Universität Karlsruhe (TH)
Mathematisches Institut II
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16	17	18	19	20	$\sum$

Karlsruhe, May 09, 2005

Student No.: .....

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Worksheet 4
Advanced Mathematics II for Mechanical Engineering

Problem 16: Compute the antiderivative

$$\int \frac{4x^4 - 2x^3 + 29x^2 - 6x + 50}{x^5 - x^4 + 8x^3 - 8x^2 + 16x - 16} dx.$$

Problem 17: Using the substitution $u = \tan(\frac{x}{2})$, determine

$$\int \frac{2\sin x - \sin x \cos x - (1 + \cos x)^2}{(2 + 2\cos x + 3\sin^2 x)} dx.$$

Problem 18: Compute

$$\int_0^{\pi/4} \frac{dx}{1 + \tan x}$$

a) using the substitution $u(x) = \tan x$,

b) using the substitution $v(x) = \tan \frac{x}{2}$.

Problem 19: Investigate the existence of the following integrals and determine their value where necessary:

$$\text{a)} \int_0^1 \ln x \, dx, \qquad \text{b)} \int_0^{\pi/2} \tan x \, dx \qquad \text{c)} \int_2^\infty \frac{x+2}{x^3 - x^2 - x + 1} dx$$

Problem 20: Show the existence of the following integrals:

$$\text{a) } J_1 = \int_0^1 \frac{\sqrt{x}}{e^x - 1} \, dx \quad , \quad \text{b) } J_2 = \int_1^\infty \frac{\sqrt{x}}{e^x - 1} \, dx$$

and estimate them from above. What can you say about the existence and the upper bound of the integral $J := \int_0^\infty \frac{\sqrt{x}}{e^x - 1} dx$?

Due date: Monday, May 16, 2005, 1:00 pm (in the slots outside room 208.1 of the mathematics building)