

Universität Karlsruhe (TH)  
 Mathematisches Institut II  
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Karlsruhe, June 13, 2005

Student No.: .....

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**Worksheet 9**  
**Advanced Mathematics II for Mechanical Engineering**

**Problem 41:** Given the following nonhomogeneous Euler's differential equation

$$-15u(x) + 3xu'(x) + x^2u''(x) = 8x^{-3},$$

- a) find a real fundamental system;
- b) compute a particular solution using the method of variation of constants and determine the general solution of the differential equation.

**Problem 42:** Solve the initial value problem

$$y''(x) - 2xy'(x) - 2y(x) = 0, \quad y(0) = 1, \quad y'(0) = 0$$

by using the power series method (the formula for the coefficients should be proven by induction). Determine the radius of convergence of the series and give the solution in closed form.

**Problem 43:** Find a recursion formula for the coefficients of the power series solution to the initial value problem (a closed form is not needed)

$$xu''(x) + 4u'(x) + 3u(x) = 3, \quad u(0) = 2,$$

For which  $x \in \mathbb{R}$  does the series converge absolutely?

**Problem 44:** Solve the initial value problem

$$(2x - x^2)y''(x) + (1 - x)y'(x) = 0, \quad y(1) = 1, \quad y'(1) = 0$$

with the power series method and give the solution in closed form.

**Problem 45:** Find the general solution to the differential equation

$$x^2y''(x) + x^2y'(x) - 2y(x) = 0$$

using the power series method. A recursion formula for the coefficients is sufficient, you needn't write out the solution in closed form.

**Due date:** Monday, June 20, 2005, 1:00 pm (in the slots outside room 208.1 of the Mathematics Building)