

DEPARTMENT OF PHYSICAL SCIENCES IISER-MOHALI

IDC 402 - Nonlinear dynamics**Assignment-1****Date: 24.01.2025****Due date: 01.02.2025, 5.00 PM****Name:****Roll No.:**

- Q 1.** Find an approximate fixed points and discuss their stability graphically for the following dynamical system:

$$\dot{x} = \exp(x) - \cos(x)$$

where $\dot{x} = dx/dt$.

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- Q 2.** Identify the dynamical system that has following fixed points with respective stabilities on the real axis: Clearly, there are multiple answers. You need to identify one possible system.

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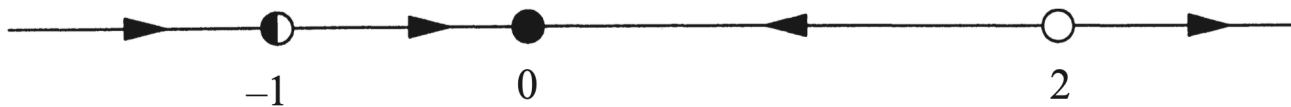


Figure 1: Fixed points with distinct stabilities

- Q 3.** Show that following dynamical system displays saddle-node bifurcation. Plot fixed plots and discuss their stabilities for various regions of control parameter r . What is the bifurcation point and also plot bifurcation diagram.

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$$\dot{x} = r + x - \ln(1 + x)$$

- Q 4.** Consider the normal form of subcritical pitchfork bifurcation,

$$\dot{x} = rx + x^3$$

where r is the control parameter. This system is discussed in class. When $r > 0$, there is no stable solution for this system. Now to stabilize the system, an additional term is added which results into following dynamical system,

$$\dot{x} = rx + x^3 - x^5.$$

Calculate all its fixed points and discuss their nature. Draw bifurcation diagram and also argue why there is a possible hysteresis effect in this system.

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- Q 5.** Solve the exercise 4.4.4 Strogatz's text book.

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