ETY404 - Diffusion and Mass Transfer Phenomena

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY 404	**SEMESTER**	4
COURSE TITLE	Diffusion and Mass Transfer Phenomena		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	4
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	General background
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (IN ENGLISH)
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims to make the undergraduate students familiar with diffusion phenomena (especially with mass diffusion, which is influence the production process of a big variety of materials) as well as with other subjects which are correlated with mass transfer phenomena. Special attention is given to the building blocks of matter such as atoms, molecules, macromolecules, particles, etc, as they involved to the field of Science, Technology, and Engineering of materials. Moreover, the relation of such building blocks with the Physicochemical and Thermodynamic theory, as it is taught in Chemical Engineering Metallurgical Engineering, Chemistry, etc. departments, is presented. By completing the course, the students are expected to have acquired the following:

Knowledge:

The undergraduate students will learn about heat and mass transfer phenomena. They will understand the basic transfer principles and different transfer mechanisms as well as the physical meaning of several constants and parameters which are used for problems solving.

They will also learn how the different temperatures are the driving force for the heat transfer and how the different concentrations are the driving force for the mass transfer.

Abilities:

Using the theoretical background and their skills on solving mass and/or heat balances, the undergraduate student should possess the ability to make the appropriate assumptions and simplifications on a problem in order to choose the right parts for the development of complex systems.

Skills:

Using the theoretical knowledge students should possess the ability to develop heat and/or mass transfer balances under steady or non-steady state conditions. Moreover, they should be able to simplify more complex problems which involve heat and/or mass transfer phenomena. The undergraduate students learn to develop the appropriate differential equations concerning the mass and energy balances, and to calculate mass and heat transfer rates as well as concentration and temperature profiles for a system using the appropriate boundary conditions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of free, creative, and inductive thinking
- Team work
- Decision-making
- Adapting to new situations
- Project planning and management
- Criticism and self-criticism

(3) SYLLABUS

Basic phenomena. Introducing to mass, heat, and momentum diffusion. Mechanisms. Fick law, net flow, gradients, balances, steady and non-steady state. Fourier law and Newtons law for the viscosity and divergencies. Navier-Stokes equation. Dimensional analysis. Scale up procedure, Transport phenomena. Reynolds and Froude number, drag force, Kolmogorov analysis. Diffusion coefficients comparison for gasses, liquids, fluids, and solids. Mass diffusion into materials. Diffusion into monocrystalic and polycrystalic solids. Kirkendall phenomenon. Self-diffusion and viscosity of polymeric fluids, de Gennes model. Diffusion of type I, II & III. Diffusion through composite materials. Diffusion and separations. Cahn-Hilliard equation. Fluids, particles, and pores. Particles in fluids, Stokes equation, Brown equation, Stokes-Einstein equation. Flow through porous media and particle beds. Poiseuille equation Carman-Kozeny equation. Knudsen diffusion. Fluidization.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class, lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory*	Use of PC for data and information, preparation of deliverables, communication of the team using email/social media/ecourse platform

education, communication with students	
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHOD OF EVALUATION: Written final exam based on theory and problems demonstration which were provided through course lectures

Activity	*Semester workload*
Lectures	39
Tutoring	13
Self-study for preparing for final examination	48
Course total	100

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Cengel Yunus., Ghajar A., Heat and Mass Transfer: Fundamentals and Applications, 5th Ed.
- Brodkey Robert S., Hershey Harry C., Transport phenomena: A unified approach.

–