COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Agricultural Sciences		
ACADEMIC UNIT	Biosystems & Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE_620	**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	3	
Tutorials	2	
Laboratory		
TOTAL	**5**	**5**
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, specialised general knowledge, skills development*	Scientific area, background and skills development
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek .-For Erasmus students in English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
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*

At completion of the course students will have acquired knowledge and familiarity with the laws of thermodynamics and their practical engineering applications. They will also:

- Have developed ability to perform thermodynamic calculations
- Application of the principles of electrochemistry and the Nernst equation to the prediction by calculations of the spontaneous or non-spontaneous redox reaction.
- Use of ionic power, coefficients of activity and Debye Huckel Theory. in approximate solutions and applications in environmental systems

In general, by completing this course the student will have further developed the following general skills (from the list above):

Search, analysis and synthesis of data and information, using the necessary technologies, Adaptation to new situations, Decision making, Autonomous and team work, Respect for the natural environment, Promotion of free, creative and inductive thinking

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…*
	…….

In general, upon completion of this course the student will have further developed the following general skills (from the list above):
Search, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Respect for the natural environment
Exercise criticism and self-criticism

(3) SYLLABUS

Introduction to Transport Phenomena: Transport Phenomena and their importance in the field of agricultural engineering
Mechanisms of transfer by molecular means: The case of heat transfer. The case of mass transfer. The case of momentum transfer. Newtonian and non-Newtonian fluids. The ratio of the relationships between the different phenomena. Heat, mass and momentum diffusions. Thermal conductivity, viscosity and diffusion coefficient. Comparison of heat and mass momentum transfers.
Generalized balance of properties (for all three properties): Balances and the concept of conservation of mass and energy. The terms of entry, exit, production and accumulation. Balance in differential form. Balance for one-dimensional transport by molecular means and synagogue. Transfer by molecular means. Synagogue transport. The equilibrium equation in the three dimensions. The continuity equation. The general property balance for incompressible fluid.
General property balance and transfer by molecular means: Permanent state. One-dimensional transport without production. Fixed area transfer. Transport with stable production in permanent condition. Application for heat or mass transfer with constant production. Momentum transfer with production in steady state. Laminar flow of Newtonian fluid in a tube. The Hagen-Poiseuille law. Laminar flow of Newtonian fluid between parallel plates. Variable production.
Synagogue transport: Momentum transport: Balances. Coordinate systems. Shear. Continuity equation. Energy Balance. Navier-Stokes equations. Smooth - turbulent flow. Fully developed Newtonian fluid flow between plates. Boundary layer theory. The marginal level. Elements of fluid mechanics: Properties of the fluid. Types of flow. Control volume. Conservation of mass and energy in Control Volume. Fluid statics: Euler equilibrium differential equations. Manometers. Pressure measurements. Forces on the walls of containers Atmospheric models. Fluid kinematics: Flow field description. Flow lines - orbits .. Fluid dynamics :. Mechanical energy conservation equation. Bernoulli equations. Flow in piping: Flow in pipe. Calculation of total losses. Major - Minor Losses - Piping Networks. Pumps - Pump Types - Characteristic Curves. Operating Point
Week 1 Introduction to Transport Phenomena.
Week 2,3,4: Mechanisms of transport by molecular means
Week 5,6,7 Generalized balance of properties (for all three properties).
Week 8 General property balance and transfer by molecular means

Week 9 Synagogue Transfer: Momentum Transfer
Week 10,11,12 Elements of fluid mechanics.
Week 13: Review, summary

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of ICT (power point) in Teaching • Use of ICT (power point) in Laboratory Training • Use of ICT in Communication with students (Learning process support through the electronic platform e-class).
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.* 1	1. The main assessment criteria focus on understanding and correlating the knowledge that students gain from the course with other knowledge. Particular emphasis is placed on whether they have developed the ability to apply this knowledge to crop selection and to assess the impact of these changes on the environment. Emphasis is also placed on demonstrating critical ability and justifying the choices they make in each problem. 2. Evaluation is dynamic. It mainly involves problem solving. is done orally or in writing or with a combination of the two, with or without pre-examination on the basic principles of the course, with or without exculpatory advances and with other test or inventive methods, depending on the composition of the dynamics and the needs of the audience. 3. The above are done in the Greek language. For foreign language students (eg Erasmus students) conducted in English

Activity	*Semester workload*
Lectures	39
Tutorials	26
Final Exams	26
Study hours and preparation for tutorials and the final examination	44
Course total	**125**

(5) RECOMMENDED LITERATURE

- R. S. Brodkey, H. C. Hershey, Φαινόμενα Μεταφοράς, Εκδόσεις Τζιόλα, 2001, Mc Graw Hill, 1988
- «ΒΑΣΙΚΕΣ ΦΥΣΙΚΕΣ ΔΙΕΡΓΑΣΙΕΣ ΜΗΧΑΝΙΚΗΣ» McCABE,SMITH & HARRIOT Εκδόσεις Τζιόλας
- Elger, D. F., Williams, B. C., Crowe, C. T., Roberson, J. A., Μηχανική ρευστών για μηχανικούς, Εκδόσεις Τζιόλα,2016,