NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF INDUSTRIAL AND SYSTEMS ENGINEERING

INDUSTRIAL ENGINEERING PROGRAM

TP223 – INDUSTRIAL PROCESSES I

I. GENERAL INFORMATION

CODE	**:**	TP223 – Industrial Processes I
SEMESTER	**:**	6
CREDITS	**:**	05
HOURS PER WEEK	**:**	05 (Theory – Laboratory)
PREREQUISITES	**:**	TP213 – Physical Chemistry and Unit Operations
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

This course provides an overview of the state of technological development of the different chemical industry sectors and their manufacturing processes as well as their implication in the development of other productive sectors. Analyze the processes detailing the flowcharts from raw materials and inputs, to final products and waste. The foundation of technologies, operational variables, equipment, catalysts, etc. is presented. Physicochemical properties of raw materials and products are detailed, in addition to the uses and applications of industrial products.
Guided technical visits to industrial plants are carried out allowing the student to incorporate and contrast the theoretical knowledge with reality.

III. COURSE OUTCOMES

At the end of the course the student will:

- Differentiate the economic sectors and know their importance in the country's economy.
- Interpret and elaborate flowcharts of industrial chemical processes.
- Meet the most important natural resources as a source of raw material for the national industry.
- Integrate knowledge of Physical chemistry, thermodynamics, inorganic chemistry, organic chemistry, manufacturing materials and notions of unit operations with the description of chemical industry processes.
- Meet technologies of industrial chemical use of water, air, nitrogen, oil, natural gas, sodium chloride, metal sulphides, clays, silica, limestone, phosphoric rock, grease and oilseeds, corn, barley, starches, wood, sugarcane, vine, cotton, metallic minerals, etc.
- Acquire critical sense regarding the environmental impact and energy requirements of industrial processes.
- Understand the usefulness of standardization and become familiar with the search for industrial patents and information relevant to the course.

IV. LEARNING UNITS

1. INTRODUCTION

Introduction. Industrial processes. Technology. Operations and Processes. Patents. Economy sectors. The chemical industry and industrial chemistry. Resources and natural reserves. Industrial materials and supplies. Industrial standardization. National energy matrix. Industrial internal gross product. Unified industrial international code. Process flow diagrams (symbology).

2. WATER POTABILIZATION

Water chemistry and interpretation of water analysis. Unitary operations in water purification. Coagulation, Flocculation. Sedimentation, Filtration. Disinfection. Technology applied to rural areas. National norms and guidelines of the World Health Organization as drinking water.

3. WATER TREATMENT FOR INDUSTRIAL USE

Industrial water quality as process water or service water. Water for boilers. Softening processes, ion exchange. Classification of ion exchange resins. Microbial activity control. Membrane separation technologies.

4. STUDY OF FOSSIL FUELS. THE OIL INDUSTRY

The Peruvian petroleum. Quality of crude oil. Crude desalination process. Atmospheric distillation Vacuum distillation. Alkylation. Isomerization. Polymerization. Catalytic hydro-desulfurization. Catalytic cracking. Claus process. Quality parameters of gasoline, diesel, fuel oils, etc.

5. STUDY OF FOSSIL FUELS. THE NATURAL GAS INDUSTRY

Natural Gas (NG) composition. Liquified natural gas (LNG). Properties of LNG. Natural gas cleaning and preparation processes NG. Cryogenic processes (Linde, Claude). Separation of LNGs liquids. Importance of natural gas from basic petrochemicals and steel. Camisea gas. The coal industry Classification of coal. Coal gasification.

6. INDUSTRIAL GAS INDUSTRY

Oxygen and Nitrogen fractionation plant technology. Production Diagram. Double Linde column. Argon separation process. Noble gases. Acetylene. Carbon dioxide. Hydrogen. Uses of industrial gases.

7. CHLORINE- SODA INDUSTRY / SODIUM CARBONATE INDUSTRY

Brine processing. Chlorine production. Caustic soda production. Brine electrolysis with mercury cathode. Brine electrolysis using membranes. Diaphragm Method Synthesis of hydrogen chloride and obtaining hydrochloric acid. Obtaining sodium hypochlorite. Industrial applications of chlorine - soda industry products. Sodium carbonate manufacturing process

8. NITROGEN DERIVATIVES INDUSTRY

State of the industry in the country. Process Technology: Natural gas reform. Purification of the reforming gas. Ammonia manufacturing process. Evolution of reactors of the Born-Haber process. Ammonia liquefaction.

9. AMONIA DERIVATIVES INDUSTRY

Technology of nitric acid manufacturing plants. Urea manufacturing technology from ammonia and carbon dioxide. Manufacture of ammonium nitrate. Manufacture of ammonium sulfate. Applications, uses and importance.

