e-Portfolio of Elementary Principles of Chemical Processes

LECTURER: Prof. Dr. Kamarul Bin `Asri

SECTION: 06

LECTURE TIME: Lecture 8.00 am - 10.00 am

Lecture 8.00 am - 9.00 am

Tutorial 9.00 am - 10.00 am

This course introduces student to the chemical engineering profession and the fundamental operations of chemical process equipment. It also provide students with the basic principles of chemical engineering material balances as well as calculation technique to solve material balance problems for chemical process system and equipment. It also provide students with the basic principles of the First Law of thermodynamics and its application.

WEEK 1

1.Introduction to engineering calculation
1.1units and dimensions
1.2conversion of units
1.3system of units
2.Process and process variables
2.1Mass and volume
2.2Flow rate
2.3Chemical composition
2.4Process and process equipment in chemical industry

We have learn how to convert one set of units in a function or equation into another equivalent set, other than that we also learn to calculate the composition in term of mole fractions and vice versa when the composition of a mixture is given in term of mass fractions. Determine the average the average molecular weight of a mixture from the mass or molar composition of the mixture.

WEEK 2
3. Fundamentals of material balances
3.1Process classification
3.2Balances
3.3Material Balance calculation

We define a system and draw the system boundaries for which material balance is to be made.An open and closed system we learn to differentiate them.

WEEK 3
3. Fundamentals of material balances
3.4General procedures for single unit.

We wrote a set of independent material balance equations for a process. We also solve some set of linear equations, and solve one or two simultaneous nonlinear equations.

WEEK 4
3. Fundamentals of material balances
3.5Balances on multiple unit processes

To solve question in this chapter, we have been taught to solve problem by apply the 10 step strategy without chemical reactions.

WEEK 5
3. Fundamentals of material balances
3.6Balances on single or multiple unit process with recycle and bypass

We learn how to draw a flow diagram for problems involving recycle, bypass and purge. We can apply the strategy to solve steady state problems with and without chemical reaction involving recycle, and/or bypass, and/or purge streams.

WEEK 6
4. Material Balances on reactive processes
4.1Chemical reactions stoichiometry
4.2Limiting and excess reactants, fractional conversion, extent of reaction and chemical equilibrium
4.3Multiple reactions, yield and selectivity

Learned to write and do a balance chemical reaction equation and identify excess reactant, limiting reactant, conversion, degree of completion, selectivity and yield in a reaction.

WEEK 7
4. Material Balances on reactive processes
4.4 Balances on reactive system using the atomic, molecular and extent of reaction approach

Applied the material balance equation when chemical reactions occur and the strategy to solve problems involving chemical reactions.

WEEK 8
4. Material Balances on reactive processes
4.5Balances on reactive system involving recycle
4.6Balances on reactive system involving purging
4.7Balances on combustion reactions

Defined flue gas, stack gas, Orsat analysis, dry basis, wet basis, theoretical air (oxygen), required air (oxygen) and excess air (oxygen) also applied the strategy to solve problems involving combustion reactions.

WEEK 9
5.Single phase system
5.1Liquid and solid densities
5.2Ideal gases
5.3Standard Temperature and pressure
5.4Ideal gas mixture
5.5Equation of states for non ideal gases (EOS)
5.6Compressibility factor equations of states
5.7Compressibility factor equations of states for non ideal gases.

Wrote down the ideal gas law, defined and manipulated all its variables and parameters and their associated dimensions. Calculated the values and units of the ideal gas law constant R in any set of units from the standard conditions, also the reduced temperature, reduce pressure and reduced volume for real gas law and use any two of these parameters to obtain the compressibility factor, z, from the compressibility charts. Compressibility

factors used and appropriate charts to predict the p-V-T behavior of a gas, or given the required data to find compressibility factors.Calculated the vapor pressure of a substances from an equation that relates the vapor pressure to the temperature, such as Antoine equation and look up the vapor pressure in reference books.

WEEK 10
6.MULTI PHASE SYSTEM
6.1Single component phase equilibrium
6.2The Gibbs phase rule
6.3Gas-liquid systems: One condensable component
6.4Multi component Gas-liquid system

Applied Raoult's Law for a single condensable species, other than that explained the meaning of ideal solution and the applicability of Henry's Law and Raoult's Law.Diagram used to determine the Bubble and Dew point temperatures and pressure, compositions and relative amounts of each phase in a two phase mixture and the effects of varying temperature and pressure on Bubble point, Dew point and phase amount and compositions.

WEEK 11
6.Multi phase system
6.1Single component phase equilibrium
6.2The Gibbs phase rule
6.3Gas-liquid systems: One condensable component
6.4Multi component Gas-liquid system

Applied Raoult's Law for a single condensable species, other than that explained the meaning of ideal solution and the applicability of Henry's Law and Raoult's Law.Diagram used to determine the Bubble and Dew point temperatures and pressure, compositions and relative amounts of each phase in a two phase mixture and the effects of varying temperature and pressure on Bubble point, Dew point and phase amount and compositions.

