UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
CVEE-465	Mathematical Models in Environmental Engineering	6
Department	**Semester**	**Prerequisites**
Engineering	Fall, Spring	CVEE-341, ECE-290, MATH-330
Type of Course	**Field**	**Language of Instruction**
Elective	Civil & Environmental Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	4th	Dr Nectarios Papanicolaou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Introduce the students to the environmental flows and the physical processes of dispersion and diffusion of pollutants in Water, Air and Soil.
- Obtain knowledge of the fundamental mathematical laws defining these types of flows (conservation of Mass, Momentum and Energy, continuity of mass equation in integral form, dispersion and diffusion).
- Provide the general concepts of single and multiphase flows at both: underground and surface.
- Learn methods for simulating 1D physical processes (e.g. atmosphere, channels, rivers and percolating fluids in the subsurface)
- Perform simulations in 2D (e.g. city ventilation, lakes and water aquifers).
- Provide the principles of advanced topics like: numerical stability, dimensional analysis and dealing with boundary layers.
- Explain to the students the standard numerical methods (e.g finite difference, finite elements) as well as advance methods (e.g matched asymptotic expansions) with the help of Matlab and the software package Modflow.
- Prepare the students for both theoretical and applied examples to deal with the analysis of the behavior of such systems (plume evolution) so as to limit the adverse effects of environmental pollutants.

Learning Outcomes:

After completion of the course students are expected to:

- Apply the fundamental principles of environmental modeling (for air, water and soil).
- Demonstrate how flow models assist in environment-friendly designs.
- Implement the physical processes of transport and diffusion.
- Demonstrate knowledge and understanding of groundwater and aquifer

pollution.
- Utilize their scientific knowledge obtained by the course to address environmental engineering problems. (e.g., assess processes to limit pollution).

Course Contents:

- Fundamentals and principles of modelling.
- Introduction to Modflow.
- Transport and diffusion in environmental systems.
- Solution of transport and diffusion.
- Transport and Sorption.
- Flow modelling (water, air).
- Groundwater drawdown by pumping (fluid flow in porous media: soil).
- Advance mathematical methods with Matlab (Matched asymptotic expansions, boundary layer)

Learning Activities and Teaching Methods:

The course is being taught through a series of lectures providing the theoretical fundamentals. Solving extensive examples on the board, combined with computer laboratory exercises, through a continuous exchange of information between students and lecturer will create the firm understanding of the various topics. The course is being accompanied by practical computer applications on Matlab and the software package Modflow such that the students will be exposed to simulations and appreciate the importance of mathematical modeling in environmental engineering.

Assessment Methods:

Homework (applied exercises), computer laboratory exercises, midterm exam(s), project and final exam.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Ekkehard Holzbecher	Environmental Modeling Using Matlab	Springer, New York	2007	9783540729365

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Andrew Ford	Modeling the Environment, 2nd Edition	Island Press	2009	9781597264730
John Wainwright and Mark Mulligan	Environmental Modelling: Finding Simplicity in Complexity	John Wiley and Sons	2004	9780470749111