Computer Lab

- Create a subdirectory **Proj1** within the existing directory **MA302**.
  - ◇ Move all files relevant to the first project into directory **Proj1**, including the write-up of your report.
  - ◇ Change into this directory and work from within this directory.
- Use the RKF45 routine *ode45.m* in MATLAB to solve your differential equations.
  - ◇ Always set $AbsTol = RelTol \leq 10^{-7}$.
  - ◇ If your problem involve some parameters, try different values of the parameters. Watch for the qualitative difference, if any, of these solutions.
  - ◇ Always ask yourself the question, "How can I trust the numerical solution without knowing the true solution?"
- Post-processing of your output:
  - ◇ The output **[t,y]** of your solution is a matrix where data are stored as

$$\begin{bmatrix} t_0 & y_1(t_0) & y_2(t_0) & \dots \\ t_1 & y_1(t_1) & y_2(t_1) & \dots \\ t_2 & y_1(t_2) & y_2(t_2) & \dots \\ \vdots & \vdots & \vdots & \end{bmatrix}.$$

    That is, the first column contains all values of the independent variable t that has been generated by the *variable step sizes*, the second column (the first column of y) contains all solutions of the first dependent variable y_1 at the corresponding values of t, the third column (the second column of y) contains solution information of y_2, and so on.
    - ▷ You may use command **size([t,y])** to check the size of your matrix.

- ▷ Use **who** or **whos** to check what variables have been defined.

◇ If your problem is 2-dimensional,

- ▷ Use **plot(y(:,1),y(:,2))** to plot the phase portrait.
- ▷ Use **plot(t,y(:,1),'r',t,y(:,2),'b')** to plot the $y_1(t)$ in *red* and $y_2(t)$ in *blue*, respectively, versus t on the same figure. You certain can change to other colors.

◇ If your problem is 3-dimensional,

- ▷ Use **plot3(y(:,1),y(:,2),y(:,3))** to plot the phase portrait in R^3. This is going to be a space curve.
- ▷ If you want to see the behavior of y versus t, use the **plot** command.

◇ You can hold the pictures by the command **hold** or **hold on**.

◇ You can open another window to draw additional graphs by using the command **figure(k)** where k is the window id.

◇ Text can be added to the plot by the command **text(x,y,'string')** where (x, y) is in units from the current plot and *string* can be any text you want to add. For 3-D plot, use (x, y, z) as the coordinates. This will help readers to identify which curve is what.

◇ You can plot several graphs in tiled positions, i.e., you can break the current window into an array of small windows for different graphs. Check out the command **subplot** for more details.

- How to print graphs?

◇ The best way to do is to first save the graph(s) to a file. The syntax of the command to be used is

$$\textbf{print}[-\textbf{ddevice}][-\textbf{options}] < \textbf{filename} >$$

where *device* can have many choices depending on what you intend to do with the file. Type **help print** to see the options.

◇ The graphs can then be inserted to the text of your report.