

DEPARTMENT OF PHYSICAL SCIENCES
IISER-MOHALI

IDC 402 - Nonlinear dynamics

Endsem:PartB

Date: 03.05.2025

Due date: 03.05.2025, 5.00 PM

Name:

Roll No.:

- Show all the steps of your calculations, marks will be deducted for missing steps.
- For questions involving graphs, label your axes properly.

Q 1. In the electric circuit below, R is the resistor, C is the capacitance are in series with a battery of constant dc voltage V_0 . At $t = 0$ the switch is closed and no charge in the capacitor. At any time, V_0 is being $RI + Q/C$ where I is the current and Q is the charge.

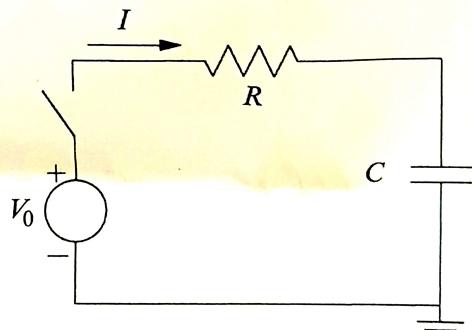


Figure 1: Electric circuit

- (a) Find the fixed point and its stability.
- (b) Draw charge Q with time t with proper axes labels.

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Q 2. Consider following system

$$\begin{aligned}\dot{x} &= -y - x^3 \\ \dot{y} &= x\end{aligned}$$

Using linearization, show that the fixed point is a center. Finally show that fixed point is actually a spiral and linearization fails. Is it spiral inward or outward?

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Q 3. Show that the following system has a periodic solution

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