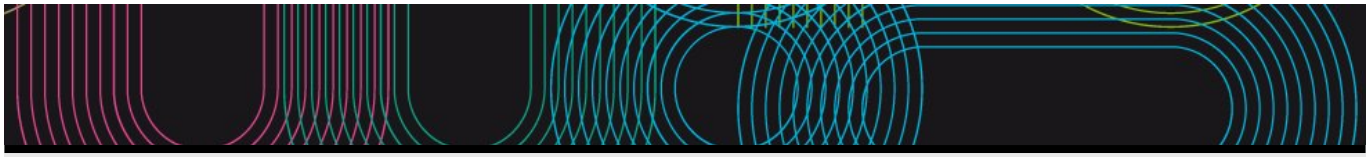

IDENTIFYING DATA				
Mechanism and machine theory				
Subject	Mechanism and machine theory			
Code	P52G382V01206			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Pérez Vallejo, Javier			
Lecturers	Cacabelos Reyes, Antón Pérez Vallejo, Javier			
E-mail	jvallejo@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The main objective of the subject is to provide the student with knowledge of the principles of the Theory of Machines and Mechanisms, a competence contained in the Ministerial Order CIN/351/2009 which establishes the requirements for the verification of the degrees that enable for the exercise of the profession of Industrial Technical Engineer. This subject addresses the aforementioned competence and allows the development of related competences in subsequent subjects.			

Training and Learning Results	
Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
C13	Knowledge of the principles of the theory of machines and mechanisms.
D2	Problems resolution.
D6	Application of computer science in the field of study.
D9	Apply knowledge.
D10	Self learning and work.
D16	Critical thinking.

Expected results from this subject	Training and Learning Results		
Know the basic foundations of the Theory of Machines and Mechanisms and their application in Mechanical Engineering to solve the problems related with said matter in the field of Industrial Engineering.	B3 B4	C13	D2 D9 D10 D16
Know, understand, apply and practice the concepts related to the Theory of Machines and Mechanisms.		C13	D2 D9 D10 D16
Know and apply the techniques of kinematic and dynamic analysis of mechanical systems.		C13	D2 D9 D10 D16

Know and use mechanism analysis software effectively.		C13	D2 D6 D9 D10 D16
ENAEE learning outcome: 1. KNOWLEDGE AND UNDERSTANDING. 1.2.- Knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront. Level of achievement: Basic (1).	B3	C13	
ENAEE learning outcome: 2. ENGINEERING ANALYSIS. 2.2. Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints. Level of achievement: Advanced (3).	B4		D2 D9 D16
ENAEE learning outcome: 3. ENGINEERING DESIGN. 3.1. Ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical, societal, health and safety, environmental, economic and industrial considerations; to select and apply relevant design methodologies. Level of achievement: Basic (1).	B4		D2 D9
ENAEE learning outcome: 5. ENGINEERING PRACTICE. 5.3. Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study. Level of achievement: Basic (1).			D6 D9

Contents

Topic	
Unit 1: Introduction to the topology of mechanisms.	- Basic concepts: link, kinematic pair, kinematic chain, mechanism, machine. - Types of mechanisms. - Degrees of freedom. - Four bar mechanisms. Theorem of Grashof.
Unit 2: Analysis of positions and displacements.	- Graphic method. - Grafic-analytical method. - Analytical method: closed-loop equations.
Unit 3: Analysis of velocities.	- Elementary movements: rotation and translation. - Analysis of relative velocities. - Calculation of instantaneous centres of rotation. - Graphic method. - Analytical method.
Unit 4: Analysis of accelerations.	- Elementary movements: rotation and translation. - General movement with relative velocity, acceleration of Coriolis. - Relation between the acceleration of two points of the same element. - Graphic method. - Analytical method.
Unit 5: Analysis and synthesis of real mechanisms.	- Schematization of mechanisms. - Inversions. - Mechanical advantage.
Unit 6: Statics.	- Foundations. - Reduction of systems of forces to a point.
Unit 7: Dynamics of planar motion.	- Dynamically equivalent systems. - Inertia forces in planar motion, D'Alembert's principle.
Unit 8: Dynamics of rotary motion.	- Static balancing. - Dynamic balancing. - Balancing analysis.
Unit 9: Dynamic regulation of mechanisms: the flywheel.	- Analysis of machines with cyclic operation. - The flywheel as a control system of cyclic motion. - The flywheel as an energy storage system.
Unit 10: Cams.	- Cam and follower mechanism: types. - Displacement diagram and bond curves. - Kinematic analysis of the movement. - Graphic design of cam profiles.

