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

Exam: Calculus I

Hamburg University of Applied Science
Faculty of Engineering & Computer Science, Department of Information and Electrical Engineering
Prof. Dr. Robert Heß, January 23rd 2013, duration: 90 Min.

Result: ..... of 100 points Mark: ..... points.

Problem 1 (18 points)

Find all roots in polar or cartesian form:

1. $\sqrt{\mathrm{j}}$ 2. $\sqrt[3]{8}$ 3. $\sqrt[4]{81}$

Problem 2 (14 points)

Check convergence for:

$$f(z) = \sum_{k=0}^{\infty} \frac{(z+1)^k}{k!}, \quad z \in \mathbb{C}$$

Problem 3 (15 points)

Resolve, i.e. differentiate the following expressions:

1. $\frac{\mathrm{d}}{\mathrm{d}x} \ln^2(2x)$ 2. $\frac{\mathrm{d}^n}{\mathrm{d}t^n} \hat{u} e^{2\pi \mathrm{j} f t}$ 3. $\frac{\mathrm{d}}{\mathrm{d}x} \frac{x^2+x-2}{\cos(2\pi x)}$

Problem 4 (22 points)

Perform partial fraction decomposition on: $f(x) = \frac{3x^2+2x-1}{x^3-x^2+x-1}$

Problem 5 (6 points)

For a three times continuous differentiable function $f : \mathbb{R} \to \mathbb{R}$ which of the following statements are always true?

1. If $f(x)$ is increasing we have: $f'(x) \geq 0$ for all x
2. At an extremum x_e we have: $f''(x_e) \neq 0$
3. If $f''(x_1) = 0$ and $f'''(x_1) \neq 0$ then x_1 is an inflection point
4. If $f'(x_2) = 0$ and $f''(x_2) = 0$ then x_2 is an saddle point

Problem 6 (25 points)

Analyse the function $f(x) = x^4 - 6x^2 + 8x - 2$ with respect to extrema and inflection points.