VNIVERSITAT DE VALÈNCIA

Course Guide
44432 Transport phenomena

COURSE DATA

Data Subject	
Code	44432
Name	Transport phenomena
Cycle	Master's degree
ECTS Credits	4.5
Academic year	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
2209 - M.D. in Chemical Engineering	School of Engineering	1	First term

Subject-matter

Degree	Subject-matter	Character
2209 - M.D. in Chemical Engineering	5 - Transport phenomena	Obligatory

Coordination

Name	Department
VAZQUEZ NAVARRO, ISABEL	245 - Chemical Engineering

SUMMARY

The subject ***Transport Phenomena*** is part of the subject matter ***Processes and Product Engineering***, the general aim of which is that students acquire the basic principles of the chemical engineering for subsequent application to the design and analysis of the operation of chemical reactors and unit operations of the process industry. It is a compulsory subject that is taught quarterly basis in the Master in Chemical Engineering in the first quarter. The curriculum consists of a total of 4.5 ECTS.

This course aims to go more deeply into the basis of momentum, heat and mass transfer processes, by introducing two fundamental tools for the chemical or physical process analysis and design: microscopic balances and rate equations, so much for the molecular transport and for the turbulent processes. The necessary theoretical aspect of the matter complements with a big practical component in which, after the introduction of the basic concepts, the students will realise numerous exercises of application.

The **general objectives** of the course are:

• To deepen in the laws governing the momentum, heat and mass transfer in any physical or chemical process, to tackle then the equipment design of the chemical process industry.

• To develop in students the ability to pose and solve numerical problems in transport phenomena, and to interpret the results.

• To enhance the student's skills in reasoning and systematic work.

The course **contents** are:

• Conservation and change equations. Rate equations.

• Design equations in molecular and turbulent transport.

• Boundary Layer Theory.

• Analogies between transport phenomena.

• Application to the resolution of practical cases.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Students with a BSc degree in Chemical Engineering do not need any additional requirements.
Students from other degrees should have the following skills:
-To be familiar with rectangular, cylindrical and spherical coordinates systems.
-Know how to perform operations between scalars, vectors and tensors and know how to solve systems of equations.
-To be familiar with the concept of reaction rate and to possess basic knowledge of thermodynamics.
-To be familiar with the balances approach and basic concep

OUTCOMES

2209 - M.D. in Chemical Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Lead and define multidisciplinary teams which can make technical changes and address managerial needs in both national and international contexts.
- Be able to apply the scientific method and the principles of engineering and economics to formulate and solve complex problems in processes, equipment, facilities and services in which matter changes its composition, state or energy content, these changes being characteristic of the chemical industry and of other related sectors such as pharmacology, biotechnology, materials science, energy, food or the environment.
- Conceive, plan, calculate and design processes, equipment, industrial facilities and services in the field of chemical engineering and other related industrial sectors in terms of quality, safety, economics, rational and efficient use of natural resources and environmental conservation.
- Know how to establish and develop mathematical models by using appropriate software in order to provide the scientific and technological basis for the design of new products, processes, systems and services and for the optimisation of others already developed.
- Integrate knowledge and handle the complexity of formulating judgments and decisions, based on incomplete or limited information, which take account of the social and ethical responsibilities of professional practice.
- Communicate and discuss proposals and conclusions in specialised and non-specialised multilingual forums, in a clear and unambiguous manner.
- Adapt to changes and be able to apply new and advanced technologies and other relevant developments with initiative and entrepreneurship.
- Have skills for independent learning in order to maintain and enhance the specific competences of chemical engineering which enable continuous professional development.
- Be able to access information tools in different areas of knowledge and use them properly.
- Be able to assess the need to complete their technical, scientific, language, computer, literary, ethical, social and human education, and to organise their own learning with a high degree of autonomy.
- Be able to defend criteria with rigor and arguments and to present them properly and accurately.
- Be able to take responsibility for their own professional development and specialisation in one or more fields of study.
- Design products, processes, systems and services for the chemical industry and optimise others already developed, on the basis of the technologies of various areas of chemical engineering including transport processes and phenomena, separation operations and engineering of chemical, nuclear, electrochemical and biochemical reactions.

- Apply critical reasoning to their knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience and practice, in order to establish economically viable solutions to technical problems.
- Conceptualize engineering models; apply innovative methods in problema solving and applications suitable for the design, simulation, optimization and control of processes and systems.
- Be able to solve unfamiliar and ill-defined problems that have specifications in competition by considering all possible methods of solution, including the most innovative ones, and selecting the most appropriate, and correct implementation by evaluating the different design solutions.

