

**Exercises to the classes  
Numerical Methods in Sciences and Technics**

**Exercises no. 7**  
to 17.11.2003

**The solution of exercise 1 is to submit in the exercise classes on Monday, 01.12.2003 !**

Statements given in the lecture can be used in the solution of the exercises without proof. All other statements have to be proved.

1. Extend the matlab script for the coarse grid correction scheme applied to the model problem to a matlab script for the multigrid  $\gamma$ -cycle. The smoother should be the damped Jacobi iteration with damping factor  $\omega = 0.5$ . The input parameters of the multigrid  $\gamma$ -cycle should be
  - $\gamma$ ,
  - number of levels,
  - number of smoothing iterations.

The coarse grid should have two intervals such that the fine grid is determined by the number of levels. Solve the model problem with  $f = 0$  ( $\implies$  solution is  $u = 0$ ) for different  $\gamma \in \{1, 2, 3\}$ , different numbers of levels and different numbers of smoothing iterations  $\in \{1, 2, 3\}$  using the initial iterate

$$u^0(x) = \sin(\pi x) - 6 \sin(7\pi x) + 12 \sin(64\pi x).$$

(Take the values of  $u^0(x)$  in the nodes of the grids to define the initial vector  $u^0$ ). Stop the multigrid  $\gamma$ -cycle if the  $l^2$ -norm of the residual is less than  $10^{-10}$ . Count the number of iteration for achieving this accuracy and present a table with the results.