

# Mass Balance Course Syllabus

<b>Mass Balance – Theory Content .....</b>	<b>2</b>
MB0 Overview.....	2
<i>Section 1: Course Overview .....</i>	<i>2</i>
MB1 Introduction to Mass Balance .....	2
<i>Section 1: Introduction and Theory in Mass Balance .....</i>	<i>2</i>
<i>Section 2: Mass Balance Basic Concepts .....</i>	<i>2</i>
MB2 Single-Phase Mass Balance .....	3
<i>Section 1: Phases, liquids and solids.....</i>	<i>3</i>
<i>Section 2: Phases, ideal gases and real gases.....</i>	<i>3</i>
MB3 Multiple-Phase Mass Balance.....	4
<i>Section 1: Phase Theory and Vapor Pressure .....</i>	<i>4</i>
<i>Section 2: Vapor-Liquid Systems (1 and 2+ condensable substances).....</i>	<i>4</i>
<i>Section 3: Solid-Liquid and Liquid-Liquid Systems .....</i>	<i>4</i>
MB4 Transient State in Mass Balance .....	5
<i>Section 1: Transient State and Accumulation .....</i>	<i>5</i>
<i>Section 2: Mass Balances Exercises in Transient State .....</i>	<i>5</i>
MB5 Conclusion.....	6
<i>Section 1: Ending Notes .....</i>	<i>6</i>
<b>Ending Notes .....</b>	<b>7</b>

# Mass Balance – Theory Content

## MB0 Overview

### Section 1: Course Overview

An overview of what is going to be taught in the course. It is recommended if you want to get an idea of what Mass Balance is and what type of theory you are expected to know and to learn. The course structure is showed here, the syllabus is also exposed in a condensed way.

If you want to see the course overview, click **here** to go to the Video in the Web Page.

### MB1 Introduction to Mass Balance

The mass balance introduction block MB1 is the most important block in the whole course. This block establishes the basics of the mass balancing theory and application. The mass balance equation is analyzed here. Many theoretical concepts such as systems, unit operation, streams, flow diagrams and many others are seen here. If you succeed in this block, all other blocks are easy to understand (theory) and to solve (problems).

If you want to see the introduction clip, click **here** to go to the Video in the Web Page

### Section 1: Introduction and Theory in Mass Balance

Section 1 includes the introduction of Mass Balance. Questions such as, “What is mass balance? Where do I apply it? Why do I need to study it?” are discussed here. Also some basic, yet, very important theory is exposed. Learning this theory will help you not only to understand mass balance but also to start understanding chemical engineering and chemical processes in general. Some of the content can be seen next:

- Theory: System, Process, Unit Operation, Streams, Flows, Variables, Flow Diagrams, MB
- Click **here** to go to the Video in the Web Page.

### Section 2: Mass Balance Basic Concepts

Section 2 is the most important section of all sections in the course. We start studying the concept of mass balance, where does the equation comes from, types of systems and how and when to apply them. We will see mass balancing with one, two or even many more units in the process. Some exercises are included to understand as we go through the theory but the problem section is ALWAYS recommended for deep understanding. The content is as follow:

- Mass Balance basics: 1 Unit Mass Balance; 2+ Unit Mass Balance; MB with/without reaction; Mass Balance in Combustion; Purge, Bypass & Recycle
- Click **here** to go to the Video in the Web Page.

## MB2 Single-Phase Mass Balance

Mass Balance in Single Phase (either liquid, solid, gas or mixture between them in which only one phase takes place). The analysis centers in the study of gases due to its volume-pressure-temperature dependence. Ideal Gases are the first approach and then Real gases, use of more complex equations to describe how real gases work and can be modeled. At the end, we still work with problems of mass balance involving gases.

If you want to see the Introduction to the Block MB2, click **here** to go to the Video in the Web Page

### Section 1: Phases, liquids and solids

This section is easy to understand; many have been seen in previous science classes. It is important to understand all the concepts specially the one of phases.

