COURSE OUTLINE

(1) GENERAL

SCHOOL	**UNIVERSITY OF THESSALY**		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ΓΚ0406	**SEMESTER**	4
COURSE TITLE	PARTIAL DIFFERENTIAL EQUATIONS		

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**
	4	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, specialized general knowledge, skills development*	General background
PREREQUISITE COURSES:	(Recommended) Ordinary differential equations, Calculus II
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	http://eclass.uth.gr/eclass/courses/MHXC153/

(2) LEARNINGOUTCOMES

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 EducationArea*
- *DescriptorsforLevels6,7&8oftheEuropeanQualificationsFrameworkforLifelongLearningand AppendixB*
- *Guidelines for writing LearningOutcomes*

The course, building up on the knowledge of ordinary differential equations and infinitesimal calculus of multivariable functions acquired during the previous semesters, deals with differential equations with partial derivatives with an emphasis on both theory and applications, especially coming from physics. Focusing on the essence of the basic ideas, analytical solution methods, and their application to the mathematical modeling of classical physics problems in the context of engineering, special attention is paid to the development of the understanding and ability to formulate differential equations with partial derivatives in higher dimensions as initial and boundary value problems and the subsequent analytical solution and interpretation of their solution.

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 thenecessarytechnology	*Project planning and management*
Adapting to newsituations	*Respect for differenceandmulticulturalism*
Decision-making	*Respect for the naturalenvironment*
Workingindependently	*Showing social, professional and ethical responsibilityand sensitivity to genderissues*
Teamwork	*Criticism andself-criticism*
Working in aninternationalenvironment	*Production of free, creative andinductivethinking*
Working in aninterdisciplinaryenvironment	*……*
Production of newresearchideas	*Others…*
	…….

The course aims at learning and applying methods for the analytical solution of differential equations with partial derivatives, with an emphasis on both theory and applications, particularly in problems of physics and technology. At the same time, the aim is to promote critical thinking as well as productive and inductive thinking regarding the applicability of applied mathematics and in particular of differential equations with partial derivatives in the study of Nature.

(3) **SYLLABUS**

Fourier series (periodic functions, functions with period 2L, general Fourier series, series coefficients and Euler-Fourier formulas, sine and cosine Fourier series, Fourier series derivatives and integrals, complex Fourier series representation)

Basic concepts (linear and non-linear equations, classification of 2nd order PDEs, superposition principle, 2-point boundary value problems, eigenvalues and eigenfunctions, Dirichlet and Neumann boundary conditions, change of independent variable, change of dependent variable, conversion of 2nd order PDEs to normal form)

Basic PDEs for the civil engineer (Laplace equation, Poisson equation, wave equation, heat/diffusion equation, soil solidification equation, convection-diffusion equation, biharmonic equation)

Examples from civil engineering science (Airy's stress function and plane elasticity problem, steady irrotational flow of ideal fluid, traffic flow, Navier-Stokes equations)

General solutions in special cases (d'Alembert solution, two-dimensional Laplace equation, some special 1st order and 2nd order linear PDEs, exponential substitution method, general solution of the two-dimensional biharmonic equation)

Method of separation of variables (initial and boundary value problems, one-dimensional wave equation, one-dimensional heat/diffusion equation, two-dimensional Laplace equation and Dirichlet problem in an orthogonal domain, non-homogeneous boundary conditions, non-homogeneous differential equations)

Applications to bar and beam oscillations (axial bar oscillations, beam bending oscillations)

PDEs in curvilinear coordinates (Laplace equation in polar, cylindrical, and spherical coordinates, inner and outer Dirichlet problem for a circle, potential flow around a stationary cylinder, two-dimensional heat/diffusion equation and Bessel functions)

(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*
Lecture hours	56 hours
Study and analysis of bibliography	35 hours
Individual study	36 hours
Exam preparation	20 hours
Exam	3 hours
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.

Language of evaluation: Greek

The evaluation is carried out through
(a) optional exercises which the student submits at regular intervals
(b) a written examination at the end of the semester

The assessment includes:
Written examinations (80% of the final grade if the student has handed in exercises, otherwise 100%)
Optional exercises (20% of the final grade)

Assess whether the examinee has the competence:

- to construct differential equations with partial derivatives in 1, 2 and/or 3 dimensions as initial and boundary value problems in the context of mathematical modeling of natural phenomena
-to find their analytical solution and provide an interpretation of the solution

Assessment criteria are discussed in class at the beginning of the semester.

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography (in Greek)

Ακρίβης Γ.-Αλικάκος Ν., *Μερικές Διαφορικές Εξισώσεις*, 2η έκδ., 2017, Σύγχρονη Εκδοτική
Ιωακειμίδης Ν., *Εφαρμοσμένα Μαθηματικά ΙΙΙ για Πολιτικούς Μηχανικούς*, 2012, Εκδ. Gotsis
Κραββαρίτης Δ., *Θέματα Εφαρμοσμένων Μαθηματικών*, 2013, Εκδ. Τσότρας
Strauss W.A., *Μερικές Διαφορικές Εξισώσεις*, 2017, Πανεπ. Εκδ. Ε.Μ.Π.
Σταυρακάκης Ν., *Μερικές Διαφορικές Εξισώσεις και Μιγαδικές Συναρτήσεις*, 2016, Εκδ. Τσότρας
Τραχανάς Σ., *Μερικές Διαφορικές Εξισώσεις*, 2009, Πανεπ. Εκδ. Κρήτης
Haberman R., *Εφαρμοσμένες Μερικές Διαφορικές Εξισώσεις*, 2014, Εκδ. Φούντας
Χατζηκωνσταντίνου Π., *Μερικές Διαφορικές Εξισώσεις – Μιγαδικές Συναρτήσεις*, 2017, Εκδ. Gotsis*:*

- Related academic journals: