NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROCHEMICAL ENGINEERING PROGRAM

PQ421 – CHEMICAL KINETICS AND REACTOR DESIGN

I. GENERAL INFORMATION

CODE	:	PQ421 Chemical Kinetics and Reactor Design
SEMESTER	:	8
CREDITS	:	4
HOURS PER WEEK	:	5 (Theory–Practice)
PREREQUISITES	:	PM-311 Numerical Methods PQ-412 Thermodynamics for Chemical Engineering II
CONDITION	:	Compulsory
INSTRUCTOR	:	Virginia Quispe Ascencio
INSTRUCTOR E-MAIL	:	vquispe@fip.uni.edu.pe

II. COURSE DESCRIPTION

Kinetics of chemical reactions. Reactions of different types. Catalysis. Interpretation to the reactor design. Analysis for single and multiple reactors. Effect of temperature on chemical reactors. Thermodynamics applied to chemical kinetics.

III. COURSE OUTCOMES

1. Comprises the quantitative study of the rates of chemical reactions and the factors on which depend speeds.
2. Knowledge of the use of the speed data to determine the design of chemical reactors mainly in homogeneous systems.

IV. LEARNING UNITS

1. CHEMICAL KINETICS AND REACTOR DESIGN

Introduction to reactor design / Introduction to chemical kinetics: reaction rate and mechanism / Formal kinetics / Types of reactions related to chemical kinetics / Kinetics and Thermodynamics - Kinetic Viewpoint of equilibrium of elementary reactions / fundamental terms: degree of conversion and performance / Definition of the rate of reaction.

2. KINETICS OF CHEMICAL REACTIONS UNDER STATIC CONDITIONS

Irreversible reactions / 1st order irreversible reactions / 2nd order irreversible reactions / 3rd order irreversible reactions / N-th order irreversible reactions / Complex reactions.

3. KINETICS OF CHEMICAL REACTIONS IN FLOW

General rate equation / 1st order irreversible reactions / 2nd order irreversible reactions / 1st order reversible reactions / 2nd order reversible reactions.

4. KINETICS OF REACTORS IN HOMOGENEOUS SYSTEMS

Reaction speed / Discontinuous reactor of constant volume / Discontinuous reactor of variable volume / Classification of reactors.

5. INTRODUCTION TO REACTOR DESIGN

Design Equations / Ideal reactors / Mechanical properties of discrete systems / Mechanical properties of continuous or flow systems.

6. DESIGN OF SIMPLE REACTIONS

Discontinuous reactor / Reactor of full mix flow at steady state / Graphical representation of a mixed reactor / Reactor of plug flow at steady state / Graphical representation of a plug flow reactor / Comparison of design equations for discontinuous reactors and for plug flow reactors / Space time, space velocity and residence time for flow systems.

7. ANALYSIS OF IDEAL REACTORS

Design of simple reactors / Comparative study of sizes in single reactor systems / Multiple reactor system / Loop reactor.

8. DESIGN OF MULTIPLE REACTIONS

Introduction / Parallel reactions / Reactions in series.

9. EFFECTS OF TEMPERATURE AND PRESSURE

Simple reactions / Thermodynamics / Thermodynamic conclusions.

10. NON ISOTHERMAL REACTORS

Equations of conservation of energy / Batch Reactors / Continuous tank reactors / Tubular flow reactors.

11. HETEROGENEOUS PROCESSES

Introduction / Total reaction rate / Types of heterogeneous reactions / Catalysis / Nature of catalytic reactions / Mechanism.

V. METHODOLOGY

The course is developed in theory and practical sessions. In the theory sessions, the instructor presents the concepts, theorems and applications. In the practical sessions, various problems are solved and their solutions are analyzed. In all sessions the active participation of the student is encouraged.

VI. EVALUATION FORMULA

The Average Grade PF is calculated as follow:

PF = (EP + 2EF + PP) / 4

EP: Mid-Term Exam
EF: Final Exam
PP: Average of practices

VII. BIBLIOGRAPHY

1. **SMITH, J.H.**
   Engineering of Chemical Kinetics.
2. **LEVENSPIEL**
   Chemical Kinetics of Reactors.