COURSE OUTLINE

1. GENERAL

SCOOL	ENVIRONMENT AND AGRICULTURAL ENGINEERING		
DEPARTMENT	NATURAL RESOURCES MANAGEMENT AND AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	261	SEMESTER	7th
COURSE TITLE	HEAT AND MASS TRANSFER		

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	3
LABORATORY PRACTICES	2	2
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	SPECIAL BACKGROUND
PREREQUISITECOURSES:	- APPLIED THERMODYNAMICS - PHYSICS - MATHEMATICS III
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (IN CLASSES OF MORE THAN 5 STUDENTS)
COURSE WEBSITE (URL)	ELECTRONIC NOTES AND PRESENTATIONS OF THE COURSE ARE AVAILABLE FOR THE STUDENTS OF THE SEMESTER AT THE ADDRESS, https://oeclass.aua.gr/eclass

2. 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*

The subject of the course is understanding the basic physical processes by which energy (heat) and mass are transferred. Energy and mass transfer are fundamental to many biological and environmental applications included in the field of Agricultural Engineering, such as food processing and preservation, thermal design of buildings (e.g. greenhouses, livestock buildings), etc.

The main transport mechanisms in these processes are conduction, convection associated with fluid mechanics, radiative heat transfer, and diffusion. It is important for the student to understand and use these concepts as a complete and unified subject.

The laboratory work aims to train students in calculations for the design of applications related to energy and mass transfer phenomena, such as agricultural buildings, food

processing and preservation chambers, packaging systems, etc. In addition, the laboratory exercises include experiments demonstrating energy and mass transfer processes as well as a brief presentation of computational methods for simulating such processes.

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, analysis and synthesis of data and information, using the necessary technologies	Project planning and management
Adapting to new situations - Making decisions	Respect for diversity and multiculturalism
Autonomous work - Group work	Respect for the natural environment
Work in an international environment	Demonstrating social, professional and ethical responsibility and sensitivity to gender issues
Work in an interdisciplinary environment	Exercise criticism and self-criticism
Generating new research ideas	Promotion of free, creative and inductive thinking

3. SYLLABUS

- Introduction and basic concepts
  - Thermodynamics and heat transfer
  - Heat and other forms of energy
  - The first law of thermodynamics
  - Heat transfer mechanisms
  - Conduction - Convection - Radiation
- Steady heat conduction
  - Steady heat conduction on flat walls
  - The concept of thermal resistance
  - Thermal contact resistance
  - Generalized networks of thermal resistance
  - Heat conduction in cylinders and spheres
- Transient heat conduction
  - Lumped system analysis
  - Transient heat conduction in ordinary geometries
- Numerical methods in heat conduction
  - Why numerical methods are used
  - Formulation of differential equations with finite differences
  - One-dimensional permanent heat conduction
  - Two-dimensional permanent heat conduction
  - Transient heat conduction
- The basic principles of convection
  - The physical mechanism of convection - The Nusselt number
  - Classification of fluid flows
  - Velocity boundary layer - Thermal boundary layer
  - Construction of the differential equations of convection
  - Solving the convection equations for a flat plate
- Types of convection
  - External forced convection
  - Internal forced convection
  - Natural convection
- Heat exchangers

- Types of heat exchangers
- The total heat transfer coefficient
- Analysis of heat exchangers
- The log-mean temperature difference method
- The effectiveness-NTU method

➢ Radiation heat transfer
- Thermal radiation
- Black body radiation
- Radiation heat transfer - black surfaces
- Radiative transport: diffusion and gray surfaces

➢ Heat transfer and phase transitions
- Freezing – melting
- Evaporation – condensation – boiling
- Latent heat

➢ Mass transfer
- Analogy between heat and mass transfer
- Mass diffusion
- Mass transfer through a membrane

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	Use of ICT in teaching and 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	*Activities* / *Semester workload* Lectures: 75 Laboratories: 50 *Course total*: *125*
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	I. Written examination in the theory of the course, including: - Multiple-choice questions on the semester's syllabus. - A solution to an exercise if applicable. II. Written examination in the laboratory part of the course, including: - Development, judgment and multiple-choice questions on the semester syllabus.

interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

5. ATTACHED BIBLIOGRAPHY

- E-NOTES
- Cengel, Yunus A. , Ghajar, Afshin J.. Heat and Mass Transfer: Fundamentals and Applications. 5th Edition, McGraw Hill, (2014)
- Datta, Ashim K.. Heat and Mass Transfer: A Biological Context, CRC Press; 2nd edition (2017)