COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Industrial Design and Production Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**4005**	**SEMESTER**	**4**
COURSE TITLE	Differential Equations		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
	Lectures	3	3
	Exercises/Tutorials	1	2
		4	**5**
COURSE TYPE	General background		
PREREQUISITE COURSES:	No		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/IDPE298/		

(2) LEARNING OUTCOMES

Learning outcomes

The aim of the course is the familiarity with the use and solution of differential equations so that students can use them in modeling problems in the specialty of Engineer. Upon successful completion of the course, students:

- will have understood basic mathematical concepts and the methodology of solving first and higher order differential equations, differential equation systems as well as the use of Fourier series
- will be able to utilize differential equations and model problems of their specialty, solve them and draw conclusions
- will be able to connect the mathematical methodologies taught and apply the acquired knowledge in the subject of Engineering, in general will be able to apply all of the above in other thematic areas of the specialty of Engineer
- will use the Matlab software environment to implement the course methods and algorithms.

General Competences

- Criticism and self-criticism.
- Mathematical thinking and analysis.
- Mathematical and analytical presentation of geometrical concepts.
- Search for, analysis and synthesis of data.
- Working independently.
- Production of free, creative and inductive thinking.

(3) SYLLABUS

- **Basic concepts.** Classification of differential equations. Solution of differential equation (partial and general). Initial and boundary value problems. Well placed problem. Introduction to the modeling of simple physical problems with differential equations.
- **Ordinary First Order Differential Equations.** Classification and methods of solution. Separate variables. Linear. Homogenous. Complete. Integration factors. Bernoulli. Ricatti. Applications in problems of the Engineer's specialty.
- **Upper order linear differential equations with constant or variable coefficients.** Definitions. Wronsky Determinant. Solving methods. Homogenous solution. General solution of the linear differential equation. Method of determining the coefficients. Lagrange method of parameter change. Euler equation. Class demotion method. ODE systems. Initial values problems and applications in engineering and electricity.
- **Solution of differential equations using power series.** Regular and irregular (special) points. Existence of analytical solutions. Development of a solution in ordinary and normally specific points.
- Systems of linear differential equations, matrix method.
- **Laplace Transformation.** Definition, properties and inversion. Application in solving linear differential equations and systems of differential equations with constant coefficients. Evolution and applications.
- **Bessel and Legendre equations.** Gamma Functions, δ-Dirac.
- **Differential equations with partial derivatives.** 1st order PDE. 2nd order PDE (elliptical, parabolic, hyperbolic). Method of separation of variables. Laplace and Poisson boundary value problems. Initial-boundary value problems for the diffusion and wave equations. Applications in engineering.
- **Fourier series.** Dirichlet conditions. Parseval identity. Applications of the Fourier series.
- **Complex Functions** and their applications.
- **Applications using Matlab software.** Directional fields and integral ODE curves in Matlab. Matlab ODE Solvers (ODE Suite). Functions for ODE. Euler method. Runge-Kutta Method. Solution of 1st order ODE system. Solution of higher order ODE. Linearization. Numerical solution of ODE (direct and repetitive). Time-stepping methods. Convergence class investigation.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-face	
USE OF INFORMATION ANDCOMMUNICATIONS TECHNOLOGY	Communication with students through the platform with emails & announcements on the course's website (e-class). Powerpoint display with projector and laptop. Demonstration of modern mathematical software (Matlab, Mathematica, Wolfram Alpha) on the taught subjects. Announcement of course notes in electronic form on the course's website (e-class). Referral to websites with related applications (Desmos, Maxima, Geogebra). Utilization of the computer laboratory of the Department. Possibility of examinations through the tool of Exercises in e-class.	
TEACHING METHODS	***Activity***	***Semester workload***
	Lectures	39
	Study of theory and examples	39
	Individual study	72

	Course Total (30h/ECTS)	**150**
STUDENT PERFORMANCE EVALUATION	**Language of assessment:** Greek (English for ERASMUS students upon request). Students are assessed through a written examination, which includes short-answer questions and problem solving. There is a possibility for an intermediate examination in the middle of the semester. Delivery of assignments and written/oral examination in the Tutorials (20%). Students with learning difficulties are examined in accordance with article 37 of the Internal Regulations of the UNIWA. The evaluation criteria have been presented to the students before the final examination and the individual grade of the subjects is written in them. Students can see their writing and their individual grades in the topics, as well as receive clarifications about them after pointing out any mistakes.	

(5) **ATTACHED BIBLIOGRAPHY**

- Suggested bibliography:

1. Σεραφειμίδης Κ., 2009, Διαφορικές Εξισώσεις, Εκδόσεις Σοφία.
2. Σταυρακάκης Ν., 2017, Διαφορικές Εξισώσεις: Συνήθεις και Μερικές. Θεωρία και Εφαρμογές από τη Φύση και τη Ζωή, Εκδότης: Τσότρας Αθανάσιος.
3. W.E. Boyce, R.C. Di Prima, 2015, Στοιχειώδεις διαφορικές εξισώσεις και προβλήματα συνοριακών τιμών, εκδόσεις ΕΜΠ.
4. Τραχανάς Σ., 2008, Συνήθεις διαφορικές εξισώσεις, ΙΤΕ-Πανεπιστημιακές εκδόσεις Κρήτης.
5. Γεωργούδης Ιωάννης, Μακρυγιάννης Αριστείδης, Πρεζεράκος Νικόλαος, 2016, Μαθηματικά για Μηχανικούς, Εκδότης: Σύγχρονη εκδοτική ΕΠΕ.
6. Χαλιδιάς Ν., 2021, Εφαρμοσμένα Μαθηματικά για Οικονομολόγους και Μαθηματικούς, Broken Hill Publishers.
7. Richard Bronson, 1978, Εισαγωγή στις Διαφορικές Εξισώσεις, ΕΣΠΙ εκδοτική.
8. Spiegel Murrey, 1978, Ανάλυση Fourier, ΕΣΠΙ εκδοτική.
9. Goodwine B. , 2011, Engineering Differential Equations, Springer.
10. Kalbaugh David V., 2017, Differential Equations for Engineers: The Essentials, CRC Press.
11. Kreyszig E., 2005, Advanced Engineering Mathematics, 9th edition, Wiley.
12. Glyn, J. et al., 2010, Advanced Modern Engineering Mathematics, 4th edition, Addison-Wesley Pub. Co.
13. Wylie C.R. and Barrett L.C., 1995, Advanced Engineering Mathematics, 6th edition, McGraw-Hill.
14. Zill D.G. and Cullen M.R., 2006, Advanced Engineering Mathematics, 3rd edition, Jones & Bartlett Pub.