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Numerical Mathematics II

Exercise Problems 07

Attention: The approach for getting a solution has to be clearly presented. All statements have to be proved, auxiliary calculations have to be written down. Statements given in the lectures can be used without proof.

1. Find with the approach from Problem 2 from Exercise Problems 06 the general solution of the following linear second order ordinary differential equation

$$y''(x) + (1 + x^2)y'(x) + x^2y(x) = 0.$$

Hint: use $y_0(x) = \exp(-x)$. It is sufficient to give the solution in integral form.

2. Find the general solution of the following linear system of ordinary differential equations

$$\begin{aligned}y'(x) &= x + y(x) + z(x) + u(x) \\z'(x) &= x + z(x) + u(x) \\u'(x) &= x + u(x) .\end{aligned}$$

Hint: use an appropriate ansatz for finding a special solution of the inhomogeneous system.

3. Continue Problem 3(d) from Exercise Problems 06.
 - (a) In addition to the methods from Problem 3(d) from Exercise Problems 06, the method GMRES(restart) with $\text{restart} \in \{5, 10, 20, 30, 40, 50\}$ should be applied for solving the arising linear systems of equations. Use the MATLAB build-in routine with $\text{tol} = 1e - 10$, the maximal number of outer iterations should coincide with the dimension of the problem, and the initial iterate should be the zero vector. How do the numbers of iterations of GMRES(restart) compare with the other methods from Problem 3(d) ? Are there trends with respect to the parameter ε or with respect to the parameter restart ?

The exercise problems should be solved in groups of two students. The written parts have to be submitted until **Tuesday, Dec. 11, 2012** either before one of the lectures or directly at the office of Mrs. Hardering. The executable codes have to be send by email to Mrs. Hardering.