NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF ENVIRONMENTAL ENGINEERING

HYGIENE AND INDUSTRIAL SAFETY ENGINEERING PROGRAM

PI111 – MATTER AND ENERGY BALANCE

I. GENERAL INFORMATION

CODE	**:**	PI111 – Matter and Energy Balance
SEMESTER	**:**	5
CREDITS	**:**	03
HOURS PER WEEK	**:**	05 (Theory – Practices)
PREREQUISITES	**:**	Thermodynamics
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course is designed so that the student is able to perform a mass and energy balance in any type of industrial production system, unit operations involving liquids, solids and gases, and also environmental processes, all represented in a flow diagram. Understand how an energy balance is made and from that know how to select the most appropriate fuel from the economic and environmental point of view.

III. COURSE OUTCOMES

At the end of the course the student will:

- Knows how to use the psychrometric chart.
- Know how to design and interpret a process flow diagram and apply a mass balance in the system.
- Know how to perform an energy balance to select the most suitable type of fuel plus the energy requirement of a system.
- Know how to select the most suitable unit operations for an industrial or environmental process.
- Know how to calculate GHG emissions from combustion.

IV. LEARNING UNITS

1. PSYCHROMETRY

Absolute humidity / Relative humidity / Psychometric chart / Humid volume, Humid heat, Enthalpy / Humid bulb temperature, Dry bulb temperature, Dew temperature, Adiabatic saturation temperature / Humidification and dehumidification operations / Humidity measurement.

2. MATTER BALANCE WITHOUT CHEMICAL REACTION

General equation of matter balance / Process flow diagram / Equipment symbology / Recirculation lines, purge, losses, fugitive emissions, replacement / Definition of purity, yield, concentration / Balance in unit operations / Filtration, sedimentation, centrifugation, distillation , dried.

3. MATTER BALANCE WITH CHEMICAL REACTION

Definition of chemical reaction / Reaction rate / Type of chemical reactions / Reactors / Stoichiometry of a reaction / Limiting reagent and reagent in excess / Yield and conversion of a reaction / Conversion per step and overall conversion / Selectivity and catalysts.

4. BASIC CONCEPTS OF ENERGY AND ENERGY BALANCE

Energy measurement units / Energy, sources and types of energy / General equation of energy balance / heat transfer / heat transfer equipment / heat exchangers, furnaces, boilers, condensers, cooling towers / thermal insulators.

5. STEAM AND BOILER SYSTEMS

System for the generation and distribution of steam / boilers, fuel and combustion / energy balance and thermal efficiency in steam cauldrons / energy balance with chemical reaction / fuel selection / energy balance and calculation of greenhouse emissions / electric power..

V. LABORATORIES AND PRACTICAL EXPERIENCES

Students will work in a project in which they have to do energy balances that occur in everyday life, such as consumption of natural gas at home, consumption of LPG, heating, electricity consumption.

VI. METHODOLOGY

The course is developed in theory sessions, practice. In the theory sessions, the teacher presents the concepts, theorems and applications. In the practical sessions, various problems are solved and their solution is analyzed. The fourth practice will be developed in class in group and in an integrated way. In all the sessions the participation of the student is promoted. The course is aimed at students of environmental engineering.

VII. EVALUATION FORMULA

The learning will be evaluated through the "F" system.

- Partial Exam: Weight 1
- Final Exam: Weight 1
- Qualified Practices: Weight 1.

Calculation of the Final Average:

$$FA = \frac{PE + 2 * FE + PA}{3}$$

PE: Partial Exam; FE: Final Exam, PA: Practices Average

For the Practices Average the three practices with the highest grades:

$$PA = \frac{QP1 + QP2 + Q3}{4}$$

VIII. BIBLIOGRAPHY

- V.Ganapathy. Industrial Boilers and Heat Recovery Steam Generators. Marcel Dekker, Inc, 2003.
- Himmelblau D.M. Principios Y Cálculos Básicos De La Ingeniería Química.
- Felder/ Rosseau. Principios Básicos De Los Procesos Químicos.

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