**EN618/401 Energy Systems Modelling and Analysis**

**Computer Project #1**

1. Consider the ODE with
2. Write programmes to solve the ODE using implicit Euler, explicit Euler, trapezoidal and RK4 schemes.
3. For each scheme draw a graph with plots using different values of timestep (). There will be total four graphs or figures. Also, plot the exact solution in the same graph. Take both in stable and unstable region (for the schemes which are conditionally stable.) Plot at least for 5 values of with only one in unstable region. (Choose values appropriately).
4. At *t* = 5, compute error and draw a loglog plot of error versus . For this plot use only in the stable region.

Write interpretation for each figure with figure number (in terms of error , stability etc.).

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2. Write programmes to solve the ODE using implicit Euler, explicit Euler, trapezoidal and RK4 schemes.
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Write interpretation for each figure with figure number (in terms amplitude and phase error).

1. Consider Example 4.4 in the reference book (book by Parviz Moin).
2. Write programmes for linearized and non-linear solution using implicit Euler and trapezoidal scheme. (You will need to derive implicit Euler linearized scheme. Include the derivation and non-linear scheme in your report.)
3. Plot error at t = 1 similar to figure 4.7 for both trapezoidal as well as Euler scheme. All plots should be on the same graph.