Assignment 8

➽ **Read the assignment carefully! Remember that the first line of a script must be the call to the script preamble.**

A. Mandatory

A highly simplified model of population dynamics is the *Verhulst-Pearl model*:

$$y' = k\,y\,(1 - y/M),$$

where k is the growth rate, and M is the population limit (carrying capacity).

Write a MATLAB script with the name Assignment08A_IDxx.m[1] that solves the following problems, using dsolve and symbolic computation.

1. Find and display the general solution $y(t)$ that is not a constant. No hard coding!
2. Find, display and plot the particular solution $y_1(t)$ with $k = 0.025$, $M = 12000$ and $y_1(0) = 600$ in the time interval $0 \le t \le 300$.
3. Compute the time t_1 at which the population size $y_1(t)$ surpasses q percent of the carrying capacity M, with $q = 90$. Show t_1 converted to double in the command window and by a vertical line in the plot.
4. Compute the time t_2 at which the instantaneous growth rate (first derivative) of $y_1(t)$ attains its maximum. Show t_2 converted to double in the command window and by a vertical line in the plot.

Add axis labels, a title, and a comprehensive legend to the plot. *(3 pt)*

B. Mandatory

Write a MATLAB script with the name Assignment08B_IDxx.m[1] that computes the numerical solutions to the second-order nonlinear ODE called *van der Pol's differential equation*:

$$y'' - \mu(1 - y^2)y' + y = 0,$$

with the initial conditions $y(0) = 2, y'(0) = 0$, for both $\mu = 1$ and $\mu = 10$. Create a figure and plot the solution $y(t)$ for $\mu = 1$ in the interval $0 \le t \le 20$ and for $\mu = 10$ in the interval $0 \le t \le 100$, in two subplots of the figure. *(2 pt)*

➽ **Continued on page 2!**

[1] xx is your (group's) ID number

C. Optional

Write a MATLAB script with the name Assignment08C_IDxx.m[2] that computes a numerical solution to the second-order linear ODE called *Mathieu's differential equation*:

$$y'' + [a - 2q\cos(2t)]y = 0,$$

in the interval $0 \leq t \leq 100$, for $a = 1.25$, $q = 0.25$ and the initial conditions $y(0) = 0, y'(0) = 2$. Plot the solution $y(t)$ and its derivative $y'(t)$ superimposed in the same figure. *(2 pt)*

➽ **Make sure that the relevant results and *only* those are shown in the output to the command window. Submit the script(s) until 5pm on May 26, 2021. Don't forget to put your partner in cc! Any violation of the naming convention will lead to the rejection of the submission.**

[2]xx is your (group's) ID number