Homework 2 **Deadline: 14 Apr 2019 (23:59 PM)**

It is often a convenient practice, yet reliable in most applications, to replace a reservoir fluid by a binary mixture in simulating certain reservoir processes in the laboratory. A reservoir hydrocarbon fluid has been modelled by a mixture of **C1** and **nC10** (**60-40 mole%**). The initial reservoir temperature and pressure are **377.6 K** and **32.4 MPa**, respectively.

a) Calculate the bubble point (p_b) of the fluid through using **PR EOS**. (Use the proposed algorithm)

b) Plot the trend of correcting the assumed pressure versus iterations.

c) Describe why the introduced error in step 10 should theoretically converges to zero.

d) Fill the following table, and also determine if the given mixture at the above-mentioned thermodynamic conditions of pressure and temperature is Under saturated (U) or Saturated (S) oil reservoir. Accordingly, discuss the generated results about the effects of mixture compositions on the calculated p_b.

No.	C1	nC10	p_b	U/S
1	0.5	0.5		
2	0.6	0.4		
3	0.7	0.3		
4	0.8	0.2		

The Proposed Algorithm:

1. The required properties of all components (MW, T_C, P_C, ω_i) are read from the PVT tables.
2. Calculate the PR EOS relevant parameters for each component. (a_i, b_i, α_i)

3. Assume a p_b as an initial guess. (Make it equal to the initial pressure. It has a technical reason which has already been discussed)
4. Calculate a set of equilibrium ratios (K_i) for the mixture. It is typically recommended to use *Wilson's model*.
5. Calculate the composition of the vapour phase. $\left(K_i = \frac{y_i}{x_i}\right)$
6. Forming the coefficients of ***A*** and ***B*** for ***each phase***.
7. Calculate Z^L and Z^v.
8. Calculate the ***fugacity coefficient*** of both components in each phase. The required model for liquid phase is $\ln \phi_i^L = \frac{b_i(Z^L-1)}{\sum_i x_i b_i} - \ln(Z^L - B^L) - \frac{A^L}{2\sqrt{2}B^L}\left[\frac{2[\sum_j x_j \sqrt{a_i \alpha_i a_j \alpha_j}(1-k_{i,j})]}{\sum_i \sum_j [x_i x_j \sqrt{a_i \alpha_i a_j \alpha_j}(1-k_{i,j})]} - \frac{b_i}{\sum_i x_i b_i}\right] \ln\left[\frac{Z^L+(1+\sqrt{2})B^L}{Z^L+(1-\sqrt{2})B^L}\right]$. For vapour, $L \Longrightarrow v$ & $x \Longrightarrow y$.
9. Calculate the ***fugacity*** of both components in each phase. (Slide No. 79)
10. Evaluate the Error as $\sum_i^N \left(1 - \frac{f_i^L}{f_i^v}\right)^2$.
11. If the output of step 10 is not less than 10^{-12}, update the K_i by means of fugacity coefficients. It has been described in Slide No. 80. If the calculated error satisfies the requirement of 10^{-12}, the employed pressure is equal to the p_b.
12. The updated K_i are then taken to correct the assumed pressure. $\left(p_b^{j+1} = p_b^j \sum_i^N x_i K_i\right)$
13. Go back to Step 5.

If you have any question about the homework, you are very much welcome to have contact with me, or you can come to my place, blue building, in front of room 210.