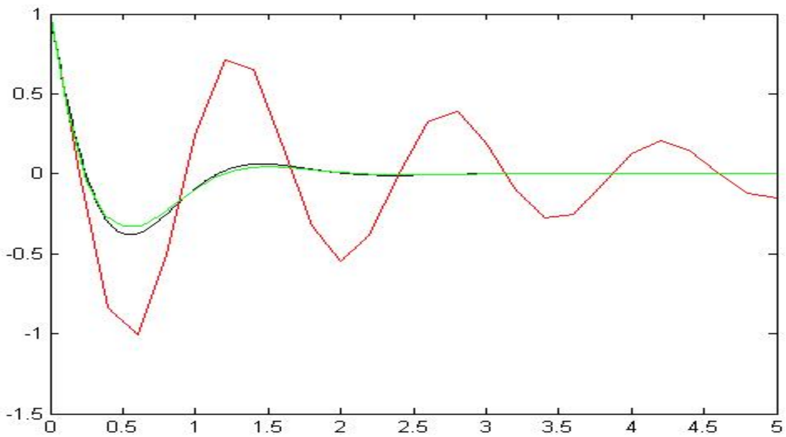
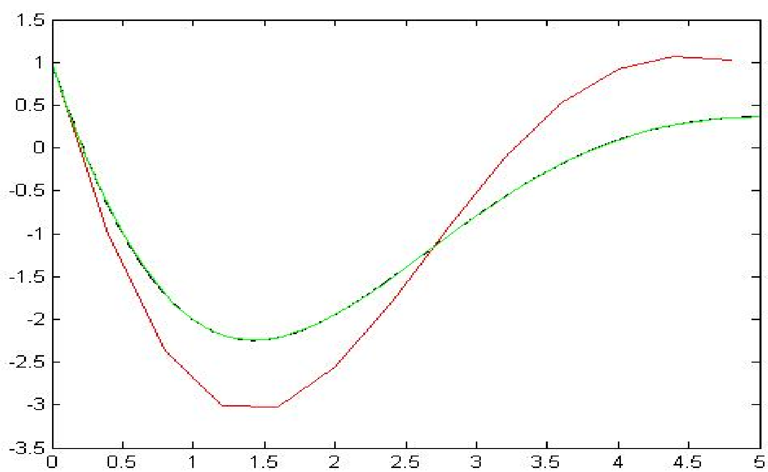
ii) Bad integrations: (Black-Analytical; Red-Euler; Green-ODE45)

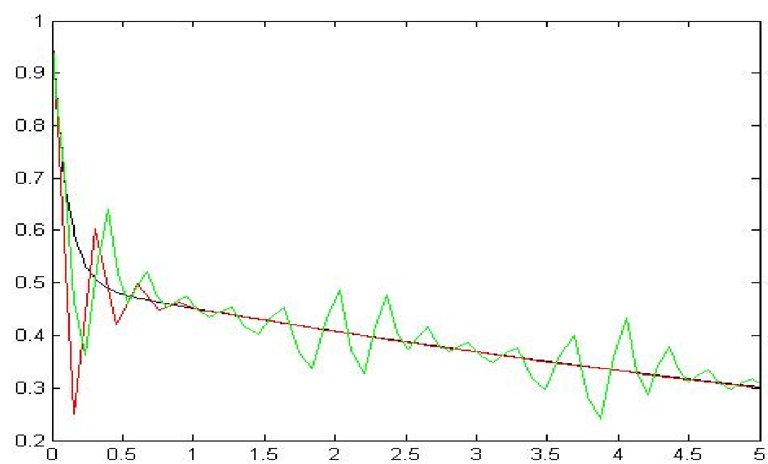
1: wn=4; Z=0.5 (dtE=0.2, RelTol=AbsTol=1e+20)



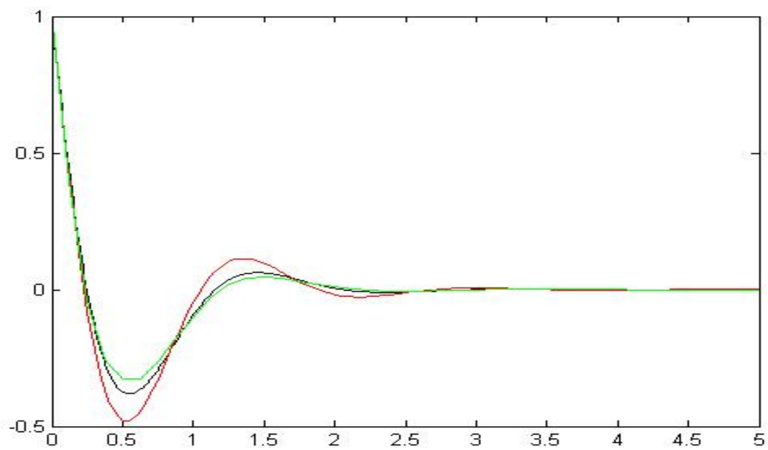
2: wn=1; Z=0.5 (dtE=0.4, RelTol=AbsTol=1e+20)



