Department of Applied Mathematics
Preliminary Examination in Numerical Analysis
January 2014

Submit solutions to four (and no more) of the following six problems. Justify all your answers.

1. **Root Finding.**
   Construct a continuous function $f(x)$, defined over $x \in (-1, 1)$ such that, for any starting point x_0 that is not itself a root, the Newton iterations for solving $f(x) = 0$ will be uniquely defined, stay bounded, but nevertheless fail to converge.

2. **Numerical Quadrature.**
   The trapezoidal rule has error $O(h^2)$ and Simpson's rule error $O(h^4)$, in both cases with even powers only in their full error expansions. These are the first two members of the Newton-Cotes family of methods, with errors (starting from the trapezoidal case) h raised to 2, 4, 4,

4. **Linear Algebra**