



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING**  
**PETROCHEMICAL ENGINEERING PROGRAM**

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**HC527 – PETROCHEMICAL PROCESSES**

**I. GENERAL INFORMATION**

<b>CODE</b>	:	HC527 – Petrochemical Processes
<b>SEMESTER</b>	:	10
<b>CREDITS</b>	:	4
<b>HOURS PER WEEK</b>	:	5 (3 Theory – 2 Practice)
<b>PREREQUISITES</b>	:	Basic Petrochemistry – HC412, Processes of Oil Refining II – HC515
<b>CONDITION</b>	:	Compulsory

**II. COURSE DESCRIPTION**

The development of a country is identified with the consumption of fertilizers, plastics, synthetic fibers, synthetic rubbers, among other petrochemical products, which originate in oil and natural gas. The student must achieve a holistic view of the petrochemical industry through the sequential study of: synthesis, industrial manufacturing and, to a lesser extent, the commercialization of petrochemical products. Likewise, to examine the petrochemical industry as an industry that provides value for the transformation of the raw material (oil and natural gas) through its different processes towards products of greater value, and that are destined to different industrial sectors to conform final products Of greater aggregate.

**III. COURSE OUTCOMES**

At the end of the course, the student:

1. It relates the processes, products and by-products of oil refineries and natural gas plants as sources to obtain raw materials for the petrochemical industry.
2. It differentiates the raw materials for petrochemicals according to the process and the petrochemical product to be elaborated.
3. It differentiates petrochemical products by classifying them in the petrochemical family to understand its processes of elaboration and behavior in the market.
4. It relates the concepts learned in previous courses, such as polymers, transportation phenomena (pumps, compressors, reactors, columns, etc.), engineering principles, to integrate them into the understanding of petrochemical processes and their products.
5. Difference between licensors of technology that provide petrochemical technology according to petrochemical process and product to obtain.
6. Justifies the choice of technologies for petrochemical processes and products to be obtained according to previously established criteria based on the specialized bibliography and current regulation.
7. It relates the critical variables of operation (pressure, temperature, etc.) and the influence exerted by these variables on the processes and the final petrochemical product.
8. It outlines a petrochemical complex composed of specific petrochemical processes based on a profile of products that can demand the national or international market.
9. It investigates and deepens petrochemical processes and their products based on technical journals and specialized technical articles.
10. It calculates the structure of the production costs of petrochemical products to highlight the influence of the cost of the matter, as well as apply the terminology applicable to the industrial processes.
11. It differentiates the petrochemical industry from other transformation industries by the characteristics that define it.

#### **IV. LEARNING UNITS**

##### **1. RAW MATERIALS FOR PETROCHEMICAL PROCESSES / 8 HOURS**

Raw materials for petrochemical processes obtained from the distillation of petroleum, or separation or fractionation of natural gas. From the oil refineries obtaining virgin naphtha, kerosene, olefin GLP; Of the natural gas plants obtaining methane, ethane, propane, butane, petrochemical naphtha.

##### **2. CHARACTERISTICS OF THE PETROCHEMICAL INDUSTRY / 8 HOURS**

Differentiate the petrochemical industry from other transformation industries (metallurgy, food, etc.) by identifying the characteristics that define it. These are: raw materials, basic petrochemicals, intermediate and final, the petrochemical tree, process technology, petrochemical poles, conversion factors, and process integration.

##### **3. ORGANIC BASIC PRODUCTS AND ITS PROCESSES - I / 6 HOURS**

Production of light olefins. The steam cracking process for obtaining light olefins: ethylene, propylene, butadiene (1-3 butadiene), butylenes (1-butene and 2-butene). Study of the hot zone and cold zone of the steam cracking. Other processes to obtain light olefins: FCC (Catalytic Fluid Cracking), Catalytic Dehydrogenation, Metathesis, MTO (methanol to olefins). Technology Licensors.

