



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL**  
**ENGINEERING**

**METALLURGICAL ENGINEERING PROGRAM**

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**ME624 – ORGANIC CHEMISTRY AND POLYMERS**

**I. GENERAL INFORMATION**

<b>CODE</b>	: ME624 – Organic Chemistry and Polymers
<b>SEMESTER</b>	: 9-10
<b>CREDITS</b>	: 3
<b>HOURS PER WEEK</b>	: 3 (Theory–Practice)
<b>PREREQUISITES</b>	: ME323 Materials Science and Engineering
<b>CONDITION</b>	: Elective

**II. COURSE DESCRIPTION**

The course provides students the knowledge of the fundamentals of organic chemistry and polymers. Both natural and synthetic polymers are analyzed, as well as their physical-chemical properties, polymerization mechanisms, polymerization technologies, as well as the use of commercial polymers in industry including petrochemical industry.

**III. COURSE OUTCOMES**

At the end of the course, students:

1. Explains physical-chemical properties and characteristics of polymer materials.
2. Analyze the general behavior of synthetic polymers, before, during, and at the end of different transformation processes.
3. Identify the general characteristics of the most used synthetic polymers at industry.
4. Understand the importance of polymers and their multiple applications in different areas of science and engineering.

**IV. LEARNING UNITS**

**1. INTRODUCTION**

Definitions / Structure and properties of polymers / Classification of polymers / Copolymers / Isomerism / Molecular weight and shape / Viscoelasticity.

**2. PHYSICAL CHEMISTRY OF POLYMERS**

Primary chemical links / Secondary chemical links / Intermolecular forces and physical properties / Crystallinity and crystal melting point / Glassy transition in polymers.

**3. POLYMERIZATION MECHANISMS**

Poly-condensation / Polymerization by addition / Polymerization by free radicals / Ionic polymerization / Stereo specific polymerization / Relationships between molecular structures and properties / Molecular weight / Links crossing / Branching.

**4. POLYMERIZATION PROCEDURES**

Mass polymerization / Polymerization by addition / Suspension polymerization / Emulsion polymerization.

**5. CONDUCT OF POLYMERS**

Elastomers / Properties / Types / Elasticity / Molecular requirements / Viscoelastic properties.

## 6. TECHNOLOGY AND USE OF POLYMERS

Industrial transformation of polymers / Testing methods for polymer materials / Thermoplastic polymers / Applications / Thermo-stable polymers / Applications.

## 7. STEREO POLYMERS

Stereo-isomerism in alkenes / Asymmetric centers in polymeric structures / Stereo isomeric structures: Tacticity / Characterization of Isotactic structures, syndiotactic and atactic.

## V. LABORATORY AND PRACTICAL WORK

**Session 1:** Stoichiometric balance in polymers.

**Session 2:** Calculation of average molecular weight. Polymerization rate.

**Session 3:** Density determination.

**Session 4:** Specific works assignation.

## VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory, faculty presents and analyze concepts and methods. In practice sessions diverse problems related to polymers synthesis and polymerization methods analyzed and solved. In laboratory sessions, students perform tests and verify expected outcomes and results. After each laboratory experience, students submit a report describing procedures and summarizing results and conclusions. Student active participation is promoted.

## VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

$$PF = (EP + EF + PL) / 3$$

EP: Mid-term Exam

EF: Final Exam

PL: Average of Practical and Laboratory Works

## VIII. BIBLIOGRAPHY

1. JAVIER AREIZAGA, M. MILAGROS CORTÁZAR, JOSÉ M. ELORZA JUAN J. IRUIN. Polymers, Ed. Synthesis, Madrid, Spain, 2002.
2. JOHN. J. MCKETTA MARCEL DEKKER. Chemical Processing and Design Encyclopedia. CRC Press, 1990.