



CHEMICAL ENGINEERING THERMODYNAMICS II (0905323)
06. BUBBLE-P AND DEW-P USING RAOULT'S LAW

ALI KH. AL-MATAR (aalmatar@ju.edu.jo)

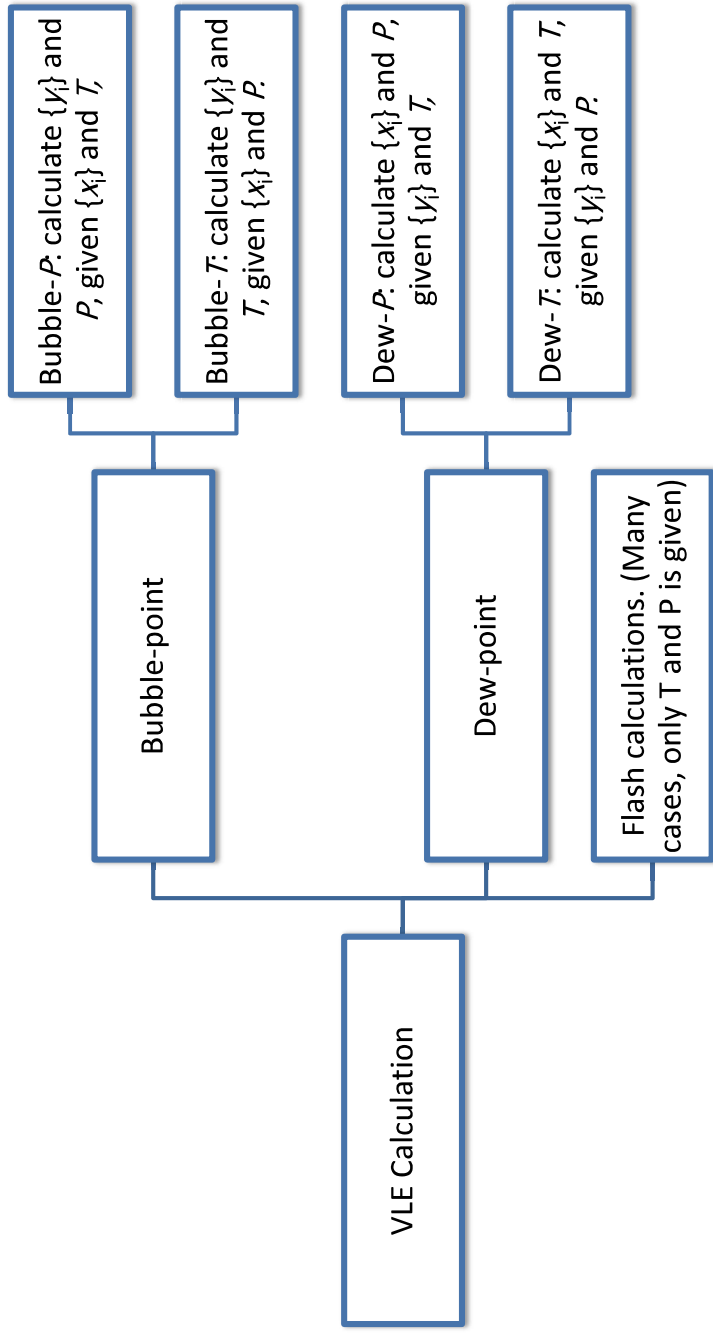
Chemical Engineering Department
University of Jordan
Amman 11942, Jordan

Outline

- VLE Calculations: Ideal Solutions
- Hierarchy of Complexity
- Bubble-*P*: Concept and Algorithm
- Dew-*P*: Concept and Algorithm
- Examples

