Proyecto/Guía docente de la asignatura

Course/ Asignatura	Transport Phenomena Analysis / Análisis de Fenómenos de Transporte		
Unit / Materia	Thermodynamics and Transport in Chemical Processes / Termodinámica y Transporte en los Procesos Químicos		
Module / Módulo	Process & Product Engineering / Ingeniería de Procesos y Producto		
Degree / Titulación	Master in Chemical Engineering/ Máster en Ingeniería Química		
Plan Code / Plan	542	**Couse code/** Código	53741
Period/ Periodo de impartición	2nd Semester / 2º CUATRIMESTRE	**Type /** Tipo/Carácter	COMPULSORY / OBLIGATORIA
Level/Cycle / Nivel/Ciclo	MÁSTER	**Year** / Curso	1º
ECTS credits / Créditos ECTS	4.5 ECTS		
Language / Lengua en que se imparte	INGLÉS		
Staff / Profesor/es responsable/s	ÁNGEL MARTÍN MARTÍNEZ SERGIO BORDEL VELASCO		
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Department / Departamento	Ingeniería Química y Tecnología del Medio Ambiente		
Fecha de revisión por el Comité de Título	16/07/2024		

1. Situación / Sentido de la Asignatura

1.1 Contextualization

This subject is taught in the second semester of the first year of the Master's Degree in Chemical Engineering. It is an eminently practical subject in which students develop the ability to make use of conservation equations, proceeding to their integration and calculating the derived magnitudes necessary in the design and analysis of real processes.

1.2 Relationship with other subjects

This subject belongs to the module "Process and Product Engineering", and is considered closely related to other subjects of the module in the same semester, especially with 53747 DISEÑO DE PROCESOS CON REACCIÓN and 53748 DISEÑO DE PROCESOS DE TRANSFERENCIA DE MATERIA.

1.3 Prerequisites

Basic knowledge of transport processes (heat, matter, momentum). Ability to apply mathematical tools for analytical and numerical resolution of differential equations. Use of scientific calculation programs (Matlab/Python)

2. Learning ouctomes

2.1 General

CG01. Capacidad para aplicar el método científico y los principios de la ingeniería y economía, para formular y resolver problemas complejos en procesos, equipos, instalaciones y servicios, en los que la materia experimente cambios en su composición, estado o contenido energético, característicos de la industria química y de otros sectores relacionados entre los que se encuentran el farmacéutico, biotecnológico, materiales, energético, alimentario o medioambiental.

CG05. Saber establecer modelos matemáticos y desarrollarlos mediante la informática apropiada, como base científica y tecnológica para el diseño de nuevos productos, procesos, sistemas y servicios, y para la optimización de otros ya desarrollados.

CG11. Poseer las habilidades del aprendizaje autónomo para mantener y mejorar las competencias propias de la ingeniería química que permitan el desarrollo continuo de la profesión.

2.2 Specific

CEP01. Aplicar conocimientos de matemáticas, física, química, biología y otras ciencias naturales, obtenidos mediante estudio, experiencia, y práctica, con razonamiento crítico para establecer soluciones viables económicamente a problemas técnicos.

CEP03. Conceptualizar modelos de ingeniería, aplicar métodos innovadores en la resolución de problemas y aplicaciones informáticas adecuadas, para el diseño, simulación, optimización y control de procesos y sistemas.

3. Objetives

- To propose and solve, in particular cases, the general equation of conservation of any extensive property.
- Calculate property flows.
- Estimate the value of transport properties.
- To know the usefulness of the main theories on the boundary layer.
- Apply theoretical knowledge to propose and solve models of transport phenomena numerically or analytically.

