NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CHEMICAL AND TEXTILE ENGINEERING
CHEMICAL ENGINEERING PROGRAM

PI365 – POLYMERS I

I. GENERAL INFORMATION

CODE	**:**	PI365 – Polymers I
SEMESTER	**:**	8-10
CREDITS	**:**	3
HOURS PER WEEK	**:**	4 (Theory–Practice)
PREREQUISITES	**:**	PI144 Mass Transfer, PI318 Chemical Processes Industry
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

The course prepares students in the understanding, analysis and synthesis of polymers. Both natural and synthetic polymers are analyzed, as well as their physical and chemical properties, polymerization mechanisms, polymerization technologies, as well as the wide range of applications in industry and everyday life.

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.