Theory (phases)

Liquids, Solids

Mass Balances involving liquid and solids

Click **here** to go to the Video in the Web Page

### Section 2: Phases, ideal gases and real gases

In this section, we analyze the P-V-T relationship between gases and vs. liquids and solids. The gases will be modeled initially by ideal gas law, which is seen in many sciences classes before this one. "Real gases", for the other hand, is a new topic for the student and must be understand completely. Many equations are not show in this course since many are seen in the Thermodynamic Course.

Gases: Ideal Gas, Real Gases: Cubic Equations, Z compressibility factor

Mass Balances involving Ideal and Real Gases

Click **here** to go to the Video in the Web Page

## MB3 Multiple-Phase Mass Balance

Multiple Phase Mass Balances block MB3 studies the interaction of different phases between each other phases. Theory is needed to understand the different concepts of phases such as equilibrium line, vapor pressure, PV and PT diagrams, vapor-liquid systems, liquid-liquid systems, solid-liquid systems and many other concepts. The block is characterized by the application of Vapor Pressure concept to many of the course content. If you are interested in learning Multiple Phase Mass Balance, please click **here** to go to the Video in the Web Page

### Section 1: Phase Theory and Vapor Pressure

Here we will see phases and more importantly the concept of vapor pressure. The understanding of this concept is very important for mass balance, energy balance, thermodynamics, equilibrium, mass transfer and many other subjects in chemical engineering. Antoine and Clapeyron Equations are very important equations for estimation of vapor pressures.

- Single Phase Theory (Phase-Diagrams)

- Vapor Pressure (Antoine and Clapeyron Equation)

- Gibbs Phase Rule

- Click **here** to go to the Video in the Web Page

### Section 2: Vapor-Liquid Systems (1 and 2+ condensable substances)

The vapor-liquid system is one of the most important systems in chemical engineering. Many processes involve these two phases. Distillation, drying and absorption are some examples. The key concept here is to understand the vapor pressure of individual component and eventually understand Raoult and Henry models for vapor-liquid mixtures.

- Vapor-Liquid Systems (1 condensable)

- Evaporation, Drying, Humidity

- Vapor-Liquid Systems (multi-condensable)

- Raoult Law, Henry Law

- Dew/Bubble points

- Txy Diagrams

- Click **here** to go to the Video in the Web Page

### Section 3: Solid-Liquid and Liquid-Liquid Systems

This section is short, yet important. All other equilibriums such as solid-liquid and liquid-liquid have many industrial applications. We analyze briefly some of these. It is typical for mass transfer courses to cover these topics but we only see the mass balance of such equipment/operations.

- Solid-Liquid Systems

- Solubility and Colligative Properties

- Liquid-Liquid systems

- Extraction

- Click **here** to go to the Video in the Web Page

## MB4 Transient State in Mass Balance

Transient State Mass Balancing is one of the most interesting parts of the course since all other blocks are studied in Steady States. Transient State has many industrial applications and it's very important for the student to be able to understand and solve such problems. Many other transient state problems are combined with energy balances in order to be able to solve them (Energy Balances not included in this Course).

If you want to go to the introduction clip, please click **here** to go to the Video in the Web Page

### Section 1: Transient State and Accumulation

This section is used to remind the student of the transient state and specially how to account for the accumulation concept. Some cases and processes are analyzed.

- Theory

- Transient State Review

- Accumulation Concept

- General Methodology for Transient State

- Differential and Integral MB

- Click **here** to go to the Video in the Web Page

### Section 2: Mass Balances Exercises in Transient State

After understanding how to apply Transient State and the concept of accumulation, the student will be able to solve problems. Here are some concepts seen in the course:

- Exercises

- Mass Balances (Analytical, "by hand")

- Mass Balances (Computer solved)

- Click **here** to go to the Video in the Web Page

## MB5 Conclusion

### Section 1: Ending Notes

After studying all 4 blocks, you are now able to make a conclusion of Mass Balance Course. All theory and problems are reviewed at a glance. You are now ready to continue with the Energy Balance Course and now have many tools to understand other courses such as Heat and Mass transfers, reactor engineering and many others.

So click **here** to go to the Video in the Web Page and end your course!

## Ending Notes

Have any doubts? Send me an e-mail me at [chemical.engineering.guy@gmail.com](mailto:chemical.engineering.guy@gmail.com)