4. Contents

1: Transport properties

Workload in ECTS credits: 1,0

a. Contextualization and justification

In this section, the experimental measurement and the theoretical estimation of the transport properties (viscosity, conductivity and diffusivity) are studied

b. Learning objectives

- To know the main experimental methods of determining transport properties.
- To apply the kinetic theory of gases to describe transport processes and evaluate transport properties.
- To apply semi-empirical methods to estimate transport properties

c. Contents

1. Introduction to transport properties: constitutive equations of Newton, Fourier and Fick.
2. Transport properties of non-Newtonian fluids
3. Experimental measurement of transport properties
4. Estimation of transport properties: Kinetic theory. Semi-empirical methods.

d. Teaching methods

Classes take place in the computer room in a practical way. The teacher guides the class through explanations followed by the development of practical cases. Necessary resources: Virtual classroom (Moodle) Virtual Campus Programming software Problem solving using programming in PYTHON, MATLAB and Excel-VBA.

e. Workplan

Experimental methods are presented through a theoretical presentation followed by a visit to the laboratories. Kinetic theory and estimation methods are studied through the development of practical examples.

f. Assessment

See section 7

g Training material

g.1 Basic Bibliography

F. W: Sears, G. L. Salinger. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd Ed. Adison Wesley, 1975.
B. E. Poling, J. M. Prausnitz, J. P. O'Connell, Properties of Gases and Liquids, 5th Ed. Mc Graw-Hill, 2000

g.2 Additional Bibliography

R. Soto. Kinetic Theory and Transport Phenomena. Oxford University Press, 2016.

h. Necessary resources

Virtual Classroom (Moodle)
Virtual Campus Programming software
Problem solving using programming in PYTHON, MATLAB and Excel-VBA.

i. Timing

ECTS LOAD	PERIOD
1,0 ECTS	Weeks 1 - 3

2: Transport processes

Workload in ECTS credits: 3,5

a. Contextualization and justification

In this section the formulation, analysis and resolution of transport problems based on their conservation equations is studied.

b. Learning objectives

- To propose and resolve, in particular cases, the general equation of conservation of any extensive property.
- Calculate property flows for molecular and turbulent transport.
- To know the usefulness of the main theories on the boundary layer and calculate transport coefficients
- Calculate transport coefficients using the analogies between transport phenomena.

c. Contents

4. Generalization of transport laws. Conservation equations.

5. Microscopic conservation equations. Application to systems with molecular and turbulent transport.
6. Boundary layer theories. Transport coefficients.

d. Teaching methods

Classes take place in the computer room in a practical way. The teacher guides the class through explanations followed by the development of practical cases. Necessary resources: Virtual classroom (Moodle) Virtual Campus Programming software Problem solving using programming in PYTHON, MATLAB and Excel-VBA

e. Workplan

The study of the contents will be carried out based on the analysis of specific examples, developed in the computer room.

f. Assessment

See section 7.

g Training material

g.1 Basic Bibliography

R. B. Bird, W. E. Stewart, E. N. Lightfoot. Transport Phenomena, 2nd ed. Wiley, 2001

g.2 Additional Bibliography

R. S. Brodkey, H. C. Hersey. Transport phenomena: a unified approach. McGraw-Hill, 1988
I. Tosun. Modelling in Transport Phenomena. Elsevier Science, 2001

g.3 Other teaching materials

The virtual campus provides descriptive material and code of the examples studied.

h. Necessary resources

Virtual Classroom (Moodle)
Virtual Campus Programming software
Problem solving using programming in PYTHON, MATLAB and Excel-VBA.

i. Timing Tempora

ECTS LOAD	PERIOD
3,5 ECTS	Weeks 4-15

5. Teaching methods

Classes are developed in the computer room in a practical way. The professor guides the class by explanations followed by the development of practical cases. Examples are provided to students to build on the knowledge acquired in the classes, and begin to solve in the classroom.

6. Table of student dedication to the subject Tabla de

ON-SITE AND PRESENTIAL ON-LINE ACTIVITIES	HOURS	OFF-SITE ACTIVITIES	HOURS
Theory classes	10	Self-study	68
Practical classes	30		
Seminars + Lab visits	5		
Total	**45**	Total	**68**
		TOTAL	**113**

7. Assessment methods – Summary table

ACTIVITY	WEIGHT ON FINAL MARK	COMMENTS
Written exam	35%	
Assignments	60%	4-6 Assignments. Oral presentation of the assignments may be required.
Participation in the activities developed in the classroom	5%	

ASSESSMENT CRITERIA

• **Ordinary evaluation:**
  ○ A minimum global mark of 5.0 is required to pass.
• **Extraordinary evaluation:**
  ○ The student can choose between two options: 1) the same criteria as in the ordinary exam, or 2) Practical + written exam with 100% weight on final mark

8. Concluding remarks