10. SULFURIC ACID INDUSTRY

Sulfur and sulfuric acid. Properties of sulfur, sulfuric acid, oleum, and sulfur oxides. Roasting of the mineral and purification of gases. Contact method (conversion parameters of metal oxides). Obtaining sulfuric acid. Environmentally safe technology. Industrial uses of sulfur oxides, oleum, sulfuric acid.

11. ALCOHOLIC BEVERAGE INDUSTRY

The alcoholic beverage industry. Beer industry Barley grain composition. Industrial fermentation of starch. Technology of beer manufacturing. The wine industry Composition of grape juice. Natural enzymes Manufacturing technology of red wine, white wine, etc.

12. THE GLASS INDUSTRY

Glass. Raw materials and properties imparted to glass. Unique temperatures in glass manufacturing. Types of Glass Process Manufacture of bottles and flat glasses. Annealing and tempering of the glass. Raw materials of ceramic cake. Clays classification. Raw materials function. Industrial manufacturing process Ceramic oven and process economy. Ceramic refractories.

13. THE CEMENT INDUSTRY

Portland cement. Raw material. Clinker manufacturing process. Sintering Clinkerization oven, temperature profile. Relationship of process variables with product quality. Portland cement properties with product mineralogical composition. Design of equipment and process, determinants of economy of the process. Setting. Portland cement classification. Pozzolanic Cement Other types of cement.

14. THE SUGAR AND ALMIDON INDUSTRY

Raw Materials. Composition of sugarcane. Raw sugar manufacturing process. Sugar refining process. Factors that determine the economy of the process. Industrial use of molasses and process waste. Corn grain composition. Properties of amylose and amylopectin. Technologies of integral utilization of the corn grain. Obtaining starch. Starch hydrolysis products. Dextrin. Types of modified starches.

15. TEXTILE INDUSTRY

Types of fibers Cotton industry: Production Process: Spinning, Weaving, Dry Cleaning and Finishing.

16. PLASTIC INDUSTRY AND RESIN INDUSTRY

Raw materials and manufacturing processes of Polyethylene (PE), PP. Resin manufacturing processes. Alkyd resins. Epoxy Resins Urea-formaldehyde resins. Phenolformaldehyde Resins.

V. LABORATORIES AND PRACTICAL EXPERIENCES

The theoretical concepts are verified through six technical visits to industrial facilities of important companies.

VI. METHODOLOGY

The course is developed in sessions of theory, practice. In the theory sessions, raw materials, physicochemical properties of raw materials and products, technology of industrial processes, process flow diagrams, waste, industrial application of products, importance of industry in the productive sector are presented. In the practical sessions, through the Visits to industrial facilities the theory developed in class is complemented or topics not contemplated in class are addressed.

Students develop technical reports on technical visits. Students are oriented to the systematization of the information received through the structure of the Report and Questionnaires.

At the end of the course the student must present and present a work or monograph. It presents the state of the art of an assigned industrialization process and the new technologies for manufacturing product (s) in particular. In the End of Year Monograph Exhibition, the clarity of communication, knowledge of the subject, the use of exhibition tools and teamwork are evaluated. In all sessions the active participation of the student is promoted.

VII. EVALUATION FORMULA

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

- Partial Exam (PE): Weight 1
- Final Exam (FE): Weight 2
- Average of Practices (P): Weight 1.
- For the average of practices: 06 reports, one per technical visit to an industry (L), the report with the lowest grade is eliminated. At the of the course a Monograph (M) and an Exposition (EM) will be programmed, and with those evaluations the 07 grades will complete.

$$\boldsymbol{P} = \frac{\boldsymbol{L1} + \boldsymbol{L2} + \boldsymbol{L3} + \boldsymbol{L4} + \boldsymbol{L5} + \boldsymbol{M} + \boldsymbol{EM}}{\boldsymbol{7}}$$

$$\boldsymbol{FA} = \frac{\boldsymbol{PE} + \boldsymbol{2} * \boldsymbol{FE} + \boldsymbol{P}}{\boldsymbol{4}}$$

VIII. BIBLIOGRAPHY

- Vian-Ortuño. Course of Introduction to Industrial Chemistry. Editorial Reverté S.A., Madrid. 2nd Edition, 1994.
- Tegeder-Mayer. Chemical Industry Methods.
- Austin, George T. Manual of Chemical Processes in Industry.
- Winnacker and Weingaertner. Chemical Technology, volumes I and II. Editorial G. Gilli S.A.
- Kirk-Othmer. Manual of the Chemical Engineer. Edit UTEHA