

## COURSE OUTLINE

### (1) GENERAL

|   |   |                 |          |
|---|---|-----------------|----------|
| <b>SCHOOL</b>   | School of Science   |                 |          |
| <b>ACADEMIC UNIT</b>  | Physics   |                 |          |
| <b>LEVEL OF STUDIES</b>   | Undergraduate   |                 |          |
| <b>COURSE CODE</b>  | <b>YK014</b>  | <b>SEMESTER</b> | <b>2</b> |
| <b>COURSE TITLE</b>   | <b>Ordinary Differential Equations and Linear Algebra</b>                                   |                 |          |
| <b>INDEPENDENT TEACHING ACTIVITIES</b><br><i>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</i> | <b>WEEKLY TEACHING HOURS</b>  | <b>CREDITS</b>  |          |
| Lectures (theory and exercises)   | 4   | 6               |          |
|   |   |                 |          |
|   |   |                 |          |
| <b>COURSE TYPE</b><br><i>general background, special background, specialised general knowledge, skills development</i>  | General Background  |                 |          |
| <b>PREREQUISITE COURSES:</b>  | No  |                 |          |
| <b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>  | Greek   |                 |          |
| <b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>  | No  |                 |          |
| <b>COURSE WEBSITE (URL)</b>   | <a href="https://eclass.uoa.gr/courses/MATH586/">https://eclass.uoa.gr/courses/MATH586/</a> |                 |          |

## (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 course provides a rigorous, systematic and an in-depth study of the theory of Ordinary Differential Equations and its applications in physics problems.

With the completion of the course the student is able to:

- Apply the fundamental theorem of existence and uniqueness for initial value problems, and solve in closed form specific types of 1st order differential equations (separable differential equations, Bernoulli, Riccati, exact 1st order differential equations).
- Perform the qualitative analysis of a differential equation (determination and characterization of equilibrium points, phase diagram, bifurcation points, and bifurcation diagram).
- Employ various techniques to solve 2nd order linear differential equations (method of undetermined coefficients, method of variation of parameters, reduction of order).
- Employ the power series method in order to solve 2nd order linear differential equations.
- Solve systems of 1st order linear differential equations.
- Perform the qualitative analysis of a 2nd order differential equation (determination and characterization of equilibrium points, stability, phase plane).

### 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

Adapting to new situations

Decision-making

Working independently

Team work

Working in an international environment

Working in an interdisciplinary environment

Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

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Others...

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The course aims at the following general competences

Working independently

Production of free, creative and inductive thinking

Analytical and synthetic thinking

Critical thinking

Problem solving

### **(3) SYLLABUS**

- Autonomous scalar 1st order differential equations: well posedness of the initial value problem
- Autonomous scalar 1st order differential equations: equilibrium points, stability, and introduction to bifurcations.
- Linear 1st order differential equations in one- and two-dimensions, with constant or varying coefficients.
- Homogeneous and inhomogeneous linear 2nd order differential equations.
- Series solutions of linear 2nd order equations.

