Mathematics Department **SuSe 2024**
Prof. Dr. T. Schmidt

Mathematics III Exam
(Module: Differential Equations I)

26 August 2024

Please mark each page with your name and your matriculation number.

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Assessment according to examin. reg: with Analysis III ☐ single scoring ☐

I was instructed about the fact that the exam performance will only be assessed if the Central Examination Office of TUHH verifies my official admission before the exams beginning in retrospect.

(Signature)

Exercise	**Points**	**Evaluator**
1		
2		
3		
4		

$\sum$ =

Exercise 1) (3 points)

Compute the general solution of the following differential equation

$$y'(t) = \cos(t) \cdot \frac{1}{4y^2(t)}.$$

Exercise 2) (5 points)

a) Which of the following differential equations for $u(t)$ is exact?

(i) $u + u^3 + 3u^2u' = 0\,.$

(ii) $u^5 + \sin(t) + 5tu^4u' = 0\,.$

(iii) $ut^2 - tu^2u' = 0\,.$

Justify your answers.

b) Determine the corresponding potential and the general solution for an exact differential equation in part a).

Exercise 3) (6 points)

Determine the general solution of the following differential equation

$$u'''(t) + 4u''(t) - 5u'(t) = -1 - 5t\,.$$

Exercise 4) (6 points)

Consider the system of differential equations

$$\boldsymbol{u}'(t) \;=\; \boldsymbol{A} \cdot \boldsymbol{u}\,(t) = \begin{pmatrix} -1 & 0 & 0 \\ 1 & 1 & \beta \\ 2 & -\beta & 1 \end{pmatrix} \cdot \boldsymbol{u}\,(t)$$

with parameter $\beta \in \mathbb{R}$.

a) Analyse the stability of the stationary point $(0,0,0)^T$ of the system.

b) Let $\beta = 0$. Determine a fundamental system of the system of differential equations.