EN 634 – Nuclear Reactor Thermal Hydraulics and safety

Assignment -5

1. Starting from the basic definition of x, Show that $x = \frac{1}{1+\frac{\rho_l}{\rho_g}\frac{1-\alpha}{\alpha}\frac{1}{s}}$. Now rearrange the above expression to get $s = \frac{x}{1-x}\frac{1-\alpha}{\alpha}\frac{\rho_l}{\rho_g}$ and $\alpha = \frac{xv_g}{xv_g + s(1-x)xv_l}$
2. Show that $\beta = \frac{xv_g}{xv_g + (1-x)v_l}$
3. Starting from the definition of static density discussed in the class, for s = 1, eliminate α by using α-x-s relation and show that $\rho_{2\varphi}=1/(v_f(1-x)+v_g x))$
4. From the definitions, show that $u_g = G\left(xv_g + s(1-x)v_l\right)$ and $u_l = G\left(\frac{xv_g + s(1-x)v_l}{s}\right)$. Now proceed to show that if s = 1, $u_g = u_l = u_H = G\left(xv_g + (1-x)v_l\right)$. Now express j_g+j_l in terms of G, v_g and v_l and show that $j_g+j_l = u_H$, using the definition given above.
5. Show that. $\frac{u_H}{u_l} = \frac{1-x}{1-\beta}$
6. A bubbly mixture flows in a 25.4 mm pipe. The gas flow rate is 5 X 10^{-4} m^3/s and the bubble velocity was determined photographically to be 30 m/s. What is the void fraction? What is the liquid velocity if the liquid flow is 2.5 litres per second.
7. 130 kg/hr of air at 25 ^oC and 1.5 bar(a) flows together with 130 kg/hr of water in a 32 mm diameter pipe. What is the overall volumetric flux j? If the drift flux j_{gf} is 3 m/s, what are the average velocities of the phases.
8. Steam-water mixture with 1% quality flows at 1 bar(a) in a tube. The measured void fraction is 80%. What is the slip ratio?
9. On a graph of j_2 vs j_1, for phases with given properties, show the lines of constant j, constant G and constant x. Can a line of constant α be drawn? why?