#### (4) TEACHING and LEARNING METHODS - EVALUATION

| <p><b>DELIVERY</b><br/><i>Face-to-face, Distance learning, etc.</i></p>   | <p>Face-to-face</p> <p>Distance learning in exceptional situations</p>   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
|---|--|--|----------|-------------------|--|--|--|--|--|--|----------|----|-----------|----|--|--|--|----|--|--|---------------------|------------|
| <p><b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b><br/><i>Use of ICT in teaching, laboratory education, communication with students</i></p>   | <p>Yes</p> <p>Electronic communication with the students using ICT (Information and Communications Technology), eclass platform</p>  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| <p><b>TEACHING METHODS</b><br/><i>The manner and methods of teaching are described in detail.</i><br/><i>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.</i></p> <p><i>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</i></p>                            | <table border="1"> <thead> <tr> <th data-bbox="697 591 1029 629">Activity</th> <th data-bbox="1034 591 1361 629">Semester workload</th> </tr> </thead> <tbody> <tr> <td data-bbox="697 636 1029 665"></td> <td data-bbox="1034 636 1361 665"></td> </tr> <tr> <td data-bbox="697 665 1029 694"></td> <td data-bbox="1034 665 1361 694"></td> </tr> <tr> <td data-bbox="697 694 1029 723"></td> <td data-bbox="1034 694 1361 723"></td> </tr> <tr> <td data-bbox="697 723 1029 752">Lectures</td> <td data-bbox="1034 723 1361 752">35</td> </tr> <tr> <td data-bbox="697 752 1029 781">Exercises</td> <td data-bbox="1034 752 1361 781">17</td> </tr> <tr> <td data-bbox="697 781 1029 810"></td> <td data-bbox="1034 781 1361 810"></td> </tr> <tr> <td data-bbox="697 810 1029 925">Individual Study/ Study and Analysis of bibliography / Preparation</td> <td data-bbox="1034 810 1361 925">98</td> </tr> <tr> <td data-bbox="697 925 1029 954"></td> <td data-bbox="1034 925 1361 954"></td> </tr> <tr> <td data-bbox="697 954 1029 992"><b>Course Total</b></td> <td data-bbox="1034 954 1361 992"><b>150</b></td> </tr> </tbody> </table> |  | Activity | Semester workload |  |  |  |  |  |  | Lectures | 35 | Exercises | 17 |  |  | Individual Study/ Study and Analysis of bibliography / Preparation | 98 |  |  | <b>Course Total</b> | <b>150</b> |
| Activity  | Semester workload  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
|   |  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
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|   |  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| Lectures  | 35   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| Exercises   | 17   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
|   |  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| Individual Study/ Study and Analysis of bibliography / Preparation  | 98   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
|   |  |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| <b>Course Total</b>   | <b>150</b>   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |
| <p><b>STUDENT PERFORMANCE EVALUATION</b><br/><i>Description of the evaluation procedure</i></p> <p><i>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</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p> | <p>Final written exams in Greek</p> <p>(oral examination when appropriate)</p>   |  |          |                   |  |  |  |  |  |  |          |    |           |    |  |  |  |    |  |  |                     |            |

## (5) ATTACHED BIBLIOGRAPHY

- Συνήθεις Διαφορικές Εξισώσεις, Ν. Αλικάκος, Γρ. Καλογερόπουλος, ΣΥΓΧΡΟΝΗ ΕΚΔΟΤΙΚΗ ΕΚΔΟΣΕΙΣ ΣΥΜΜΕΤΡΙΑ, 2003, Αθήνα
- Στοιχειώδεις Διαφορικές Εξισώσεις και Προβλήματα Συναριακών Τιμών, W. E. Boyce, R.C. Di Prima, Μετάφραση- επιμέλεια, Λ. Παπαλουκάς, ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΕΜΠ, 2015, Αθήνα
- ΜΙΑ ΕΙΣΑΓΩΓΗ ΣΤΗ ΓΡΑΜΜΙΚΗ ΑΛΓΕΒΡΑ, ΒΑΡΣΟΣ ΔΗΜΗΤΡΗΣ, ΔΕΡΙΖΙΩΤΗΣ ΔΗΜΗΤΡΗΣ, ΕΜΜΑΝΟΥΗΛ ΓΙΑΝΝΗΣ, ΜΑΛΙΑΚΑΣ ΜΗΧΑΛΗΣ, ΜΕΛΑΣ ΑΝΤΩΝΗΣ, ΤΑΛΕΛΛΗ ΟΛΥΜΠΙΑ, 2012, Εκδότης: "σοφία"
- Γραμμική άλγεβρα, Δονάτος Γεώργιος Σ., Αδάμ Μαρία Χ., 2008, Εκδότης: Γ. ΔΑΡΔΑΝΟΣ - Κ. ΔΑΡΔΑΝΟΣ Ο.Ε.