SIMULATION OF ODES USING MATLAB

(Dr. Tom Co, 1/28/08)

Given the set of differential equations:

$$\frac{dx}{dt} = -\mu x \exp\left(-\frac{\beta}{y}\right) + \gamma - \alpha x$$
$$\frac{dy}{dt} = -\eta y + \phi x \exp\left(-\frac{\beta}{y}\right) + \omega$$

Step 1. Create a model file (and save it as CSTR1.m):

```
function dz = cstr1(t,z)

    x=z(1);
    y=z(2);

    alpha = 8    ;
    beta  = 15.2 ;
    mu    = 0.2  ;
    eta   = 22   ;
    omega = 40   ;
    phi   = 200  ;
    gamma = 35   ;

    dx    = -mu*x*exp(-beta/y) + gamma  - alpha*x ;
    dy    = -eta*y + phi*x*exp(-beta/y) + omega   ;

    dz  = [dx;dy];
```

Step 2. In the matlab command window, obtain the data using the following commands:

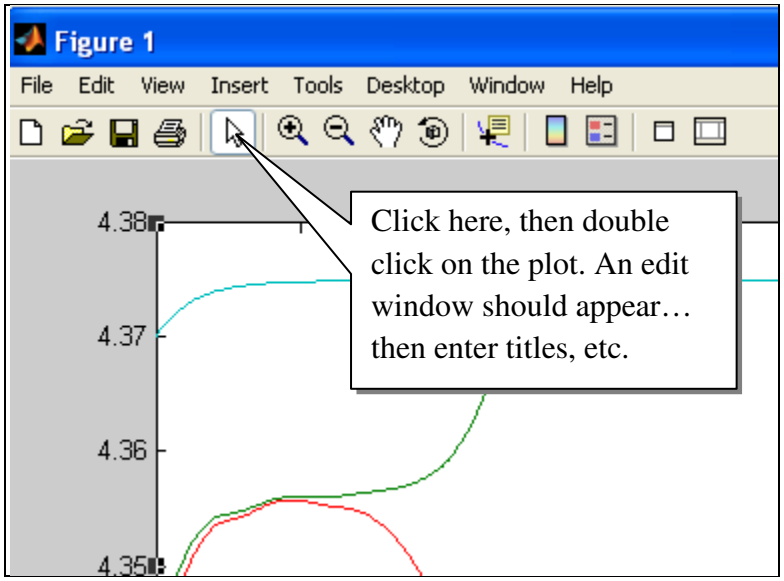
```
>> [ta,za]=ode45(@cstr1,[0:0.01:3],[4.33;20.6]);
>> [tb,zb]=ode45(@cstr1,[0:0.01:3],[4.344;8.6742]);
>> [tc,zc]=ode45(@cstr1,[0:0.01:3],[4.34;8.685]);
>> [td,zd]=ode45(@cstr1,[0:0.01:3],[4.37;1.6]);
>> xa=za(:,1);
>> ya=za(:,2);
>> xb=zb(:,1);
>> yb=zb(:,2);
>> xc=zc(:,1);
>> yc=zc(:,2);
>> xd=zd(:,1);
>> yd=zd(:,2);
```

Plot the data using Matlab (steps 3-6 below) or export to Excel (steps 3A-4A).

Step 3. In the matlab command window, plot xa vs ta, etc.:

```
>> plot(ta,xa,tb,xb,tc,xc,td,xd);shg
```

Step 4. Once the figure window pops up, edit the plot



Step 5. After editing the plot in the Figure window, select [File]→[Save As], and save in the desired format (I recommend EPS file format) which could then be imported to a word document.

Step 6. Repeat for steps 3-5 for y plots, i.e. *ta* vs *ya*, etc.

Alternatively, instead of steps 3 to 6, you can export the data to excel as follows:

Step 3A: Export data into a text file as follows:

```
>> tza=[ta za];
>> tzb=[tb zb];
>> tzc=[tc zc];
>> tzd=[td zd];
>> save dataA.txt tza -ascii -tabs
>> save dataB.txt tzb -ascii -tabs
>> save dataC.txt tzc -ascii -tabs
>> save dataD.txt tzd -ascii -tabs
```

Step 4A: Go to Excel, then import the files using [Data]→[Get External Data]→[From Text] menu item.