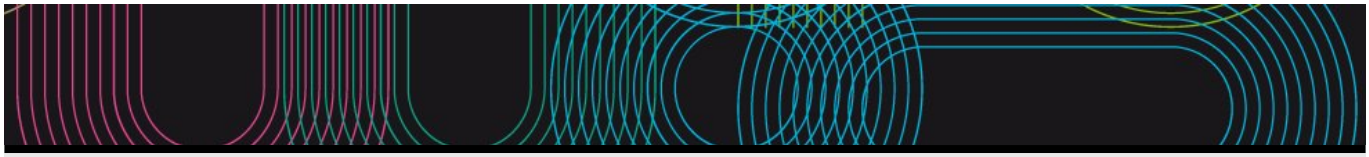

IDENTIFYING DATA				
Automobiles				
Subject	Automobiles			
Code	P52G381V01505			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	5th	1st
Teaching language	Spanish			
Department				
Coordinator	Álvarez Feijoo, Miguel Ángel			
Lecturers	Álvarez Feijoo, Miguel Ángel Casqueiro Placer, Carlos			
E-mail	alvarezfeijoo@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This guide presents relative information to the subject of Automobiles of fifth year of the Bachelor Degree in Mechanical Engineering taught in the Defense University Center at the Spanish Naval Academy, which lists the competencies that the students have to achieve, the schedule of educational activities, the contents and its temporary programming, an estimate of the work load of the student, the specific criteria for his evaluation and the bibliography recommended for a correct follow-up of the matter. The main objetive of the subject will be to develop the knowledge of the vehicular dynamics. This is an exclusive competency of this subject.			

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.
C41	CITN15/OPT11 Develop knowledge of vehicle dynamics
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D5	Information Management.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.
D12	Research skills.
D16	Critical thinking.
D17	Team working.
D20	Ability to communicate with people not expert in the field.

Expected results from this subject	
Expected results from this subject	Training and Learning Results

To know the technological basis of the automobile vehicles	B3 B4	C41	D1 D2 D3 D5 D8 D9 D10 D12 D16 D17
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.2.- knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3		
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- 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 [Intermediate (2)].	B4		D1 D2 D8 D9 D16
ENAEE learning outcome: ENGINEERING PRACTICE: LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study; [Intermediate (2)].			D5
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	B4		D2 D9 D12 D16
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.3.- understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study [Intermediate (2)].		C41	D8 D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].			D1 D3 D20
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].			D17

Contents	
Topic	
Topic 1: Introduction to the theory of the automotive vehicles. (T1)	The automotive vehicle: concept. Main requests of the automotive vehicle. The system man-machine-enviroment. Objectives and scope of the theory of the automotive vehicles.
Topic 2: Introduction to tactical vehicles. (T2)	Basic characteristics of tactical vehicles. Spanish marines' vehicles. Most common faults: diagnosis. Specific legislation of circulation.
Topic 3: Interaction between vehicle and road surface. (T3)	General characteristics of tyres. Mechanical characteristics of tyres. Longitudinal stress (traction, braking). Lateral stress (slip angle). Mathematical models. Rolling characteristics of chain vehicles.
Topic 4: Longitudinal dynamics: perfomances. (T4)	Resistance to movement. Basic equation of longitudinal motion. Maximum tractive effort limited by adhesion. Motor and transmission characteristics. Prediction of the performance of a vehicle.
Topic 5: The powertrain. (T5)	The internal combustion engine. Types of transmissions. Transmission components. The manual gearbox. Automatic gearboxes. Homokinetic joints. The differential, function and types. Differential lock. Reducer gearbox.
Topic 6: Braking of automotive vehicles. (T6)	Moment and forces of the braking process. Adhesion condition: optimal braking. Braking process. Braking system.
Topic 7: Vehicle lateral dynamics. (T7)	Steering geometry. Low speed manoeuvrability.Tipping and skid speed limit. Directional steady-state vehicle behavior. Load influence.
Topic 8: Suspension system. (T8)	Vibrations, vehicle and human effects. Suspension system: mathematical model. Kinematics of suspension. Suspension systems: elastic elements (spring, torsion bars, leaf springs) and dampers. Pneumatic suspension. Influence of suspension on the vehicle dynamic behaviour. Kinematics of suspension and tyre behaviour. Suspension set up.

Topic 9: Driving techniques. (T9)	Driver position. Use of hands. The vision. Specific off road driving techniques. Sand, mud and snow driving.
Topic 10: Vehicle recovery. (T10)	Theory of levers and pulleys: levers of first, second and third genus. Practical examples. Pulleys, forces and tensions. Pulley friction and resistance. Vehicle recovery: definition. Recovery steps. Traction recovery. Forces to consider. Recovery machines: mechanical advantage. Resistance according to the terrain and according to the slope. Recovery of overturned vehicles: forces to consider. Anchors. Exceptional traction and anchoring methods. Expedited methods of hoisting. Traction recovery practices: with return and without return. Practices of anchors: from bar to sand. IM recovery means. Capabilities of the vehicle winches in service of the IM: Hummer, Pegaso 7323 and Iveco 257M trucks. Anchors for towing, recovery and hoisting of the main IM vehicles: Hummer, Pegaso 7323 and Iveco 257M trucks, AAV, CCM M-60, Piranha III. Car M-88 and AAVR: crane and winch capabilities. General description of the M-88 car crane: limitations. Overview of the AAVR Truck Crane: Limitations.
Topic 11: Safety systems. (T11)	Active and passive safety. Driving assistance systems: traction and stability control, ABS. Influence of driving technique. Passive safety: deformable structures, safety cell, seat belts, airbag.
Topic 12: Alternative powertrains. (T12)	The fuel cell. Hybrid vehicles. Electric vehicles. Hydrogen propulsion systems.
Practical sessions 1 and 2 (2 sessions, 4 hours). Vehicle monitoring. (PL1 y PL2)	Use of Data Acquisition Systems (DAS) in the automobile: installation of hardware, configuration, reading and interpretation of data. The student will give a report about the work done and / or will answer a questionnaire.
Practical sessions 3 and 4 (2 sessions, 4 hours). Calculation of perfomances and braking characteristics (PL4)	Analysis and prediction of vehicle performance using software. Analysis and prediction of the braking performance of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.
Practical sessions 5, 6 and 7 (3 sessions, 6 hours). Lateral dynamics. (PL5, PL6 and PL7)	Analysis and prediction of lateral dynamic behavior of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	22	47
Problem solving	7	14	21
Mentored work	3	6	9
Practices through ICT	12	10.6	22.6
Laboratory practical	2	1.4	3.4
Seminars	15	10	25
Autonomous problem solving	11	11	22

