Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Second year

COURSE

27313 - Extension of Differential Equations **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject Differential Equations belongs to the M06 module (Advanced Sciences) of the Bachelor’s Degree of Industrial Technology Engineering. It has 6 of the 30 credits of the module.

The goal of the subject is to deepen the basic knowledge of mathematics required in the Order CIN/351/2009, in which the requirements for the official university grades that qualify for the Technical Industrial Engineer profession to be accredited are established.

The additional skills acquired in this subject will place the licensed students in Industrial Technology Engineering under optimum conditions for a better academic progress in the Master Degree in Industrial Engineering and also to work in engineering firms, among others, in which they participate in project development or design teams, etc.

The subject is taught in the second term of the second year of the Degree. It contains the basic aspects of the theory of differential equations and provide the students with a basic training that will allow the study of other subjects in which these concepts are needed as a tool. It will also allow to be acquainted with the knowledge of an Applied Mathematics field that is useful in several research lines.

It is recommended to have studied the first-year subjects Algebra and Calculus, and specially to know and use fluently matrix operations and integral calculus as well as the part that corresponds to series and series expansions of functions.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES OF THE DEGREE:
- G003 (specific): knowledge of basic subjects and technologies that qualify them to learn new methods and technologies, and provide them of a great versatility to adapt to new situations.
- G004 (cross competence): capacity for solving problems with initiative, decision making, creativity, critical reasoning and for communicate and transmit knowledge, abilities and skills in the industrial engineering field.
- G010 (cross competence): capacity for working in a multidisciplinary and multilingual environment.

COMPETENCES OF THE MODULE M06 (Advanced Sciences)
CA1: capacity for solving the mathematical problems that may arise in engineering. Ability to apply knowledge related to integral transforms, complex-valued functions, differential equations and systems of differential equations and their stability, Sturm-Liouville problems, second-order partial-differential equations, iterative methods for solving systems of linear equations and nonlinear equations, numerical interpolation and integration and numerical solution of ordinary and partial differential differential equations.
LEARNING OUTCOMES:
- Getting the competences of the subject will qualify the student to solve mathematical problems that arise in all engineering areas.
- The student will be able to apply knowledge about differential equations and systems of differential equations and their stability, Sturm-Liouville problems and second-order partial-differential equations.

Theoretical and Practical Contents

1. Introduction to Differential Equations and Systems of Differential Equations.
2. First-order ordinary differential equations.
3. Systems of first-order ordinary differential equations.
   - Linear systems
   - Non linear systems: Autonomous systems
4. Linear ordinary differential equations of higher-order.
5. Linear boundary-value problems.
   - Homogeneous linear boundary-value problems.
   - Nonhomogeneous linear boundary-value problems
6. Second-order partial differential equations.
   - Homogeneous partial differential equation problems. Separation of variables.
   - Nonhomogeneous partial differential equation problems.

TEACHING METHODS

The competences that the student must acquire in this module will be get through different activities based on lectures, seminars, recitations and computer laboratory sessions.
The coordination activities of the module and of the course assure a correct distribution in time of the different

assignments.
Each teacher will use the methodology that he/she considers more adequate to get the established learning outcomes, taking into account his/her context/group. In general, in the lectures and recitations the theoretical concepts will be dealt with and some exercises will be solved (the students will have a set of exercises, some of which will be solved in class and can be previously assigned by the teacher as personal work).
In general, in the seminars exercises will also be solved. For those seminars indicated by the teacher, the students will have to prepare some exercises in advance (individually or in group), being the result of this work evaluated through deliverables, oral presentations, oral or written questions or any other method that the teacher considers adequate. Attendance to the classes will never be the only instrument to evaluate the work.
In the computer laboratory sessions, students will use a mathematical software (Mathematica) to solve differential equations problems, analyzing and interpreting the results. For each session, the students will have the setting-up of the practical in advance, and the teacher can request a previous preparation of it. The result of the work related to the practicals will be evaluated through exercises to be handed-in, computer tests, or whatever method the teacher considers adequate to evaluate the learning outcomes. Attendance to the classes will never be the only instrument to evaluate the work.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5	6	7,5		9				
Horas de Actividad No Presencial del Alumno/a	56,25	9	11,25		13,5				

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Exercises, cases or problem sets 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

By default, at the beginning of the course all the students are enrolled in the continuous evaluation system (see Note 1 to renounce to that system).
The continuous evaluation of the learning outcomes will consist of:

- First written exam: 24% of the grade. Contents: First-order ODEs and Systems of first-order ODEs. It is intended to do it in March, once the corresponding topics have been taught.
- Second written exam: 56% of the grade of the subject. Contents: the rest of the chapters. It will be done coinciding with the date assigned to the subject in the official calendar of exams in the May call.
- Grade of the work associated to the seminars: 10%
- Grade associated to the computer laboratories: 10%

Not taking an exam or any kind of test (except the second written exam) will result in a grade of zero in that test.

