Homework-7 NE-620 Due: 05/01/2017

1. During a reactor coolant discharge transient due to a break in the coolant system, the reactor vessel continuously losses its pressure. The initial stagnation pressure $P_0$ (i.e. inside the vessel) and ambient pressure $P_a$ are such that they lead to critical or maximum flow. Find the time (can be named as critical time) it would take to decrease the vessel pressure to reduce the discharge flow below maximum or critical value. What is the mass of air in vessel (Volume = 10 $m^3$) at this critical time if initial pressure inside the vessel is 15 MPa (filled with air)? Temperature remains equal to 300 K inside and outside the vessel. Outside or ambient pressure is 0.101 MPa. (20 points)

(Hint: $\frac{dM}{dt} = -W$, where $W$ is the mass flow rate and $M$ is the mass of fluid in the tank.) Assume adiabatic expansion during the discharge and fluid is ideal gas.

2. Consider a system at internal pressure, $P_0$ and slightly sub-cooled i.e. at temperature slightly below saturation temperature. Under a break condition as specified in the RELAP input 'edwardspipe.i', find how maximum discharge flow rate and void fraction vary with different initial pressure conditions i.e. 0.2 MPa to 7.2 MPa with intervals of 0.5 MPa. Also show how the pressure of system varies under such break condition and what is the blow-down time for system under initial pressure of 5 MPa.