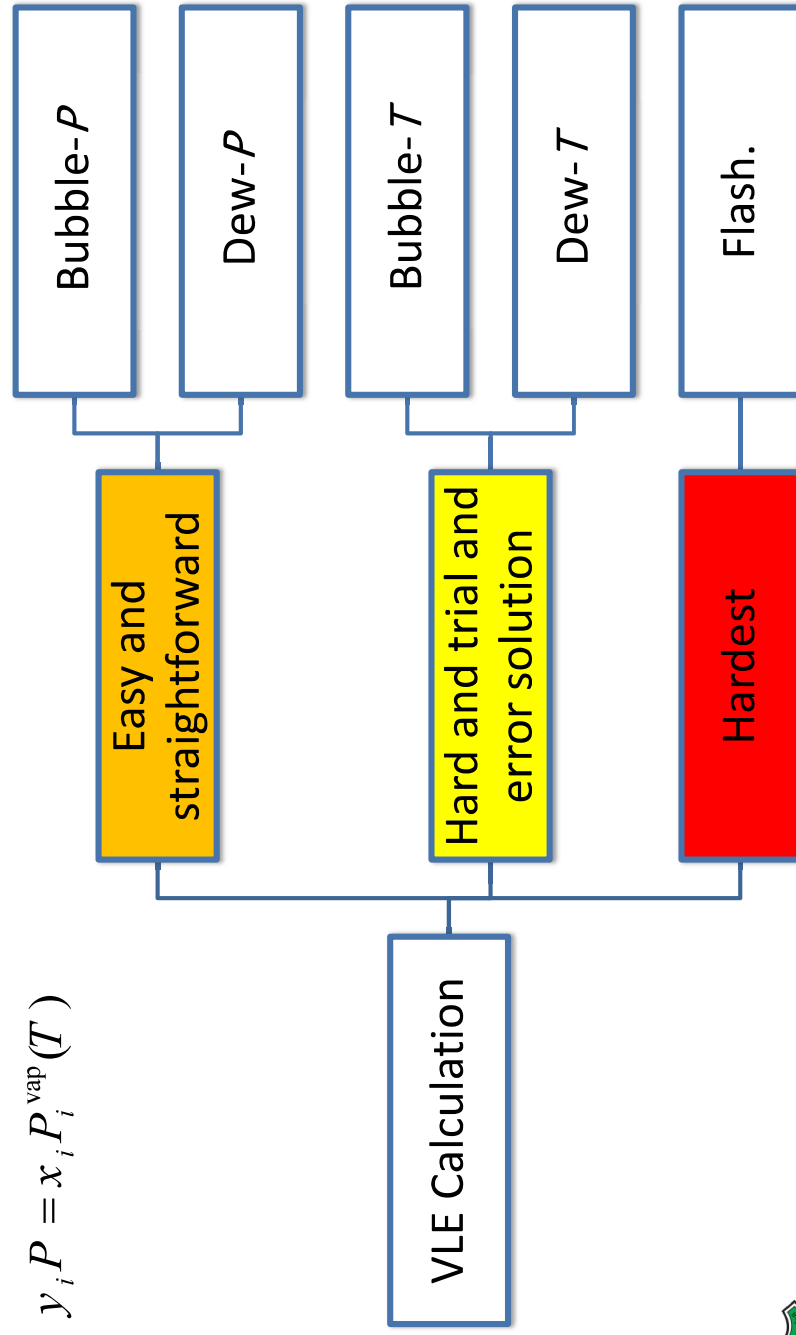


VLE Calculations: Ideal Solutions

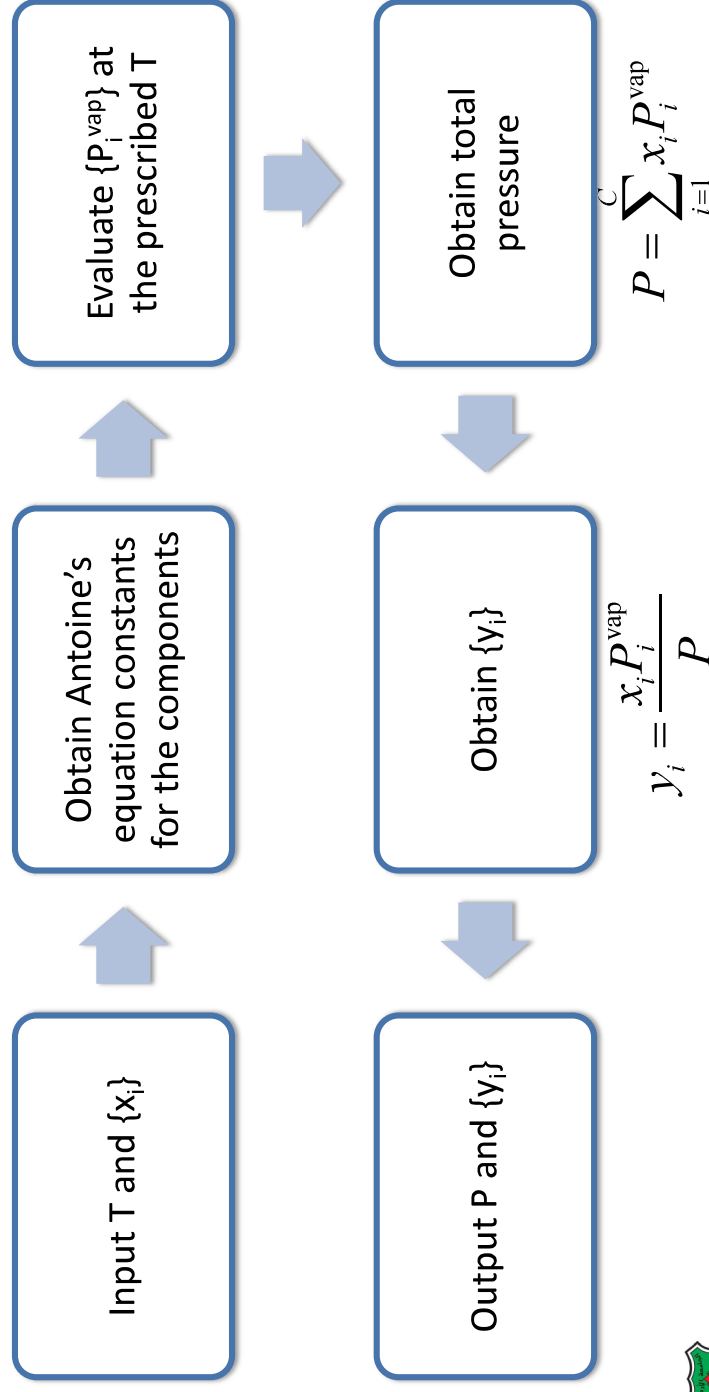


Hierarchy of Complexity

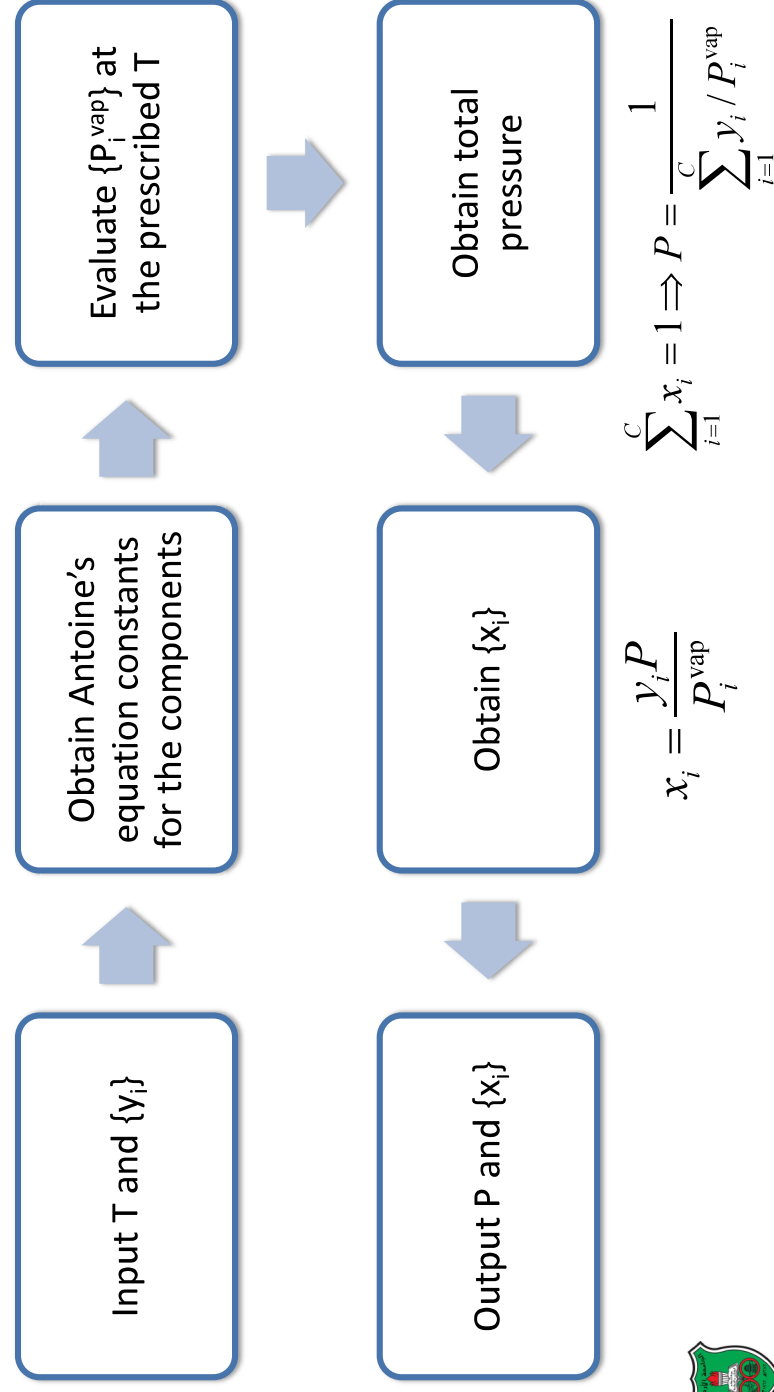
$$y_i P = x_i P_i^{\text{vap}}(T)$$



Bubble-P: Concept and Algorithm



Dew-P: Concept and Algorithm



Example: Bubble-P

■ Consider the system: benzene, toluene and m-xylene (BTX). A liquid solution of these components has the composition $\mathbf{x} = \{0.4, 0.3, 0.3\}$ for the components in their respective order at $T = 300$ K. Wanted: find the equilibrium pressure and vapor compositions at the prescribed conditions.



xi	A	B	C	P*	xiP*	yi=xiP*/P