Unit 11: Gears.	- Transmission mechanisms: generalities. - Types of gears and applications. - Main parameters of the spur gear geometry, normalisation. - Fundamental law of gearing and gear ratio. - Strengths and power transmission of the spur gears. - Gear trains.
Laboratory practices (PL).	PL1.- Analysis of machinery. PL2.- Assembly and kinematic analysis of basic mechanisms. PL3.- Kinematic analysis of real mechanisms by means of simulation software. PL4.- Dynamic analysis of basic mechanisms by means of simulation software. PL5.- Defence of the project on design of a mechanism. PL6.- Kinematic analysis and design of cams. PL7.- Assembly and analysis of gear trains.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	35	63
Laboratory practical	12	0	12
Seminars	7	7	14
Problem solving	15	24	39
Mentored work	2	7	9
Essay questions exam	13	0	13

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	In lecture sessions, the foundations of each topic are explained. The students can access to the topic information in the bibliography books or the lecture slides uploaded in the subject repository.
Laboratory practical	In the laboratory sessions, the students apply the theory to problem resolution. A series of practices are proposed in accordance with the topic to settle the concepts. Hence, the creative proposal of solutions is promoted.
Seminars	In the seminar sessions, a series of applied exercises are proposed for the students to solve, either individually or in groups, under the supervision of the lecturer.
Problem solving	Intensive course for those students who have failed the subject in ordinary call, prior to the exam in extraordinary call. Group tutoring with the lecturer. Assessment tasks and reinforcement hours.
Mentored work	The students will have to make and expose a group project on the design of a mechanism.

Personalized assistance

Methodologies	Description
Seminars	In the scope of the tutorial action, we distinguish actions of academic tutoring and personalised tutoring. The students will have at their disposal hours of academic tutoring in which they will be able to ask any question related to the contents of the subject, its organisation, evaluation, etc. These tutorials can be individualised or in a group. Notwithstanding, group tutorials will be encouraged for solving problems or clarifying different contents of the subject. In addition, the lecturer will be available for the student to comment or ask for advice on any circumstance that prevents him/her from adequately following the subject (personalised tutorials). With the combination of these two types of tutorial action, we aim to achieve an academic-personal balance that allows the student to achieve their goals in the most effective way. The faculty of this subject will be available for tutorials in the schedule published on the website of the centre, as long as the students confirm in advance by email their interest in attending them. However, the students may arrange a tutorial with the lecturer at any time (not necessarily in this schedule). Finally, the teaching staff will be able to answer the students' questions by telematic means (email, videoconference, forums on the online teaching platform, etc.).

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	Practice Reports (MP): Reports to be delivered for each laboratory practice (if the practice is carried out in a group, only one group memory will be delivered). Each report will be scored out of 10 points. The MP grade will be the average value of the grades obtained in each report delivered and will represent 10% of the continuous evaluation grade.	10	B3 B4	C13	D2 D6 D9 D10 D16

Seminars	Assessable Exercises (EE): Resolutions of problems to be delivered that will be proposed along the course (in particular in the seminar hours). Each exercise will be scored out of 10 points. The EE grade will be the average value of the grades obtained in each exercise delivered and will represent 10% of the continuous evaluation grade.	10	B3 C13 D2 B4 D9 D10 D16
Mentored work	Group Project (TG): Common project consisting of the delivery of a report and an oral presentation. The project will be scored out of 10 points. The TG grade will represent 10% of the continuous assessment grade.	10	B3 C13 D2 B4 D6 D9 D10 D16
Essay questions exam	Partial Tests (PP): Two written tests (theoretical questions and problems) that evaluate the contents taught to date. These tests will be interspersed with theory sessions during the quadmester. Each test will be scored out of 10 points. The PP1 (15%) and PP2 (15%) grades will represent 30% of the continuous assessment grade. Final Test (PF): Written test (theoretical questions and problems) that evaluate the entire subject. This test will take place at the end of the quadmester. The final test will be scored out of 10 points. The note PF will represent 40% of the continuous assessment grade.	70	B3 C13 D2 B4 D9 D10 D16

