

DEPARTMENT OF MATHEMATICS
MATHS 761 Laboratory 3 Notes

1. Use XPP and any other methods you know of to determine which of the following vector fields have periodic orbits. Questions with a star (*) are a bit trickier. Only attempt these when you are sure about the rest.

(a)

$$\begin{aligned}\dot{x} &= 0.1004 + y + x^3, \\ \dot{y} &= x + y + y^3.\end{aligned}$$

(b)

$$\begin{aligned}\dot{x} &= (x^2 + y^2)^{1/2}(x - y - x^3 - xy^2 - x^2y) \\ \dot{y} &= (x^2 + y^2)^{1/2}(x + y + x^3 - x^2y - y^3)\end{aligned}$$

(c)

$$\begin{aligned}\dot{x} &= 1.004 + y^2 - \exp(xy), \\ \dot{y} &= xy + \cos^2(y).\end{aligned}$$

(d)

$$\begin{aligned}\dot{x} &= y^2 - x, \\ \dot{y} &= y + x^2 + yx^3.\end{aligned}$$

(e)

$$\begin{aligned}\dot{x} &= x - y - \left(x^2 + \frac{3}{2}y^2\right)x, \\ \dot{y} &= x + y - \left(x^2 + \frac{1}{2}y^2\right)y.\end{aligned}$$

(f)

$$\begin{aligned}\dot{x} &= x(2 - y - x), \\ \dot{y} &= y(4x - x^2 - 3).\end{aligned}$$

(g) (*)

$$\begin{aligned}\dot{x} &= y, \\ \dot{y} &= -0.1004 + y + 10x^2 + 10xy.\end{aligned}$$

(h) (*)

$$\begin{aligned}\dot{x} &= 2xy - 2y^4, \\ \dot{y} &= x^2 - y^2 - xy^3.\end{aligned}$$