Surname: .... Forename: .... MatrNo.: ....

Exam: Mathematics 1

Hamburg University of Applied Science
Faculty of Engineering & Computer Science, Department of Information and Electrical Engineering
Prof. Dr. Robert Heß, 1.2.2016, 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: $5^n - 1$ has the divisor 4 for all $n \in \mathbb{N}$

Problem 2 (12 points)

Find all solutions in polar form for $z \in \mathbb{C}$ with $z^3 = 8\mathrm{j}$.

Problem 3 (12 points)

Resolve, i.e. differentiate the following expressions:

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

Problem 4 (14 points)

Analyse convergence by root test for: $f(z) = \sum_{k=0}^{\infty} \frac{k!(z + 1 - 2\mathrm{j})^k}{e^k}, \; z \in \mathbb{C}$

Problem 5 (25 points)

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

Problem 6 (25 points)

For the following SLE determine
a) the reduced row echelon form of the extended coefficient matrix
b) the rank of coefficient and extended coefficient matrix
c) the solution behaviour and if possible the solution
d) for the coefficient matrix the determinant and inverse matrix, if possible
Explain your answer.

$$2x + 4y + z = 1 \qquad 2x + 2y = 2 \qquad x + 2y + z = 2 \qquad x + y + z = 4$$