*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 these sessions, the basic theoretical contents of the program will be explained in detail, explaining examples with which to deepen the understanding of the subject. Computer presentations and blackboard will be used, especially to convey information such as definitions, graphs, etc. The content of these classes will be complemented with notes and the slides will also be available for the student.
Problem solving	Since the tutorial action is treated as a group support action to the student's learning process, the tutorials will preferably be conducted in seminars and in the form of small group meetings, with problem solving, exercises or case studies.
Mentored work	It is intended to motivate the student in the research activity, and to foster personal relationships by sharing problems and solutions. In order to acquire certain competences it is necessary to propose activities based on the use of active methodologies. Part of the theoretical content should be developed and / or applied to practical cases treated in group and presented in class, for which part of the time devoted to theoretical classes will be allocated.
Practices through ICT	Analysis and prediction of lateral and longitudinal dynamic behavior of the vehicle using software. The student will deliver reports with the results and / or answer questionnaires. The didactic method to follow in the delivery of practical classes is that the lecturer supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.

Laboratory practical	The didactic method to follow in the delivery of practical classes is that the lecturer supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.
Seminars	Intensive course of 15 hours stop those students that suspended the subject in first call, previous to the examination in second call. Group tutoring with lecturer.
Autonomous problem solving	Employed in the assessment tests in order to verify the abilities acquired by the student.

Personalized assistance

Methodologies	Description
Problem solving	Student solves exercises or practical cases with lecturer help. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD-ENM, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment.
Seminars	Group tutorials with the subject lecturer. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD-ENM, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment.

Assessment

	Description	Qualification	Training and Learning Results	
Mentored work	The student will carry out a research work (TI) about a case proposed by the lecturer and will deal with issues related to topics 11 and 12. The work will be scored from 0 to 10 according to their content and defense, following the rubric provided at the time of assigning the topics to the students	15	B3 B4	D1 D2 D3 D5 D8 D9 D10 D16 D17
Practices through ICT	The evaluation of the practical part (NP) will be made from the reports or questionnaires corresponding to each one (a total of 4-5), with a total value of 10 points.	15	B3 B4	D1 D2 D3 D5 D8 D9 D10 D16 D17 D20
Autonomous problem solving	Two theoretical and practical tests of continuous evaluation (15% each) will be carried out at the end of blocks or parts 2 and 3. Their evaluation will be carried out on 10 points each. The Continuous Assessment Final Test (with a 40% weight) will be carried out in the evaluation week and will be valued at 10 points. It will be necessary to obtain a grade higher or equal to 4 points out of 10 in the final exam of continuous evaluation in order to qualify for the one approved by continuous assessment.	70	B3 B4	D1 D2 D3 D5 D8 D9 D16

Other comments on the Evaluation

The final mark of continuous assessment (NEC) shall be calculated as follows:

$NEC = 0.15 \cdot P1 + 0.15 \cdot P2 + 0.15 \cdot TI + 0.15 \cdot NP + 0.4 \cdot PF$

The student must submit to the regular examination of all the contents of the subject, which will represent 100% of the grade, in the following cases:

- The final grade of continuous assessment (NEC) is less than 5.
- The non-delivery of research work.
- The non-execution or delivery of the memory of practices, unless it is exempted for good cause.

- Obtain a grade below 4 points out of 10 on the final continuous assessment exam.

The continuous evaluation note in case of not fulfilling some of the last four previous requirements will be obtained by the expression: NECS = min (4, NEC)

In any case, the student who has passed the continuous assessment, will have the possibility to submit to the regular exam to improve his/her grade.

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

Luque, P, **Ingeniería del Automóvil. Sistemas y comportamiento dinámico**, Ed. Paraninfo, 2004

Complementary Bibliography

Arias-Paz, M., **Motocicletas**, Ed. Dossat,

Bosch, **Manual de la Técnica del Automóvil**, Ed. Reverté,

Cascajosa, Manuel, **Ingeniería de vehículos : sistemas y cálculos**, Ed. Tebar,

Técnica de recuperación de vehículos de ruedas, Escuela de Aplicación de Infantería de Marina,

Conducción Todo-Terreno y Recuperación de vehículos, Escuela de Infantería de Marina.,

Manual de Características de los Vehículos de Infantería de Marina, Junta Táctica de Infantería de Marina.,

Guía del conductor militar (OR6-002), Estado Mayor del Ejército de Tierra.,

Recommendations

Other comments

Proper development of the subject requires that the student has competencies in the field of differential calculus, vector and kinematic computation and dynamics of the point and the solid.