# Assignment-5 deadline: 8th March, 2015

Assignments must be submitted in the form of report along with MATLAB codes.

**Provide graphs in your report** (use “hold on” and “subplot” wherever necessary to generate the graphs) to support your observations and conclusions. Sample codes made during the lectures are placed in lecture folder for reference.

Instruction regarding submission of report will be provided by the Lab instructors.

**Reference: Lecture19 slides**

## 1. Oscillations (SHM) (continuation from Assignment-3, last problem):

Study the effects of damping in the case of a pendulum by starting with some initial angular displacement say (theta=.5 radians) and study how the motion decays with time. Repeat the simulations for different values of damping constant and investigate its effect on the oscillations. What is the effect of different initial conditions on freq. of damped oscillations?

Investigate all the cases - underdamped, overdamped and crticially damped oscillations as discussed in the class. Report about the choice of initial conditions which lead to the above mentioned cases. Plot your result in a single graph for 3 cases. In which of the above cases the pendulum comes to the equilibrium position - the fastest i.e. minimum time to reach at rest.

Plot Phase space plot for all the three cases and explain the nature of the curve.

For analytical solution and initial condition, you can refer to problems 3.2, 3.3 (Marion and Thornton)

**You can also take the case of Spring-Mass system instead of a pendulum for your investigations. For the case/code discussed in the class today you can start with the following parameters (initial v=0; initial displacement=100; w0=1, beta=2)**

2. **Driven (damped) Oscillator:**
   Investigate the above problem (particularly the under damped case) with an external force with a given freq as discussed in the class. Compare the initial/transient behavior with the steady state behavior.

   **You can also take the case of Spring-Mass system instead of a pendulum for your investigations. [For the case/code discussed in the class today you may start with the following parameters (initial v=0; initial displacement=100; w0=1, beta=.5, F=1000; wd=10)**

   Generate a graph for frequency (driving frew. omega) vs. amplitude of the oscillating system for different values of $\beta$ (beta) (scan over freq. with some$\Delta\omega$, starting from $\omega$=0 to $\omega=5\omega_0$). Note down where is the maximum amplitude for a given $\beta$. (i.e. computationally reproducing the figure 3.16 from Marion and Thronton using "for" loop, we are interested in stady state solution). Also investigate the phase angle between the driving force and the resultant motion computationally, supported by figure.

   Also refer problem 3.24 (Marion and Thronton) for further investigations.