##### **4. ORGANIC BASIC PRODUCTS AND ITS PROCESSES - II / 6 HOURS**

Production of aromatics for petrochemicals: benzene, toluene and xylenes. The process of Catalytic Reforming and its process variables. Separation of aromatic hydrocarbons. Processes to increase the production of benzene and xylenes: hydrodealkylation, disproportionation and transalkylation. Steam pyrolysis gasoline as a source of aromatics. Technology Licensors.

##### **5. PRODUCTS DERIVED FROM OLEFINS / 8 HOURS**

Considering as a raw material the light olefins identify other petrochemical processes, their equipment, the operational conditions that allow their transformation into intermediate or final petrochemical products. Polymerization, polyethylenes (LDPE, HDPE, LLDPE) and its high and low pressure technologies, polypropylene, PVC, plastics manufacturing techniques. Technology Licensors.

##### **6. PRODUCTS DERIVED FROM AROMATICS / 8 HOURS**

Considering as a raw material the aromatics (benzene, toluene and xylene) identify other petrochemical processes, their equipment, the operating conditions that allow their transformation into intermediate or final petrochemical products. Styrene and polystyrene; Cyclohexane and nylons; Cumene and the production of phenol and acetone; Linear alkylbenzene (LAB), toluene and polyurethane; P-xylene and PET. Technology licensors.

##### **7. PRODUCTS DERIVED FROM BUTADIENE / 8 HOURS**

Considering as a raw material to 1-3-Butadiene other petrochemical processes, their equipment, and the operational conditions that allow their transformation into petrochemical products called elastomers are identified. Styrene-butadiene elastomer (SBR), natural rubber and 1-4-polyisoprene. Vulcanization and tire manufacturing technology. Technology licensors.

##### **8. PRODUCTS DERIVED FROM SYNTHESIS GAS / 8 HOURS**

Considering methane as raw material and the production of synthesis gas, we obtain: ammonia and its derivatives: urea, ammonium nitrate. Of the synthesis gas methanol and its derivatives such as formaldehyde, MTO. Licensing technology for processes.

##### **9. PRODUCTS DERIVED FROM PHOSPHATE / 2 HOURS**

The phosphates of Bayovar and the Mantaro Valley. Production of ammonium diphosphate.

##### **10. PETROCHEMICAL INDUSTRY PROJECTS AND ITS COSTS / 8 HOURS**

Projects in the petrochemical industry and calculation of the cost structure of a petrochemical product. Importance of the cost of the raw material in the final cost structure.

## **V. LABORATORY AND PRACTICAL EXPERIENCES**

In order to establish knowledge, it is proposed to carry out the following: the third qualified practice corresponds to a domiciliary research work.

Practice N° 1 - Qualified practice in the classroom

Practice N° 2 - Domiciliary work of investigation of a petrochemical process

Practice N° 3 - Oral presentation of a basic petrochemical process

Practice N° 4 - Qualified practice in the classroom

Practice N° 5 - Oral presentation of an intermediate petrochemical process

Practice N° 6 - Oral presentation of a final petrochemical process

## **VI. METHODOLOGY**

The course is developed in sessions of theory and practice. In theory sessions, the teacher presents the concepts as well as the explanation of petrochemical processes. In practical sessions, process-related problems are solved. In the practical sessions the student must present and present an integrative project or project that includes processes and products of basic, intermediate and final petrochemicals. In all the sessions the active participation of the student is promoted.

## **VII. GRADING FORMULA**

The "G" evaluation system is used. Calculation the Final Average:

$$FA = (ME + FE + AP) / 3$$

MP: Mid-term Exam.

FE: Final Exam.

AL: Average of Qualified Practices.

## **VIII. BIBLIOGRAPHY**

1. **Alain Chauvel, Gilles Lefebvre.** Petrochemical Processes - Volumes I and II. French Institute of Petroleum - 1989.
2. **Robert A. Meyers.** Manual of Processes of Production of Petrochemicals. Volume I and II - McGraw-Hill 2008.