Imperial College London
Department of mathematics
Dr I. Shevchenko

Numerical Solution of
Ordinary Differential Equations
M345N7

Assignment 3

The project should be submitted as one zip- or tar-file to i.shevchenko@imperial.ac.uk by the due date. The file should contain all codes used to generate your results and a pdf-file of the report. The assignment must include a pledge that this is all your own work, your name and CID. Any marks received for the assignment are only indicative and may be subject to moderation and scaling.

Exercise 1 (**Explicit and Implicit LMMs**)   % of CW mark: 12

a) Develop an explicit 3-step convergent method of your own design with the highest order of consistency, p, you can achieve. (**% of CW mark: 2**)

b) Develop an implicit 3-step convergent method of your own design with the same order of consistency p. (**% of CW mark: 2**); **Mastery Component**.

c) Solve the initial value problem

$$\begin{pmatrix} x_1'(t) \\ x_2'(t) \end{pmatrix} = \begin{pmatrix} -2 & 1 \\ 998 & -999 \end{pmatrix} \begin{pmatrix} x_1(t) \\ x_2(t) \end{pmatrix} + \begin{pmatrix} 2\sin(t) \\ 999(\cos(t) - \sin(t)) \end{pmatrix}, \quad \begin{pmatrix} x_1(t_0) \\ x_2(t_0) \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}, \quad t = (0, 20].$$

with each method. (**% of CW mark: 3**)

d) Compute the global error e_n vs time for each method. Study how e_n depends on the time step size. (**% of CW mark: 2**)

e) Analyse how many time steps each method needs to achieve the same global error (fix the value of the global error you like). (**% of CW mark: 2**)

f) Explain the results; how do you know that your codes are correct? (**% of CW mark: 1**)