Q1: A torsional oscillator made of a disk with moment of inertia, I , hanging from a light rod with torsional torque . The disk also experiences a *drag torque* equal to , when moving with angular velocity . The top of the rod is driven with a driving torque:

where = last non zero digit in your registration number

1. Write the equation of motion without damping and driving torque
2. For initial conditions at , write the solution for
3. By adding a *drag torque* equal to without the driving torque what is the condition for critical damping case.
4. Find the transient solution for for the case in part (c) with initial conditions at ,
5. Now adding the torque given in the problem. Find the *steady-state* solution for
6. What is the phase difference between the driving torque and
7. For the general case where Plot the amplitude and phase of your solution for the general solution as a function of . For your plot, assume that the natural frequency of oscillation of the system , and plot two curves on the same plot with . Label your curves to distinguish the two cases