Assignment

(Type 3: Duffing oscillator)

Consider the Duffing oscillator, whose model is

$$\begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = -\delta x_2 - \beta x_1 - \alpha x_1^3 + \gamma \cos(\omega t) \end{cases}.$$

Complete the following.

1. Discuss the history of the system and its applications.
2. Simulate the system in Matlab/Simulink. Then, illustrate and explain the most relevant behaviour/s.
3. Set up **2** networks composed each of 4 nodes, connected in a linearly diffusive fashion. For each of the two networks choose one between the following topologies:
   - ring graph;
   - path graph;
   - star graph;
   - all-to-all graph.

   Simulate the two networks and describe briefly what happens for different values of the (single) coupling gain.
4. Select **1** of the two networks you realised. Add one or more controlled nodes to try to control the network towards a desired trajectory. Discuss the results you got.