

Exam: Mathematics 1

Hamburg University of Applied Science
Faculty of Engineering & Computer Science, Department of Information and Electrical Engineering
Prof. Dr. Robert Heß, 4.7.2016, 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 (12 points)

Prove by mathematical induction: $2^n > n^3$ for all $n \geq 10, n \in \mathbb{N}$

Problem 2 (12 points)

Find all solutions in polar form for $z \in \mathbb{C}$ with $z^3 = -27$.

Problem 3 (12 points)

Resolve and simplify the following expressions:

$$a = \frac{d}{dx} \frac{x^2 - 1}{x^2 + 1} \qquad b = \frac{d}{dx} \frac{1}{\sin(4x^2)} \qquad c = \frac{d^n}{dt^n} e^{j\omega t}$$

Problem 4 (14 points)

Analyse convergence by root test and sketch the region of convergence for:

$$f(z) = \sum_{k=0}^{\infty} \left(\frac{z}{2} + 2j \right)^k, \quad z \in \mathbb{C}$$

Problem 5 (25 points)

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

Problem 6 (25 points)

For the following SLE determine

- the reduced row echelon of the extended coefficient matrix
- the rank of coefficient matrix and extended coefficient matrix
- the solution behaviour and if possible the solution
- for the coefficient matrix the determinant and inverse matrix, if possible

Explain your answer.

$$2x + 4y - 2z = 8 \qquad -x + 3z = -8 \qquad y + 2z = -5 \qquad -3x - 2y - 2z = 7$$