

Problem Set 4

In[153]:=

```
maxt = 10;
μ = 0.1;
ω = 1.0;
ν = 1.0;

sol[x0_, y0_] := NDSolve[{x'[t] == μ*x[t] - ν*y[t]^3 - x[t]*y[t]^2 - ν*x[t]^2*y[t] - ω*
y'[t] == ω*x[t] + μ*y[t] + ν*x[t]*y[t]^2 + ν*x[t]^3 -
x[0]==x0, y[0]==y0},
{x,y},
{t,0,maxt}]

sol[x0_, y0_] := NDSolve[
{
x'[t] == μ*x[t] - ν*y[t]^3 - x[t]*y[t]^2 - ν*x[t]^2*y[t] - ω*y[t] - x[t]^3,
y'[t] == ω*x[t] + μ*y[t] + ν*x[t]*y[t]^2 + ν*x[t]^3 - y[t]^3 - x[t]^2*y[t],
x[0] == x0,
y[0] == y0
},
{x, y},
{t, 0, maxt}
]

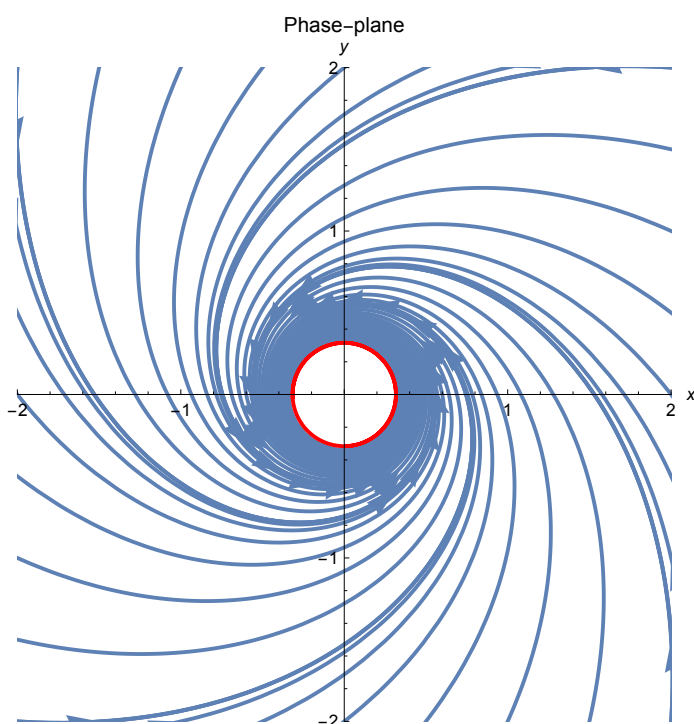
minx=-2;
miny=-2;
maxx=2;
maxy=2;
step = 0.5;
initialC=Join[
Table[{minx,y},{y,miny,maxy,step}],
Table[{maxx,y},{y,miny,maxy,step}],
Table[{x,miny},{x,minx,maxx,step}],
Table[{x,maxy},{x,minx,maxx,step}]];
solLC = NDSolve[
{
x'[t] == μ*x[t] - ν*y[t]^3 - x[t]*y[t]^2 - ν*x[t]^2*y[t] - ω*y[t] - x[t]^3,
y'[t] == ω*x[t] + μ*y[t] + ν*x[t]*y[t]^2 + ν*x[t]^3 - y[t]^3 - x[t]^2*y[t],
x[0] == N[Sqrt[μ]],
y[0] == 0
},
{x, y},
{t, 0, 100}
];
p1=Show[
Table[
ParametricPlot[
```

```

        Evaluate[{x[t],y[t]} /. sol[initialC[[i,1]], initialC[[i,2]]],
        {t,0,maxt},
        PlotRange→{{minx,maxx},{miny,maxy}},
        AxesLabel→{x,y}
    ]
    /. Line[x_]→{Arrowheads[{{0.05, 0.5}, {0.05, 0.0}}],Arrow[x]},{i,1,Length[init
],
ParametricPlot[
    Evaluate[{x[t], y[t]} /. solLC],
    {t, 90, 100},
    PlotStyle → {Red, Thick}
],
PlotLabel → "Phase-plane"
]

```

Out[166]=



In[169]:=

```

Jt = {
  {(-4/10 * Pi)/(11/10), 0},
  {(4 * Sqrt[1/10] * Pi)/(11/10), 0}
}
M = MatrixExp[Jt]

```

Out[169]=

$$\left\{ \left\{ -\frac{4\pi}{11}, 0 \right\}, \left\{ \frac{4\sqrt{10}\pi}{11}, 0 \right\} \right\}$$

Out[170]=

$$\left\{ \left\{ e^{-4\pi/11}, 0 \right\}, \left\{ \sqrt{10} e^{-4\pi/11} (-1 + e^{4\pi/11}), 1 \right\} \right\}$$