



PDE and Boundary-Value Problems (Winter Term 2016/2017)  
Assignment H1 - Homework

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**Problem 1.1 (Classification - 4 Points)**

Classify the following equations:

$$\begin{array}{ll} \text{(a)} & u_t = u_{xx} + 2u_x + u \\ \text{(b)} & u_t = u_{xx} + e^{-t} \\ \text{(c)} & u_{xx} + 3u_{xy} + u_{yy} = \sin x \\ \text{(d)} & u_{tt} = uu_{xxxx} + e^{-t} \end{array}$$

**Problem 1.2 (Transformation into normal form - 12 Points)**

Transform into normal form the following equations

$$\begin{array}{ll} \text{(a)} & u_{xx} - 2xu_{xy} - \frac{1}{x}u_x = 0, \quad x > 0, \\ \text{(b)} & u_{xx} + 2u_{xy} + x^2u_x = e^{-x^2/2}. \end{array}$$

**Problem 1.3 (Definition of the type - 9 Points)**

Define the type (elliptic, parabolic, etc.) of the following equations

$$\begin{array}{ll} \text{(i)} & xu_{xx} + 2xu_{xy} + (x-1)u_{yy} = 0, \\ \text{(ii)} & u_{xy} - 2u_{xz} + u_{yz} + u_x + \frac{1}{2}u_y = 0, \\ \text{(iii)} & u_{xx} + 2u_{xy} + 2u_{xz} + u_{yy} + 2u_{yz} + u_{zz} - u = 0. \end{array}$$

**Problem 1.4 (Solving PDE - 5 Points)**

Can you find all functions  $u(x, y)$  that satisfy to the equation

$$\frac{\partial^2 u(x, y)}{\partial x \partial y} = 0?$$

How many are there?

**Deadline for submission:** November 2, 10:15 a.m. (Lecture Hall 003, Building E1 3)