WEEK 12-WEEK 14
7. Energy balance for closed and open system
7.1The concept of the conservation of energy
7.2Energy balances for closed system
7.3Energy balances for open system
7.4A general procedure for energy balance
7.5Thermodynamics property tables

Stated energy balances in words and wrote the balance in mathematical symbols for closed system, simplified the energy balance equation in conformity with the problem statement and other information,enthalphy was calculated and internal changes from tables given the initial anf final states of the materials.

Prior to the following discussion on the fulfillment of this subject on the requirement of program specifications for bachelor in Chemical Engineering all eleven programme learning outcomes would be tabulated as follows:

Programme learning outcomes (PO)	Explanations/ descriptions
PO1: apply general fundamental scientific and chemical engineering knowledge	Utilize the suitable theories and principles (such as **thermodynamics, mass balance, energy balance, fluid mechanics, mechanics of materials, materials science**) in solving the design problems in the field of chemical engineering.
PO2: identify, formulate and solve engineering problems critically and creatively.	Relate the learnt theories and knowledge with the contemporary developments in the related fields and generate useful ideas to solve the problems in these fields; creativity and innovation are required to be incorporated in problem solving.
PO3: Plan, design and conduct experiments, analyze and interpret data, and apply the skills to chemical engineering practices	Plan and design experiments to collect related data for verification of certain problems found in the literature research, solving uncertainties regarding physical data in chemical processes, etc.
PO4: Select and design a system or process to meet the desired engineering, economic, health, safety and environmental requirements towards sustainable development.	Identify the requirements of sustainable developments in chemical processes (steps to control pollution, reduce cost, recycle and reuse unused materials to achieve material usage optimization, etc.), increase

	product quality, ensure safety and health requirements, etc.
PO5: Utilize computational techniques and skills (with appropriate tools) to solve problems in chemical engineering practices.	Solve or simplify problem solving procedures using computational techniques e.g. write C++ program to solve logical problems, create Excel spreadsheet to calculate the molar flow rate of product given certain conditions, etc.
PO6: Communicate effectively in both written and oral forms	Able to communicate effectively with course-mates and lecturers in the lectures, discussions, or when leading and conducting group assignment, experiments (lab), etc.
PO7: Function effectively as an individual or in a group	Able to work independently and with other individuals for project or assignment completion.
PO8: Lead a team by setting direction, providing motivation, delegating tasks and integrating contributions	Able to be an effective leader of a group to assign tasks, motivate and connect to team members, provide guidance and directives, and integrate contributions from members to form complete version of the task result.
PO9: Practice professional ethics, integrity and social responsibility.	Demonstrate ethics in professional practice (for example in environmental and social issues related to chemical engineering).
PO10: Display life-long learning skills	Possess ability and passion to seek for contemporary developments in chemical processes and equipments, pollution control technologies, etc; able to generate learning issues and find information through literature research based on reliable sources (with firm credentials)
PO11: Apply entrepreneurship knowledge in decision making	Able to relate business thinking in design of chemical processes, equipments or problem-solving.

Reflection for Principle Chemical Process subject.

Regarding the time passed that I've been through, this subject basically need the student to be able carry out calculation on making mass balance for any processes occurred in industrial field.

We were being provided the learning steps to achieve the main objective in this course.

Starting from CO1, at this stage; we were being evaluated regarding the ability to carry out unit conversion and equipment identification for various chemical processes. According my ability, I am able achieve the objective of this stage. It is important to be able to make conversion unit in industrial field as we are going to face the quantity (material) which is not totally measured in SI unit.

In CO2, on the other hand; we are needed to calculate mass balance on single or multiphase. In this stage, I am saying that I already achieve the objective of this CO2. This one is the basic simple calculation mass balance of processes that occur without recycle, purge or bypass stream for non reactive process. It's quite complicated sometimes (to understand the condition occur) but then if we are able to understand the concept, you may come to understanding and able to sole the problem within a short period.

CO3: A little addition at this stage. There might be any reactive process. There is will also have varies processes problem in this stage. I found my self lost to achieve the understanding regarding the topics that are related to this stage. Student should have the ability to carry out simple chemical equation in chemical processes. Strong basic for making stoichiometry calculation is also important. I think my weakness can be seen after passed the both stage CO1 and 2..

We are dealing with molarity, concentration of the feed, raffinate or might be extraction. As a chemical engineering to be, roughly; this subject teach student to be able to control the flow of processes in an industrial plant. Student should prepare themselves to get ready with the challenging phases in the real situation as a chemical engineer soon.