ANNEX 2 – COURSE DESCRIPTION

Course Title	Mechanics of Automotive Engineering Materials				
Course Code	AU201				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	2nd Year / 3rd Semester				
Teacher's Name	Dr.-Ing. Loucas Papadakis (Labs: Mr. Charalambos Athanasiou)				
ECTS	5	Lectures / week	3	Laboratories/week	2
Course Purpose	New trends in automotive design aiming for weight reduction and low fuel consumption are highly related to material mechanics and their behavior during operation. The course purpose is to provide students with the necessary fundamental knowledge in the field of mechanics of materials applied in automotive industries. Upon completion of this course, the students will be able to develop skills on distinguishing between different load cases and analysing simple automotive structures in terms of their stresses and deformations. In this way students will get familiar with basic vehicle structure design tasks. The combination of theoretical knowledge and practical work will enable students to comprehend the use and behaviour of automotive materials and perform their structural analysis for various operation scenarios.				
Learning Outcomes	By the end of the course, students must be able to: • Explain the general concept on strength of automotive materials (tension, compression, bending, torsion) for static problems. • Apply the strength of material fundamental laws and determine stresses and deformations in automotive components. • Describe the force variables (Q, M) in beams and demonstrate the relationship between loads and internal force variables • Apply the integration method and constraints to calculate internal force variables. • Produce the deflection and the slope function by implementing the double-Integration method. • Outline the definition of torsion loads and estimate the deformation of circular bars of linearly elastic materials. • Describe the buckling effect and stability for columns with pinned ends and further support conditions. • Perform mechanical tests of tension, compression, shearing, torsion test, strain measurements (strain gauges), deflection of beams buckling, fatigue and appraise possible sources of errors between analytical/theoretical approaches and measurements				
Prerequisites	ME106, ME114	Corequisites	None		
Course Content	• Theory and fundamentals in Strength of Materials: normal stress and				

	strain, linear elasticity, stress-strain curve, Hooke's law, Young's modulus, ductile and brittle materials, Poisson's ratio, shear stress and strain, shear modulus • Stress and strain: Analysis of stress and strain in materials and structures, principal stresses and maximum shear stresses. • Force variables in beams: internal force variables in beams, external loads with internal force variables • Slope and deflection functions of beams with the aid of the double-integration method • Flexural (bending) stiffness of profiles • Stress analysis in beams • Torsion deformation of circular bar • Plasticity, general continuum approach especially during forming of sheet metal body components. • Buckling effect and stability of columns with pinned ends and further support conditions • Application on different examples: the taught aspects in strength of materials are applied and analysed on specific structural static problems Laboratory work, where students can apply their gained knowledge and discuss and evaluate practical test setups and measurements for better comprehension complies the theoretical part of the course. Students perform the experimental setup and carry out the experimental work in small groups in small groups of 2-3. The laboratory includes an introduction so students can get familiar with equipment, safety regulations, measuring methods and evaluation tools, i.e. Excel, data acquisition software. Thereupon tensile, compression and shearing tests are performed with different materials and tests with Strain Gauges are executed. Furthermore, tests on Beam Bending and measurements of beam deflection are conducted under different load scenarios. Finally, students have the opportunity to be introduced to torsion and buckling tests as well as flexural fatigue tests. At the end of the laboratory courses a revision including a short test/assessment takes place.
Teaching Methodology	The taught part of course is delivered to the students by means of lectures, conducted with the help of computer presentations. Lecture notes and presentations are available through the e-learning platform for students to use in combination with the textbooks. Furthermore theoretical principles are explained by means of demonstration examples and solution of specific problems. Lectures are supplemented with laboratory work carried out with the supervision of a lab assistant. Here a demonstration of actual problems and experimental methods takes place. Additionally, during laboratory

	sessions, students apply their gained knowledge and identify the principles taught in the lecture sessions by means of working on different experimental setup, measuring and evaluation methods. Students perform the experimental setup and measurements in small groups of 2-3.
Bibliography	(a) Textbooks: • B. J. Goodno and J. M. Gere, Statics and Mechanics of Materials, Cengage Learning, 1st edition, 2019 • R. C. Hibbeler and K. B. Yap, Mechanics of Materials, Pearson Education, 10th edition, 2018 (b) References: • T. A. Philpot and J. S. Thomas, Mechanics of Materials, Wiley, 5th edition, 2022 • F. P. Beer, E. R. Johnston, J. T. DeWolf, D. F. Mazurek, Statics and Mechanics of Materials, 3rd edition, 2020 • G. Davies, Materials for Automobile Bodies, Butterworth-Heinemann, 2012 • J. Brown, A Robertson, J. Serpento, T. Stan, Motor Vehicle Structures: Concepts and Fundamentals, Oxford: Butterworth, 2002 For extended **internet literature review** students are advised to use the following *keywords* related to this course: *tension/compression stresses in bars, shear stresses, 2d static problems, stress-strain curve, Hooke's law, Young's modulus, shear modulus, Poison ratio, force variables in beams, thermal expansion, Q-M-N diagrams, deflection in beams, Euler-Bernoulli beam theory, moment of area, stresses in beams, torsion of bars, twisting angle, polar moment of area, buckling of columns, plasticity, elastic/plastic deformation, application of static mechanic problems on automotive body, suspension and engine components.*
Assessment	The assessment consists of following methods for both the theoretical and practical part of the course. Each assessment method is assigned with a weight which is used for the calculation of the final grade. Problem solving assignments: 10% Mid-term exam: 10% Laboratory work, reports and test: 20% Final Exam (written): 60%
Language	English