Course guide
2400307 - 240MAU22 - Steering, Suspension and Braking Systems

Last modified: 18/06/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2026). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Zayas Figueras, Enrique Ernesto

Others: Roger Casals, Lluis

PRIOR SKILLS

Knowledge of Mechanics and Machine Theory. Knowledge of Strength of Materials and Materials Science. Knowledge of Machine Element Technology.

TEACHING METHODOLOGY

The teaching methodology is based on two types of activities:
• Classes in which the professor presents concepts and knowledge and, through practical exercises, illustrates how to apply the presented knowledge to solving real-world situations and problems; in several sessions, exercises are proposed for students to complete in class with the professor's guidance.
• And practical sessions in small groups in which students carry out activities under the supervision of a professor. During these sessions, students learn to use tools that support the pre-design and development of some of the systems covered in the course, as well as how to practice testing, measurement, and data analysis techniques.

LEARNING OBJECTIVES OF THE SUBJECT

• Possess a theoretical and practical foundation in steering, suspension, and braking systems, as well as their influence on vehicle dynamic behavior.
• Understand the different types of designs and components used in steering, suspension, and braking systems, and be able to evaluate their advantages and disadvantages.
• Be proficient in the preliminary design of steering, suspension, and braking systems.
• Be able to apply design criteria and evaluate the results obtained from calculations and simulations.
• Be proficient in testing steering, suspension, and braking systems.
• Be familiar with the instrumentation and equipment necessary for conducting tests, be able to design and implement tests, and be able to analyze and evaluate the test results.

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours small group	15,0	12.00
Hours large group	30,0	24.00

Total learning time: 125 h

CONTENTS

Topic 1: Suspension Systems

Description:
Description and types of suspensions. Suspension system components. Suspension characterization. Spring and shock absorber pre-sizing: 1/4 vehicle dynamic model. Shock absorber adjustment: 1/2 vehicle dynamic model.

Specific objectives:
• Understand the function of a suspension system. Identify the different types of suspensions, their components, and their applications.
• Be able to characterize the geometry of a suspension and size its components according to vehicle stability and comfort criteria.

Related activities:
Performing preliminary design exercises for a suspension: determining stiffness and damping. Frequency characterization of 1 and 2 degree-of-freedom systems.

Full-or-part-time: 48h
Practical classes: 12h
Laboratory classes: 6h
Self study : 30h

Topic 2: Steering systems

Description:
Types of steering systems and steering components. Geometry: Ackerman condition, characteristic angles and dimensions. Maneuverability at very low speeds. Power steering systems.

Specific objectives:
• Understand the different types of steering systems: their advantages, disadvantages, and applications.
• Be able to geometrically characterize a steering system and understand how different steering parameters affect vehicle behavior.
• Be able to define the steering mechanism using simulation tools.

Related activities:
Performing exercises to define steering geometry. Simulating steering behavior using multi-solid systems software.

Full-or-part-time: 34h
Practical classes: 7h
Laboratory classes: 6h
Self study : 21h

Tpic 3. Braking systems

Description:
Types of brakes. Characteristics. Hydraulic braking circuits. Power assist. Braking system dynamics. Optimal brake force distribution. Introduction to active safety systems: ABS, ESP, etc.

Specific objectives:
• Understand the different types of braking systems: their characteristics and applications. Know how to properly size a braking system.
• Understand brake assistance systems and basic concepts of electronic active safety systems related to braking: ABS, ESP, and others.

Related activities:
Solving exercises for sizing braking systems.

Full-or-part-time: 43h
Practical classes: 10h
Laboratory classes: 6h
Self study : 27h

GRADING SYSTEM

The grade is based on three types of assessment: a midterm exam (PP), a final exam (FE), and the evaluation of practical work (PE). Both the midterm exam and the final exam assess theoretical and practical knowledge. The final exam is comprehensive and therefore evaluates all the knowledge and skills covered in the course. Practical work accounts for 1.5 points of the final grade and is assessed through a practical report that must be submitted to the professor at the end of each session.
The final grade, NF (rounded to the nearest tenth), is calculated using the following formula: $NF = 0.2 \cdot NPP + [0.65 \cdot NFE + 0.15 \cdot NPE]$
• NPP: Midterm exam grade
• NFE: Final exam grade; NPE: Practical work exam grade.
The practical work exam grade (NPE) will be a combined grade derived from the practical work grades and the final project (TP). The final project (FP) will consist of the study and calculations of vehicle systems such as steering, suspension, and brakes, all performed on the same vehicle chosen by the student group. Groups will consist of 3 to 4 people and will, whenever possible, be the same groups as those from the "Product Planning" course and the subsequent "Vehicle Dynamics" course in the third semester.

Re-evaluation: A re-evaluation exam is scheduled for July for students who have not passed the course. The re-evaluation exam grade (NRE-EV) will replace the final exam grade (NFE) in the final grade calculation algorithm.

EXAMINATION RULES.

In both the partial test (PP) and the final exam (EF), notes and reference material can be taken while performing practical exercises.

BIBLIOGRAPHY

Basic:
- Gillespie, T. D. Fundamentals of vehicle dynamics . Warrendale : Society of Automotive Engineers, [1992]. ISBN 1-56091-199-9.
- • Randolph, T. Brake Design & Safety. ISBN 1-56091-261-8.
- Milliken.. Race Car Vehicle Dynamics. ISBN 1-56091-526-9.
- Font, J. i Dols, J. F.. Tratado sobre automóviles (tomos del I al IV). ISBN 84-7484-110-0.
- Luque, P.; Álvarez, D.; Vera, C. Ingeniería del automóvil: sistemas y comportamiento dinámico. 2ª ed. Madrid. ISBN 9788420683805.

Complementary:
- Alonso Pérez, J. M. Técnicas del automóvil: chasis. 8ª ed. Madrid. ISBN 9788497326612.

RESOURCES

Other resources:
Class slides. Audiovisual material used in lectures. Accessible through the Atenea Campus