

Notes for MAT-INF1310 – 4
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1 Calculus

Exercise 1.1 Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be the function defined by:

$$f(x) = (e^x - 1)/x \quad \text{if } x \neq 0, \quad (1)$$

$$f(0) = 1. \quad (2)$$

Show that f is continuously differentiable (i.e. the differential $f'(x)$ is defined for all $x \in \mathbb{R}$ – in particular for $x = 0$ – and f' is continuous on \mathbb{R} – in particular at 0).

2 Check-list for the mid-term exam

The curriculum for the mid-term exam is:

- Calculus (derivation of functions and limits)
- Linear scalar equations, integrating factor
- Separable equations
- Exact equations
- Substitution methods, homogeneous equations
- Gronwall's lemma

This corresponds to Part I of Robinson or Chapter 1 in Edwards & Penney, plus the notes on Gronwall's lemma. But there will *not* be questions on phase diagrams and *no* questions on systems of differential equations (no order-reduction or making equations autonomous).

Notations: \log denotes the function defined by:

$$\log(t) = \int_1^t (1/s) ds \quad (3)$$

The open interval with extremities a and b is denoted $]a, b[$, that is:

$$]a, b[= \{s \in \mathbb{R} : a < s < b\} \quad (4)$$

Typical exercises: All exercises from Robinson that have been corrected in class are typical (see the “forelesningsplan” on the website of the course for their list) of what can be given at the midterm. The exercises on “Notes 1” are more theoretical than what will be given on the midterm but, concerning Gronwall's inequality, you must be able to do exercise 9.7 ($t \geq s$), 6.2 and 6.3 in Robinson.

Time allocation: There will be seven questions, where each question is of the form “differentiate this function...”, or “solve this linear differential equation...”, or “show that the following equation is exact...”, or “compute the limit in ... of the solution of this differential equation...” etc.