COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	EN0510	**SEMESTER**	6th
COURSE TITLE	Transport 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	5	6
Add rows if necessary. The organisation 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:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18356&lang=en

(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*

Upon completion of the course it is expected that the student:

- Is able to predict the properties of transport coefficients
- Is able to apply the continuity equation and property balances to relatively simple systems (one- or two-dimensional flow, transient flow)
- Is able to calculate the profiles of velocity, temperature and concentration in relatively simple systems
- Understands and applies boundary layer theory to all transport phenomena.
- Understands the main principles and peculiarities of mass transport and its applications.
- Understands the analogies of the transport phenomena.

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

- Independent work
- Project planning and management
- Promoting creative and inductive thinking

(3) **SYLLABUS**

- Deviation from thermodynamic equilibrium: transport phenomena. Examples of complex transport phenomena.
- Unification of molecular transport laws of Fourier, Fick and Newton.
- Microscopic interpretation of molar transport of momentum, heat and mass on the basis of kinetic theory of gases and statistical mechanics.
- Formulation of the differential balance for a general transport property. The balance statement for a fixed control volume.
- Molecular and convective transport. The vectorial nature of heat and mass flux. The tensorial nature of momentum flux. Generalization of molecular transport laws in three dimensions.
- Boundary conditions on solid walls and fluid interfaces.
- Applications of one-dimensional transport: Steady heat conduction through an electrical wire. Viscous heating of a lubrication bearing. Inclined film flow. Analysis of a diaphragm cell for measuring diffusivity.
- Convective transport: laminar boundary layer, mass/heat transport in a pipe, mixing cup temperature/concentration.
- Emphasis on mass transfer: definitions and explanation for the convection induced by mass transfer. Equimolar counterdiffusion in gases. Unimolecular diffusion in gases. Diffusion with heterogeneous and homogeneous chemical reaction. Diffusion through solids. Knudsen diffusion. Diffusion through membranes.
- Definition of the mass transfer coefficient. Dimensional analysis: the Schmidt and Sherwood numbers. The Reynolds and Chilton-Colburn analogies between heat, mass and momentum transport.
- Mass transfer across interfaces.
- Simultaneous heat and mass transfer.

(4) **TEACHING and LEARNING METHODS - EVALUATION**

DELIVERY ***Face-to-face, Distance learning, etc.***	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory 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

Activity	*Semester workload*
Lectures	56
Laboratory practice	4
Study and analysis	60
Homework	30
Course total	150

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.*	Assessment Language: Greek Evaluation methods: (a) final exam (90%), including multiple choice test, Short Answer Questions and problem solving (b) Homework (10%) The homework is returned corrected to the students. The students have the right to see their written exams on a specific day and time.

(5) **ATTACHED BIBLIOGRAPHY**

-Suggested bibliography:

- Brodkey, R.S. & Hershey, H.C. “Transport Phenomena: A Unified Approach”, Brodkey Publishing, 2003. [Greek translation]
- E.L. Cussler, Diffusion-Mass Transfer in Fluid Systems, 2nd Ed., Cambridge University Press, NY (1997).
- R.B. Bird, W.E. Stewart, and E.N. Lightfoot, Transport Phenomena, John Wiley & Sons, New York (2001).
- Truskey, G.A., Yuan, F., and Katz, D.F., "Transport Phenomena in Biological Systems". 2nd ed., Pearson Prentice Hall (2010).
- C.J. Geankoplis, Transport Processes and Unit Operations, 3rd Ed., Prentice-Hall, Inc., Englewood Cliffs, NJ (1993).
- J.R. Welty, C.E. Wicks, R.E. Wilson and G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th edition.
- S. Middleman, An introduction to mass and heat transfer: principles of analysis and design, Wiley, 1998.