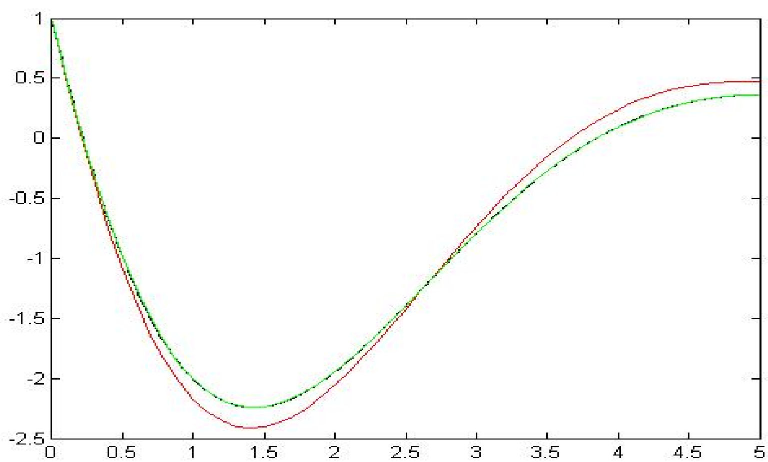
3: wn=1; Z=5 (dtE=0.15, RelTol=AbsTol=1e+0)



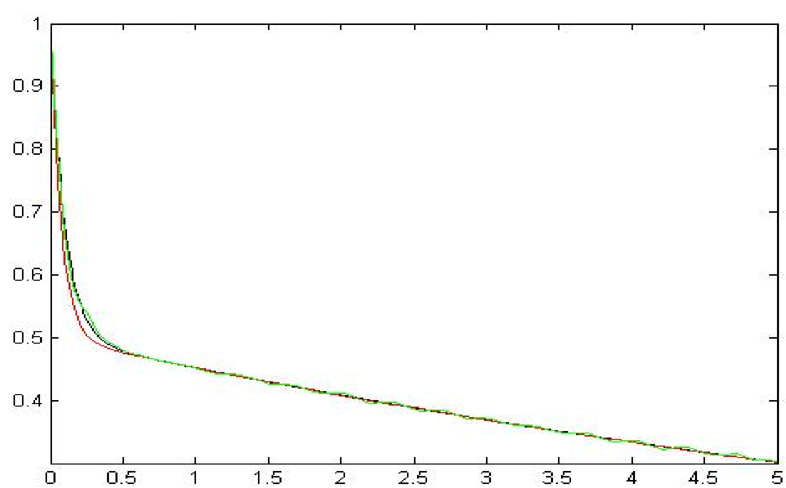
Good Integrations: (Black-Analytical; Red-Euler; Green-ODE45)
1: wn=4; Z=0.5 (dtE=0.05, RelTol=AbsTol=1e+10)



2: wn=1; Z=0.5 (dtE=0.1, RelTol=AbsTol=1e+10)



3: wn=1; Z=5 (dtE=0.05, RelTol=AbsTol=1e-1)



iii) The step size in Euler method is adjusted in a decreasing order to try and find the proper value which generates a good match, e.g., from 0.4 to 0.3. to 0.1….The relative and absolute errors for ode45 are adjusted in the same way.

For the Euler method, increases in the Z and wn require a smaller step size to maintain the goodness of the match, which is evident in the three figures for the “good” integrations.

For the ODE45 method, change in the wn does not appear to have a significant impact on the relative and absolute errors, which is shown by the Fig 1 and Fig.2 of the “good” integrations. Increase in the Z does require a substantial decrease in the relative and absolute errors to get a good match, which is illustrated by comparing Fig.2 and Fig. 3 of the “good” integrations.

iV) A smaller step size will be used and the numerical solution will be computed again, the new and previous numerical solutions will be compared. If the differences between them are approaching zero or small enough, you can know that you have an accurate numerical solution.