

MATH 308. Differential Equations

Homework 2

Nataliya Goncharuk, natasha_goncharuk@tamu.edu

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1. (3 pt) Solve the differential equation

$$yy'(x) + \frac{x}{2y^2} = \frac{1}{2y^2}$$

with initial condition $y(0) = -1$. Find the domain of this solution.

2. (4 pt) Solve the differential equation

$$y' + 2y/x = \frac{\sin x}{x^2}$$

Show that all solutions except one tend to infinity as $x \rightarrow 0$. Find this only exceptional solution, and find its limit at zero.

3. (3 pt) Use the Euler's method to study the solutions of the ODE $y' = y(\sin x - 1) + \cos x$. Observe that for various (choose 2-3) initial conditions $y(0)$ the solution approaches a certain periodic function. What is the period of this periodic function (up to the first decimal digit)?

You may modify and run the program here

[https://mybinder.org/v2/gh/urkud/ODE-notebooks/master?filepath=Euler's method.ipynb](https://mybinder.org/v2/gh/urkud/ODE-notebooks/master?filepath=Euler's%20method.ipynb)

(you will not be able to save your progress, please keep a copy on your computer). You may also write your own program. You are supposed to include the screenshots of the program and its output, with necessary explanations.