COURSE OUTLINE

CE0310 – Differential Equations

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0310**	**ΕΞΑΜΗΝΟ ΣΠΟΥΔΩΝ**	3^0
COURSE TITLE	**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, specialised general knowledge, skills development*	General Background Course
PREREQUISITE COURSES:	Analysis I, Analysis II, Linear Algebra.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	-
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV249/

(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*

The aim of the course is to introduce the students to the fundamental concepts of Differential Equations theory, by familiarizing them with the process of describing basic engineering problems through differential equations or systems of differential equations and by developing appropriate methodologies to solving them.

Upon successful completion of the course, students will have:

- Basic knowledge of the concepts of the theory of differential equations.
- Knowledge and understanding of the techniques for solving first and second order differential equations,

linear equations with constant coefficients and linear differential systems with the help of closed formulas and the Laplace transform.

- In-depth knowledge and understanding of the important role of differential equations.
- Skills in describing and modeling various Civil Engineering problems through ordinary and partial differential equations.
- Critical understanding of the importance of analytical and theoretical methods in problem solving and familiarity on implementing the relevant software.

Specifically, students will be able to:

- solve 1st order differential equations such as separable equations, linear, complete, Bernoulli, and Ricatti as well as initial value problems.
- solve 2nd order linear differential equations with constant coefficients by applying various techniques, such as the methods of order reduction, variation of parameters, integrating factor and undetermined coefficients.
- Formulate and apply the power series method on solving 2nd order linear differential equations.
- Develop and implement various techniques derived from Linear Algebra to solve 1st order systems of linear differential equations with constant coefficients.
- Calculate the Laplace transform and apply it to solve initial value problems.

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…*

Upon successful completion of the course, students will have acquired the following general skills:

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Decision Making.
- Autonomous work

(3) SYLLABUS

1. Introduction: Derivation - mathematical models, concept of a differential equation, classification, concept of solution, initial boundary value problems, well-posed problems.
2. First-order Differential Equations: Linear equations of separated variables, exact differential equation and integrating factors, homogeneous, formulation of the theory of existence and uniqueness, modeling of physical problems.
3. Linear Differential Equations: Theory of homogeneous differential equation, linear independence of functions or solutions and Wronskian determinant, Abel's theorem, reduction of the order - d' Alembert's method, non-homogeneous differential equation and the method of varying coefficients - Lagrange method, equations with constant coefficients, characteristic polynomial-simple, multiple, complex roots, method of determining coefficients.
4. Laplace Transform: Definition, solving initial value problems, Heaviside and Dirac functions, equations with discontinuous non-homogeneous term, convolution theorem, Volterra equations.
5. First Order Systems Differential Equation: Homogeneous linear with constant coefficients, complex, multiple eigenvalues, phase portrait, autonomous systems and stability, non-homogeneous linear systems.

6. Solving Linear Second Order using Power Series: Solution in a regular point, Legendre equation, Legendre polynomials, Euler equation, solutions near a regular singular point, Bessel equation.
7. Boundary Value Problems: Homogeneous Sturm-Liouville problems, eigenvalues and eigenfunctions.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures. Blackboard presentations. Exercises, tests and homework.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Communication and Electronic Submission.
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*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>52</td></tr><tr><td>Essay writing</td><td>26</td></tr><tr><td>Personal Study</td><td>47</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**125**</td></tr></table>
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 • Final written exam: 100% or • Mid-term exam: 20% • Final written exam: 80% The evaluation criteria are presented to the students prior to the exam, the grading system assigned to the examination is clearly determined and the final grade received by the students is accessible via the online platform of the Institution. In addition, the students can see their writings, their overall and individual scores for each examination question and they can be given clarifications. Finally, any mistakes are also reported and pointed out.

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Alikakos N.D., Kalogeropoulos G.H, (2003), “Ordinary Differential Equations”, Modern Publishing L.T.D.
2. Boyce W.E., Diprima R.C., (2015), Elementary Differential Equations and Boundary Value Problems”, Press N.T.U.A, greek translation.

Foreign Bibliography:

3. Simmons G.F., (1991), “Differential equations with applications and historical notes”, McGraw-Hill, Inc., New York.
4. Sneddon I., (1964), “Elements of Partial Differential Equations”, McGraw-Hill, Inc.