Universitatea Babeş–Bolyai
Facultatea de Matematică şi Informatică

Exam on Dynamical Systems.
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1. We say that a differential equation exhibit resonance when all its solutions are unbounded.

For what values of the mass m will $mx'' + 25x = 12\cos(36\pi t)$ exhibit resonance?

2. Find the solution of the following Initial Value Problem

$$y'' - \frac{y'}{x} = x^2 \quad y(2) = 0\,, \quad y'(2) = 4\,.$$

3. Represent the phase portrait of the following differential equation:

$$\dot{x} = 4x - x^3\,.$$

4. We consider the nonlinear autonomous planar system:

$$\begin{cases} \dot{x} = -x + xy \\ \dot{y} = -4y + 8xy\,. \end{cases}$$

Find its equilibria and study their stability.

5. Write the definition of the first integral for a differential equation in symmetrical form.

6. Write the definition of a fixed point of some scalar map.