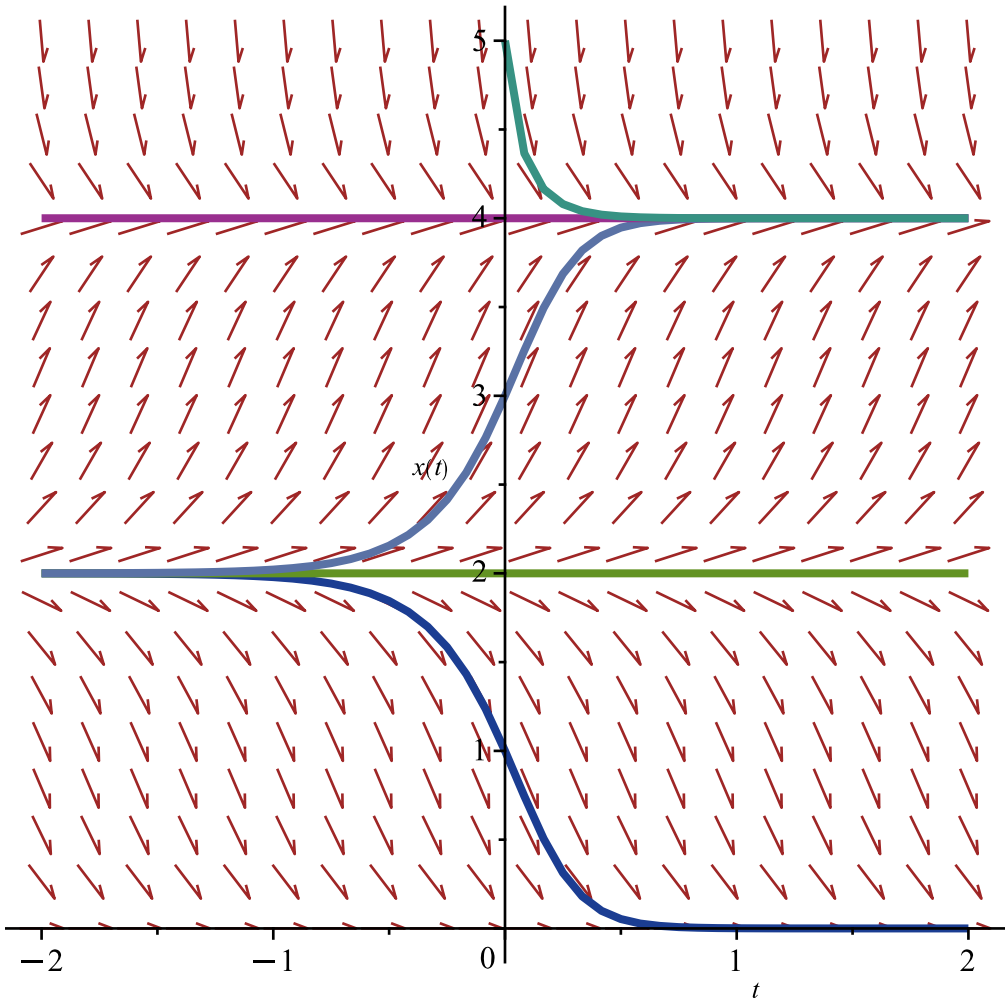
$$0,\ 4,\ 2$$

$$-8$$

$$-8$$

$$4$$

```
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further left of -.73473324e-1,
probably a singularity
```




```
ec2 := (1 + x^2)·diff(y(x), x$2) + 4·x·diff(y(x), x) − 10·y(x) = 0;
solGen2 := dsolve(ec2, y(x));
solPC2 := dsolve({ec2, y(0) = a, D(y)(0) = 1}, y(x));
y2 := unapply(rhs(solPC), x);
L2 := limit(y2(x), x = infinity);
a2 := solve(3 Pi/32 + a, a);
```

$$ec2 := \left(x^2+1\right)\left(\frac{d^2}{dx^2}\,y(x)\right)+4\,x\left(\frac{d}{dx}\,y(x)\right)-10\,y(x)=0$$

$$solGen2 := y(x)=c_1\left(5\,x^2+1\right)+\frac{c_2\left(\left(15\,x^4+18\,x^2+3\right)\arctan(x)+15\,x^3+13\,x\right)}{x^2+1}$$