Benzene	0.4	9.2806	2788.51	-52.36	0.138105	0.055242
Toluene	0.3	9.3935	3096.52	-53.67	0.041706	0.012512
m-Xylene	0.3	9.5188	3366.99	-58.04	0.012318	0.003695
				P	0.071449	1

K_i		
1.932914	α_{12}	3.311427
0.58371	α_{13}	11.21155
0.172404	α_{23}	3.385715



Example: Dew-P

■ Consider the system: benzene, toluene and m-xylene (BTX). A vapor phase of these components has the composition $\mathbf{y} = \{0.4, 0.3, 0.3\}$ for the components in their respective order at $T = 300$ K. Wanted: find the equilibrium pressure and liquid compositions at the prescribed conditions.



	y_i	A	B	C	p^*_i	y_i/p^*_i	$x_i=y_iP/p^*_i$
Benzene	0.4	9.2806	2788.51	-52.36	0.138105	2.896337	0.084089
Toluene	0.3	9.3935	3096.52	-53.67	0.041706	7.193255	0.20884
m-Xylene	0.3	9.5188	3366.99	-58.04	0.012318	24.35432	0.707072
				P		0.029033	1

K_i	
4.756892	α_{12}
1.436509	α_{13}
0.424285	α_{23}



Quiz

- Determine the bubble point pressure for an equimolar binary system of components A and B. The vapor pressure of A and B are 10 and 12 kPa, respectively.
- Would you recommend ordinary distillation to separate these components? Justify your answer.



- Consider the system: ethanol/and phenol at 1 bar. Would you consider applying Raoult's law to this system? Justify your answer.