REQUIREMENTS TO PASS THE SUBJECT:

To pass the subject it is necessary, apart from a minimum average grade (according to the previously described percentages) of 5/10:
- to get at least a 4.5/10 as a weighted average of the written exams (0.3*First-written-exam +0.7*Second-written-exam >=4.5),
- at least a 4/10 in the second written exam,
- at least an average grade of 3 over 10 in the computer laboratories.

In case the average is greater or equal to 5 but some of these three requirements are not satisfied, the final official grade will be 4.9, and thus, the student will not pass the subject.

NOTE 1: RENUNCIATION TO THE CONTINUOUS EVALUATION.

Students have the right to be evaluated with a final evaluation, no matter if they have participated in the continuous evaluation or not. For that, the student must present in writing the renunciation to the continuous evaluation to his teacher, not later than week 9 from the beginning of the term, according to the academic calendar of the School.

In this case the exam will consists of two parts: a written part and a computer lab test. The grade will be calculated according to the following percentages:

- Written exam: 90%. This exam will in turn have two parts. The first part will correspond to First-order ODEs and Systems of first-order ODEs. The second part will correspond to the rest of the chapters of the subject; it will be the same that the one taken by the students with continuous evaluation.
- Computer lab exam (about the contents of all the practicals done during the course): 10%.

To pass the subject in this case the average grade must be greater than or equal to 5 over 10, with at least a 4 over 10 in the written exam and 4 over 10 in the second part of that exam, together with a 3 over 10 at least in the computer lab exam.

NOTE 2: RENUNCIATION TO THE CALL.
- The renunciation to the call will imply a grade of "No presentado" (Did not attend)
- In case the student is involved in the continuous evaluation, as the final exam (corresponding to the second written exam) has a weight of 56% of the final grade of the subject, not attending that second written exam is enough to renounce to the call and get a mark of "No presentado" (Not Attending), according to the article 12.2 of the Regulation of the Students' Evaluation in the official Grades.
- In case of a final evaluation, if the student does not attend the exam in the official date of exams this will imply the automatic renunciation to the corresponding call.

NOTE 3:

1- Those students who, having attended the first call and failing it, get an average grade greater than or equal to 5 over 10 either in the written part (with at least a 4 over 10 in its second part) or in the computer lab part, do not have to take this part in the second call (extraordinary exam call).

2- During the written tests and computer tests the use of books, notes or class notes as well as phones or electronic, informatics or any other types of devices, including calculators, by the students IS NOT allowed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The exam will consists of two parts: a written part and a computer lab test. The grade will be calculated according to the following percentages:

- Written exam: 90%
- Computer lab exam (about the contents of all the practicals done during the course): 10%.

To pass the subject the average grade must be greater than or equal to 5/10, with at least a 3 over 10 in the computer lab part.

NOTE. During the written test and computer test the use of books,notes or class notes as well as phones or electronic, informatics or any other types of devices, including calculators, by the students IS NOT allowed.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

* Simmons, F., 1993: Ecuaciones Diferenciales con aplicaciones y notas históricas, Mc Graw-Hill.
* Nagle, R. K. and Saff, E. B., 1992: Fundamentos de ecuaciones diferenciales, Addison-Wesley Iberoamericana.
* Boyce, W. E. and Diprima, R. C., 1991: Ecuaciones diferenciales y problemas de valores en la frontera, Limusa, 1991.

Detailed bibliography

* Stephenson, G., 1986: Partial Differential Equations for Scientists and Engineers, Longman, 1986.
* Ledder, G., 2006: Ecuaciones diferenciales. Un enfoque de modelado, Mc Graw-Hill.
* Gray, A., Mezzino, M. and Pinsky, M. A., 1997: Introduction to Ordinary Differential Equations with Mathematica, Springer-Verlag, New York.
* Ross, C., 1994: Differential Equations. An introduction with Mathematica, Springer-Verlag.

Journals

Web sites of interest

http://eGela.ehu.es/ (Moodle courses)
http://www.wolfram.com/ (Mathematica webpage)
http://www.ehu.es/
http://www.ingenierosbilbao.com/

OBSERVATIONS