# Section 1 Example Statements

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**Example 1.1** -Consider a simple mass-spring system with m=1, k=1, no input, x(0) = 1, v(0) = 0.

The system equation is given by $m \cdot \ddot{x} + k \cdot x = 0$.

Determine the following:
a) Use Euler's method with a step size of 0.03 to numerically solve for a time of 15 s and compare to the exact solution.

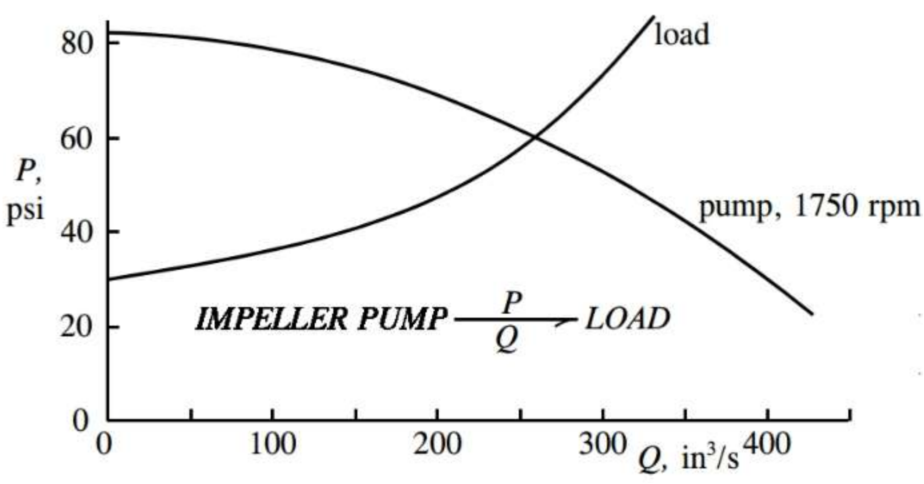
b) Repeat a) with a step size of 0.01.

c) Use a 4th order RK method with a step size of 0.03 to numerically solve and compare to the exact solution.

**Example 1.2** Consider a permanent magnet DC motor connected to a linear torsional damping load. The motor torque is dependent on the speed according to the following relationship: $T = 5 - 0.5 \cdot \omega$, where torques is in N-m and $\omega$ is in rad/s. The linear torsional damping coefficient is $B = 2 \cdot N \cdot m \cdot s$.

a. Plot the source and load curves
b. Find the equilibrium point
c. Find the initial angular acceleration if the source and load have a combined inertia of 0.25 $kg \cdot m^2$

**Example 1.3** (See textbook example 2.1, repeated here for convenience) The output pressure of an impeller pump reduces the net flow below that of the geometrically slip-free flow. The result is a nonlinear source characteristic, as plotted below. The particular load characteristic plotted in the figure also is nonlinear, typical of flows through sharp restrictions as discussed above and as employed in the water -sprinkler nozzles of section 2.1. Determine the equilibrium state for the combination of these elements, and its stability.




**Example 1.4** Use the trial and error approach to find the maximum power point for the pump in example 1.3.

**Example 1.5**: Finding the maximum power point for the motor in example 1.2 using a) constant power contours and b) calculus methods.