$$solPC2 := y(x)=a\left(5\,x^2+1\right)+\frac{\left(15\,x^4+18\,x^2+3\right)\arctan(x)+15\,x^3+13\,x}{16\left(x^2+1\right)}$$

$$y2 := x\mapsto a\cdot\left(5\cdot x^2+1\right)+\frac{\left(15\cdot x^4+18\cdot x^2+3\right)\cdot\arctan(x)+15\cdot x^3+13\cdot x}{16\cdot\left(x^2+1\right)}$$

$$L2 := \operatorname{signum}\left(\frac{3\,\pi}{32}+a\right)\,\infty$$

$$a2 := -\frac{3\,\pi}{32} \qquad \textbf{(2)}$$

$sist3 := diff(x(t), t) = x(t) - 3\cdot y(t), diff(y(t), t) = 3\cdot x(t) - y(t);$
$solGen3 := dsolve(\{sist3\}, \{x(t), y(t)\});$
$solPC3 := dsolve(\{sist3, x(0) = 0, y(0) = 1\}, \{x(t), y(t)\});$
$A3 := matrix([[1, -3], [3, -1]]);$
$eigenvals(A3);$ #Im(*sol1*) > 0 *si* Im(*sol2*) $< 0 \Rightarrow (0, 0)$ *de tip centru*
in opinia mea limta functie nu tinde sper 0, deoarece punctul de echilibru nu este unul de tip focus si cum putem vedea in portretul fazic, nu tind pre 0...
este punct de tip centru
$DEplot([sist3], [x(t), y(t)], t = -5..5, [[x(0) = 0, y(0) = 1]]);$

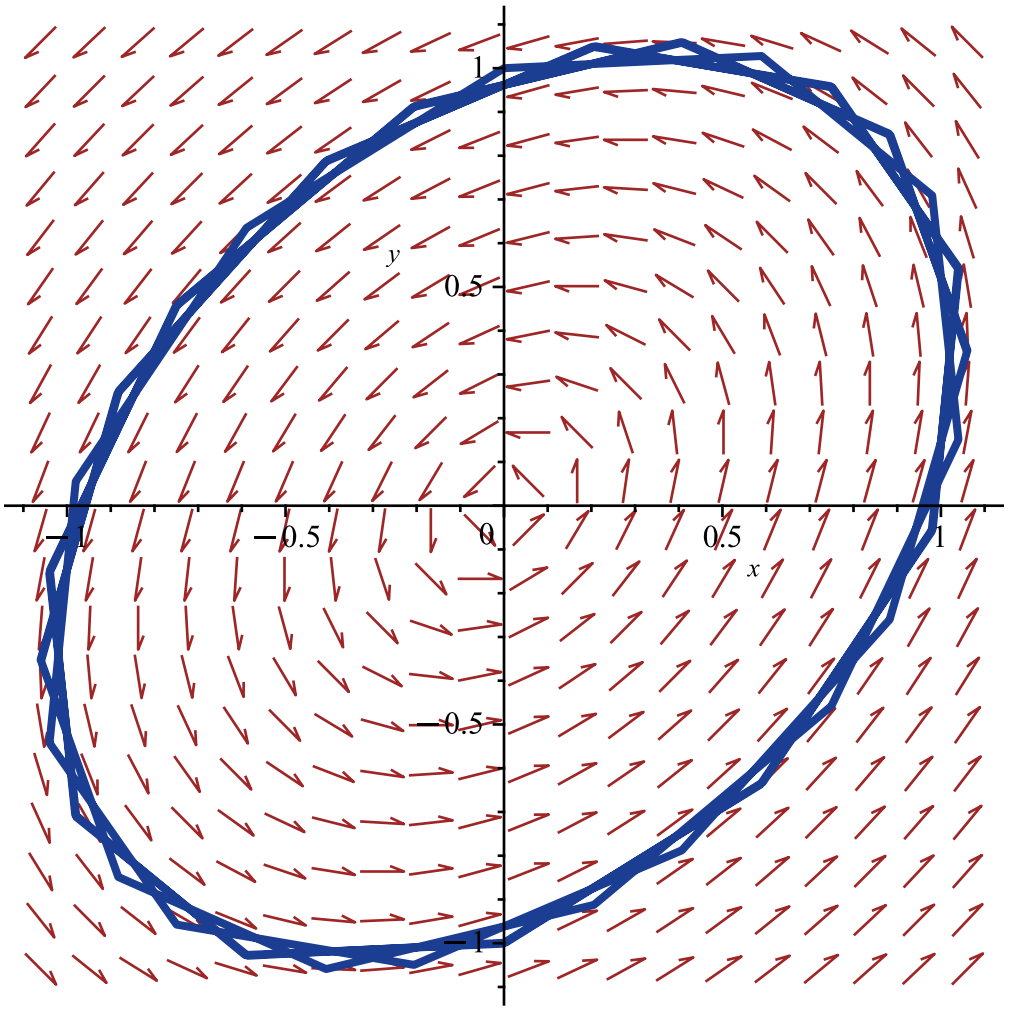
$$sist3 := \frac{d}{dt}x(t) = x(t) - 3\,y(t), \frac{d}{dt}y(t) = 3\,x(t) - y(t)$$

