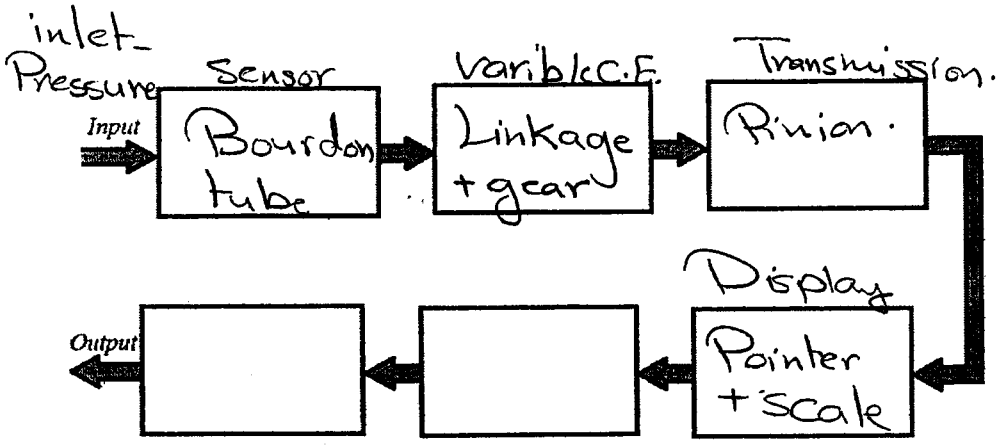
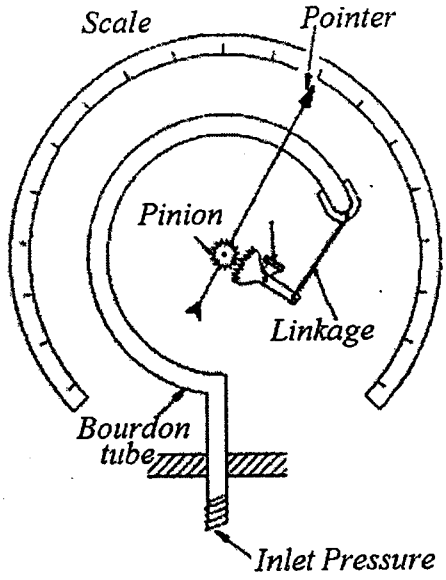
oblem 2(3 Points)

For the shown Bourdon Tube Pressure Gage, Identify the main measuring system Elements as well as the measured and output variables. (Note: there might be some extra boxes in the diagram below)





Problem 3(4 Points)

For the second order measuring system governed by the equation:

$$2q_i = \overset{q_0}{2}q_o + \overset{q_1}{0.12}\frac{dq_o}{dt} + \overset{q_2}{0.005}\frac{d^2q_o}{dt^2}$$

Find the following:

a. Natural Frequency

$\left(\frac{q_0}{q_2}\right) = \omega^2 \Rightarrow \omega = \sqrt{\frac{2}{0.005}} = 20$

b. Damping Ratio (what is the system condition)

$\zeta = \left(\frac{q_1}{q_0}\right)\frac{\omega}{2} = \left(\frac{0.12}{2}\right)\frac{20}{2} = 0.6$ under dumped.

c. Steady State Output value if the input value was (7 V)

$K = \frac{2}{2} = 1 \Rightarrow q_o = K q_i \Rightarrow q_{o_{ss}} = 7V$

d. System output after (125 msec) for the same input in (c)

$q_o = 7\left(1 - e^{-(0.6)20(125\times10^{-3})}\sin\left(\sqrt{1-0.6^2}\,20(125)\times10^{-3} + \Phi\right)\right)$

$\Phi = \sin^{-1}\sqrt{1-0.6^2} = 0.927$

$q_o = 7\left(1 - e^{-1.5}\sin(2.927)\right) = (1 - 0.0475)7$

$= 6.667\ V$