LEARNING OUTCOMES

• To know the laws governing the momentum, heat and mass transfer processes in physical or chemical processes.

• To identify and explain the physical meaning of each of the terms in the equations of microscopic property balances.

• To know how to explain the distinguishing characteristics of laminar and turbulent flow.

• To identify and describe the rate equations of molecular transport processes.

• To know how to approach and solve problems on laminar fluid motion and molecular heat and mass transfer.

• To know how to approach the rate equations for interphase transport.

• To understand the main models that explain the dependence of the transport coefficients with the physical and flow properties of the systems.

• To know and use the analogies between different transport phenomena.

• To know how to approach and solve numerical problems on heat and mass transfer between phases

DESCRIPTION OF CONTENTS

1. INTRODUCTION. MICROSCOPIC PROPERTY BALANCES

Transport Phenomena in Chemical Engineering. Transport mechanisms. Microscopic balances of property.

2. DESIGN EQUATIONS IN MOLECULAR TRANSPORT

Rate equations. Transport property. Combination of the microscopic balance and the rate equation.

3. STEADY STATE MOLECULAR TRANSPORT

Problem-solving strategies of molecular transport at steady state. Common boundary conditions. Applying the design equations of molecular transport to the resolution of different uni, bi, and tridirectional problems.

4. UNSTEADY STATE MOLECULAR TRANSPORT

Unidirectional transport in semi-infinite media. Unidirectional transport in finite media. Spot and average concentration of property. Application to bodies of finite dimensions: Newmans method. Approximate numerical-graphical solution: Schmidt method.

5. TURBULENT TRANSPORT INTRODUCTION

ntroduction. Origin of turbulence. Instantaneous values, time-smoothed values and fluctuations. Time-smoothed design equations. Turbulent transport theories.

6. INTERPHASE TRANSPORT. TRANSPORT COEFFICIENTS

Individual transport coefficient. Interphase transport. Overall transport coefficients. Boundary layer theory. Procedures for estimating the transport coefficients.

7. DESSIGN EQUATIONS FOR INTERPHASE TRANSPORT PROCESSES

Property balances. Representation on the phase or equilibrium diagram. Rate equations. Combining balances with the rate equations: design equations. Applying the equations to the design of basic operations.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	23,00	100
Classroom practices	22,00	100
Study and independent work	28,00	0
Preparation of evaluation activities	20,00	0
Resolution of case studies	20,00	0
TOTAL	**113,00**	

TEACHING METHODOLOGY

Theoretical activities

- Explanatory development of the subject with the student's participation in resolving specific issues.
- Carrying out individual evaluation test.

Practical activities

- Learning through problem, exercises and case studies solving for acquiring skills on different aspects of the matter.

EVALUATION

Individual face-to-face objective test consisting of one or more examinations which include both practical issues and problems. Weighting: 70%.

Assessment of theoretical and practical quizzes. Weighting: 20%.

Continuous assessment of each student, based on participation and degree of involvement of students, taking into account regular attendance at the planned classroom activities and resolving non-face-to-face issues and problems proposed. Weighting: 10%

REFERENCES

Basic

- Fenómenos de Transporte, R.B. Bird, W.E. Stewart, E.N. Lightfoot, Reverté, 1964

- Ingeniería Química. Tomo 2. Fenómenos de Transporte, E. Costa Novella y otros, Alhambra, 1984

Additional

- Transport Phenomena, 2nd ed. R.B. Bird, W.E. Stewart, E.N. Lightfoot, Wiley, 2002
- Fundamentals of Momentum, Heat and Mass Transfer, 4th ed., J.R. Welty, C.E. Wicks, R.E. Wilson, G. Rorrer, Wiley, 2001.
- Elements of Transport Phenomena, L.E Sissom, D.R. Pitts, McGraw-Hill, 1972.
- Transport Phenomena in Newtonian Fluids A Concise Primer. P. Olsson, Springer, 2014, e-book en UV
- Chemical and Bioprocess Engineering: Fundamental Concepts for First-Year Students, R. Simpson, S. K. Sastry, Springer, 2013, e-book en UV
- Transport Phenomena in Food Process Engineering, A. K. Datta, Himalaya Pub. House, 2010, e-book en UV
- Transport Properties of Chemicals and Hydrocarbons, 2nd Edition, C. L. Yaws, Gulf Pub., 2014, e-book en UV