$$solGen3 := \left\{x(t) = c_1 \sin\left(2\sqrt{2}\,t\right) + c_2 \cos\left(2\sqrt{2}\,t\right), y(t) = -\frac{2\,c_1\sqrt{2}\,\cos\left(2\sqrt{2}\,t\right)}{3} + \frac{2\,c_2\sqrt{2}\,\sin\left(2\sqrt{2}\,t\right)}{3} + \frac{c_1 \sin\left(2\sqrt{2}\,t\right)}{3} + \frac{c_2 \cos\left(2\sqrt{2}\,t\right)}{3}\right\}$$

$$solPC3 := \left\{x(t) = -\frac{3\sqrt{2}\,\sin\left(2\sqrt{2}\,t\right)}{4}, y(t) = \cos\left(2\sqrt{2}\,t\right) - \frac{\sqrt{2}\,\sin\left(2\sqrt{2}\,t\right)}{4}\right\}$$

$$A3 := \begin{bmatrix} 1 & -3 \\ 3 & -1 \end{bmatrix}$$

$$2\,I\sqrt{2}, -2\,I\sqrt{2}$$



$sist4 := diff(x(t), t) = -k*x(t), x(0) = x_0;$

$\#k=0.75, x_0 = 24$

$solPC4 := dsolve(\{diff(x(t), t) = -0.75*x(t), x(0) = 24\}, x(t));$

$\#x(0)=10g,\ x(8)=7g$

$solP4 := dsolve(\{diff(x(t), t) = -k*x(t), x(0) = 10\}, x(t));$

$x4 := unapply(rhs(solP4), t);$

$k4 := solve(x4(8) = 7);$

$$sist4 := \frac{d}{dt} x(t) = -k\,x(t), x(0) = x_0$$

$$solPC4 := x(t) = 24\,e^{-\frac{3t}{4}}$$

$$solP4 := x(t) = 10\,e^{-kt}$$

$$x4 := t \mapsto 10 \cdot e^{-k \cdot t}$$

$$k4 := -\frac{\ln\left(\frac{7}{10}\right)}{8}$$

(3)

$f_1 := (x, y) \to -x + y^2;$

$f_2 := (x, y) \to x^2 - 4 \cdot y;$

```
pctEchi := evalf(solve({f1(x,y)=0, f2(x,y)=0}, {x,y}));
J := jacobian([f1(x,y), f2(x,y)], [x,y]);
A1 := subs(pctEchi[1,1], pctEchi[1,2], eval(J));
A2 := subs(pctEchi[2,1], pctEchi[2,2], eval(J));
eigenvals(A1); #asim stabil de tip focus
eigenvals(A2); #instabil de tip sa
```

$$f_1 := (x, y) \mapsto -x + y^2$$

$$f_2 := (x, y) \mapsto x^2 - 4 \cdot y$$

$$pctEchi := \{x = 0., y = 0.\}, \{x = 2.519842100, y = 1.587401052\}$$

$$J := \begin{bmatrix} -1 & 2\,y \\ 2\,x & -4 \end{bmatrix}$$

$$A1 := \begin{bmatrix} -1 & 0. \\ 0. & -4 \end{bmatrix}$$

$$A2 := \begin{bmatrix} -1 & 3.174802104 \\ 5.039684200 & -4 \end{bmatrix}$$

$$-4., -1.$$

$$1.77200187285253, -6.77200187285253$$ **(4)**