

# Assignment 2

TMA682, Applied Mathematics

## A Finite Element Solver.

1. Write a computer code which solves the *Diffusion-Reaction Equation*

$$\begin{aligned} -u''(x) + u(x) &= 1, & 0 < x < \pi, \\ u'(0) &= 0, & u(\pi) = 0. \end{aligned}$$

2. Extend the code to also solve the *Diffusion-Convection Equation*

$$\begin{aligned} -\varepsilon u''(x) + \frac{1}{2}u'(x) &= 1, & 0 < x < \pi, \\ u(0) &= u(\pi) = 0, \end{aligned}$$

where  $\varepsilon$  is a constant small parameter of your own choice.

Write a short, yet detailed, report not exceeding 10 pages explaining your work. Be sure to include a commented version of the computer code and a thorough derivation of the underlying *Finite Element Method*. Give some convincing evidence that your code works, e.g., by comparing the obtained numerical results with analytical ones, if possible. Obtain representative graphs of the computed solutions.