a) $\dfrac{d^2y}{dt^2} - u * (1 - y^2) * \dfrac{dy}{dt} + y = 0$

$y_1 = y \ and \ y_2 = u^{-1} * \dfrac{dy}{dt}$

$\dfrac{dy_1}{dt} = uy_2$

$\dfrac{dy_2}{dt} = u * (1 - y_1{}^2) * y_2 - y_1 * u^{-1}$

b) Check the submitted code

c) ode45 vs ode15s Test cases:

    i)   u = 0.1 and run for ΔT = 100

        ode45: Elapsed time is 0.013029 seconds.

        ode15s: Elapsed time is 0.054804 seconds.
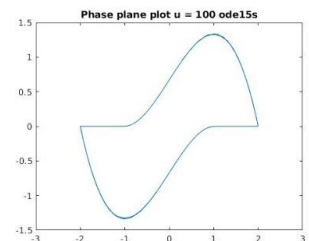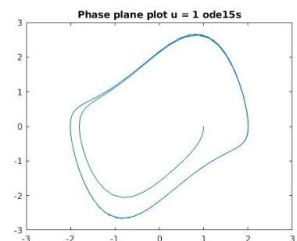
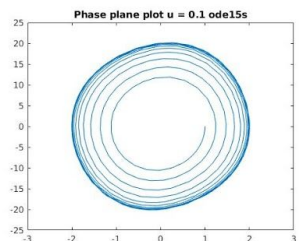   ii)   u = 1 and run for ΔT = 100

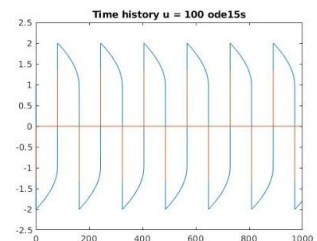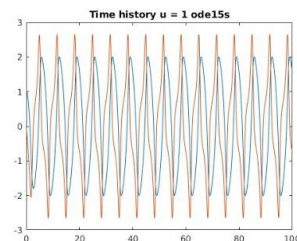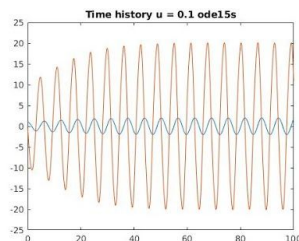   ode45: Elapsed time is 0.036793 seconds.

        ode15s: Elapsed time is 0.118220 seconds.

    iii)   u = 100 and run for ΔT = 1000

        ode45: Elapsed time is 3.664740 seconds.

        ode15s: Elapsed time is 0.253529 seconds.

d)

    From the plot it can be observed that the amplitude has a damping term subtracted from it as time increases the the damping term becomes zero and the amplitude reaches its maximum.