King Abdulaziz University
Faculty of Engineering
Mechanical Engineering

MEP 460
Heat Exchanger Design
Spring 2022
HW. # 02

Homework on boiling and condensation, Ch. 10 of Incropera 7th Edition textbook

Problem	Modification	6th edition
10.12	Change T_s from 115 to **117.0** °C	
10.14a	Change q_s'' to be **85%** of q_{max}'' instead of 50%	
10.30	Change T_s to **600 °C**	
	10.30 a Calculate the minimum film pool boiling heat flux (at Leidenfrost point) 10.30 b What will be the surface temperature T_s at Leidenfrost point when considering only convective film boiling 10.30 c What will be the corresponding surface temperature and the excess temperature if one assumes the heat flux at Leidenfrost point is operating in the nucleate pool boiling region.	

Additional problem

Starting with the equation for $\bar{h}_L$ for laminar film condensation on vertical plate (as given by Eq. 10.31), drive equation 10.38 which is

$$\overline{Nu}_L = \frac{\bar{h}_L (\nu_l^2/g)^{1/3}}{k_l} = 1.47 Re_\delta^{-1/3}$$

Where Re_δ is given by

$$Re_\delta = \frac{4 g \rho_l (\rho_l - \rho_v) \delta^3}{3 \mu_l^2}$$

Notice that from Eq. (10.26), one can write

$$\delta^4 = \frac{4 k_l \mu_l (T_{sat} - T_s)\, L}{g\, \rho_l (\rho_l - \rho_v)\; h'_{fg}}$$

Also use the approximation

$$\rho_l (\rho_l - \rho_v) \approx \rho_l^2$$