Other comments on the Evaluation

The student will have two calls to pass the subject: the ordinary and the extraordinary call. In the ordinary call, two options are considered to pass the subject: passing by continuous assessment or passing a final exam (ordinary exam), which will include all the contents of the subject. In case of failing the first call, the student will be able to pass the subject by passing the extraordinary exam, which will also include all the contents of the subject.

A numerical grading system with values between 0 and 10 will be used, according to the current legislation (R.D. 1125/2003 de 5 de septiembre, B.O.E. nº224 de 18 de septiembre).

Ordinary call: continuous assessment

The continuous assessment method (EC) will assess the results achieved by students in the different activities carried out throughout the course, grouping into five parts: Final Test (PF), Partial Tests (PP), Practice Reports (MP), Assessable Exercises (EE), and Group Project (TG). The grade of each part will be calculated as the arithmetic mean of the items made up to the moment of the evaluation in that part.

There will be two Partial Tests (PP) throughout the course. These continuous assessment tests will be interspersed with theory sessions during the quadmester. The student must present a report for each laboratory practice if indicated during the session, which will be evaluated in item MP. In the seminar and/or theoretical class hours, the student may be offered the completion and delivery of different exercises, which will be evaluated in item EE. In the event that a student cannot attend a session in which an evaluable exercise is carried out due to force majeure, he or she must notify the teachers by email so that it is recorded and this circumstance is taken into account at the assessment time. In addition, students must carry out and present a group project on the design of a mechanism (see laboratory practice PL5) that will be assessed in item TG. The final continuous assessment test (PF) will include all the contents of the subject and will have a weight of 40% in the final grade of continuous assessment.

The grade of the continuous evaluation (NEC) will be the result of applying the weighted arithmetic mean of the grade of each of the parts (PF, CT, MP, EE and TF), as reflected below:

$NEC = 0{,}40 \cdot PF + 0{,}15 \cdot PP1 + 0{,}15 \cdot PP2 + 0{,}10 \cdot MP + 0{,}10 \cdot EE + 0{,}10 \cdot TG$

To pass the subject by continuous assessment, three conditions must be met: i) having carried out all the evaluable tasks (except in duly justified cases); ii) having a score of at least 4 points out of 10 in the final continuous assessment test (PF); iii) having a value of NEC greater than or equal to 5. In case of breaching any of the first two conditions, the student's grade will be the minimum between their NEC and a 4, then obtaining a failure grade in the continuous assessment of the subject.

Ordinary call: ordinary exam

Those students who do not pass the subject through the continuous assessment method must take the ordinary exam, where all the competences of the subject will be assessed. The results of this exam will represent 100% of the student's final grade, being an essential requirement to pass the course to obtain a grade greater than or equal to 5 points out of 10. Finally, it should be noted that all students have the option of improving their grade obtained by continuous assessment (NEC) taking the ordinary exam.

Extraordinary call

Students who have not passed the subject in the ordinary call will take an extraordinary exam that will have the same format and the same requirements as the ordinary exam.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

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J.C. García Prada, C. Castejón Sisamón, H. Rubio Alonso, J. Meneses Alonso, **Problemas resueltos de Teoría de Máquinas y Mecanismos**, Paraninfo, 2014

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A. Simón, A. Bataller, J. Guerra, A. Ortiz, J.A. Cabrera, **Fundamentos de teoría de Máquinas**, Bellisco, 2005

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P. Lafont, A. Díaz Lantada, J. Echevarría Otero, **Diseño y cálculo de transmisiones por engranajes**, ETSII Universidad Politécnica de Madrid, 2009

Recommendations

Other comments

The student is required to have skills in the field of differential calculus, vector calculus and kinematics and dynamics calculus of the point and the solid. The knowledge acquired will in turn be necessary to properly study other subsequent subjects of the same Degree, such as Machine Design.