

DEPARTMENT OF PHYSICAL SCIENCES IISER-MOHALI

IDC 402 - Nonlinear dynamics

Assignment-2

Date: 18.04.2025

Due date: 25.04.2025, 5.00 PM

Name:

Roll No.:

Q 1. Analyze the long-term behavior of the map $x_{n+1} = rx_n(1 + x_n^2)$, where $r > 0$.
Find and classify all fixed points as a function of r and their stability.

1

Q 2. Calculate the Lyapunov exponent of the map : $x_{n+1} = 10x_n \pmod{1}$ with x belongs to $[0, 1]$.
Can there be periodic solutions or Chaos?

1

Q 3. For the following Lorenz system with parameters $\sigma = 10, \beta = 8.3$, plot $x(t), y(x)$ and x vs z (use jupyter notebook to solve the system and for plotting). Find fixed points for each value of r and discuss the different behaviours one observes:

1

1. $r = 10$
2. $r = 24.5$
3. $r = 126.5$

Q 4. Consider the Liénard equation

$$\ddot{x} - (\mu - x^2)\dot{x} + x = 0$$

Show that the system exhibits supercritical Hopf bifurcation around the only fixed point of the system? Use Jupyter notebook to create phase portraits for few μ values to show that bifurcation.

2

To include plots from Jupyter notebook, put all the plots with proper labels in one page or two pages and attach it with rest of the assignment i.e scanned copy. So, finally you have only one pdf file.