

Exam: Mathematics 1

Hamburg University of Applied Science
Faculty of Engineering & Computer Science, Department of Information and Electrical Engineering
Prof. Dr. Robert Heß, July 3rd 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: $\sum_{k=1}^n \frac{1}{k(k+1)} = \frac{n}{n+1}$

Problem 2 (15 points)

Is the function $f : \mathbb{C} \rightarrow \mathbb{C}, z \mapsto \sum_{k=0}^{\infty} \frac{(100z)^k}{k!}$ convergent and if yes for which values of z ?

Problem 3 (12 points)

Find all solutions for $z \in \mathbb{C}$ in Cartesian form and reduce as far as possible with $z^4 = -324$.

Problem 4 (12 points)

Resolve, i.e. differentiate the following expressions:

a) $\frac{d}{dy} \sin(xy + t)$ b) $\frac{d^2}{dt^2} \exp(j(\omega t + \varphi_0))$ c) $\frac{d}{dx} \frac{\sin(3x)}{x^2 + 2x - 1}$

Problem 5 (20 points)

Apply partial fraction decomposition on: $\frac{3x - 10}{x^3 - 4x^2 + 6x - 4}$

Problem 6 (25 points)

a) Evaluate the inverse of $A = \begin{pmatrix} 1 & 2 & 1 & 1 \\ 2 & 3 & 1 & 2 \\ 1 & 3 & 2 & 2 \\ 1 & 3 & 3 & 2 \end{pmatrix}$.

b) Derive the determinant of A .