

Exam: Mathematics 1

Hamburg University of Applied Science
Faculty of Engineering & Computer Science, Department of Information and Electrical Engineering
Prof. Dr. Robert Heß, January 26th 2018, duration: 90 Min.
Permitted aids: up to six A4-pages of personal notes (i.e. single sided sheets)

Result: of 100 points Mark: points.

Problem 1 (16 points)

Prove by mathematical induction: $\sum_{k=1}^{n-1} \frac{k}{(k+1)!} = 1 - \frac{1}{n!}$

Problem 2 (20 points)

Analyse w.r.t. inflection points: $f(x) = \frac{1}{4}x^4 - x^3 + 1$.

Problem 3 (10 points)

Find all solutions for $z \in \mathbb{C}$ in polar (or exponential) form with $z^6 = 27$.

Problem 4 (20 points)

Apply partial fraction decomposition on: $\frac{3x^2 - x - 1}{x^3 - 3x^2 + 4x - 2}$

Problem 5 (9 points)

With $\omega \in \mathbb{R}$ and $n \in \mathbb{N}$ resolve and simplify the following expressions:

$$a = \frac{d}{dx} \sin(e^{x^2}) \qquad b = \frac{d}{dx} \frac{e^x}{x^2 + 2x - 1} \qquad c = \frac{d^{2n}}{dx^{2n}} \sinh(\sqrt{a}x)$$

Problem 6 (25 points)

Given is the following SLE:

$$a + b + c = 2 \qquad a + 2b + 2d = 0 \qquad 3a + 5c + d = -1 \qquad 2b + 2c + d = -2$$

- a) Find the rank of the coefficient matrix.
- b) Find the rank of the extended coefficient matrix.
- c) Derive your conclusion of the ranks w.r.t. solution behaviour.
- d) Find the determinant of the coefficient matrix.