Department of Mechanical Engineering
University of Bath

ME40064: System Modelling & Simulation
ME50344: Engineering Systems Simulation

Tutorial 7: Time Integration Schemes

1. Solve the following ordinary differential equation (ODE) using a forward Euler time integration scheme from t=0 to t=5:

$$\frac{dy}{dt} = -10y$$

The initial condition is:

$$y(0) = 1$$

The analytical solution to this ODE is:

$$y = e^{-10t}$$

Run your code for a range of values of time step to examine the effect on stability and accuracy by comparison to the exact solution.

Reminder, for a general transient equation of the form:

$$\frac{dy}{dt} = f(y,t)$$

the Forward Euler scheme is:

$$y_{n+1} = y_n + \Delta t f(y_n, t_n)$$

2. Now solve the same equation but using the backward Euler scheme. Again test for a range of time step values and compare your results to those for Question 1.

The Backward Euler scheme is:

$$y_{n+1} = y_n + \Delta t f(y_{n+1}, t_{n+1})$$