ANNEX 2 – COURSE DESCRIPTION

Course Title	Vehicle Structures				
Course Code	AU403				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	4th Year / 7th Semester				
Teacher's Name	Dr.-Ing. Loucas Papadakis				
ECTS	6	Lectures / week	3	Laboratories/week	2
Course Purpose	New trends in automotive body design have been adopted by automotive manufacturers aiming for weight reduction and low fuel consumption. The course purpose is to provide students with the necessary advanced knowledge in the field of vehicle structure design, computation and sustainable manufacturing, disassembly and recycling as practiced in modern industries. Upon completion of this course, the students have the skills on pre-dimensioning, 3d drafting and analysing vehicle structures in terms of their stresses and deformations based on operation load scenarios. In this way students will get familiar with the overall vehicle structure design process. The combination of theoretical knowledge and computer laboratory work will enable students to comprehend the use of automotive shell design methods and perform 3d design and numerical structural analyses for various vehicle structure types considering manufacturing and joining aspects.				
Learning Outcomes	By the end of the course, students must be able to: • Perform analyses of vehicle structures by applying modelling techniques, i.e. the shear panel method, energy method etc. • Apply calculation software for analysing main vehicle structure components by define loads and support constraints. • Identify and compare different vehicle structure types. • Relate different structural components to their corresponding manufacturing method and material and discuss their advantages and disadvantages. • Apply analytical methods for the design and dimensioning of vehicle structures and assemblies. • Evaluate and explain the structural behaviour under different loading scenarios. • Design and construct main vehicle structure groups (structural component analysis) satisfying loads and safety factors. • Summarize and defend their proposed design solution and critically appraise problematic regions.				
Prerequisites	AU308	Corequisites	None		
Course Content	• Linear elasticity application to vehicle structures: Computation of the				

	dynamic load factor, know the safety factor and the basic global load cases, list the most common vehicle structure types. • Fundamental vehicle loads and their estimation. • Simple structural surface method for modelling of total vehicle shells. • Vehicle body lightweight materials: behaviour of metallic alloys, beams of prismatic and circular sections loaded longitudinally and laterally. • Behaviour of circular, rectangular and corrugated plate under bending loads. • Behaviour of polymer and composite materials under in plane and bending loads. • Basic failure modes: yield criteria, fracture strength, fatigue and creep. • Manufacturing processes for the vehicle structures production: basic principles of forming (deep-drawing, hot-forming), casting, extrusion moulding. • Joining processes in body-in-white: riveting, welding, adhesive bonding etc. and structural analysis at joints. • Advantages of manufacturing processes for achieving high structural properties and reduction of mass. • Vehicle overall structural design: analytical calculation of joined structures, and performance of vehicle structural component analysis. • Automotive sustainable design, disassembly, reuse and recycling of automotive materials, introduction of Life-Cycle-Analysis methods (LCA) • Design and modelling of vehicle structures using commercial software: Solid Works or ANSYS. Computer laboratory work, where students can apply their gained knowledge and discuss and evaluate design and computational models complies the theoretical part of the course. Students perform the computer laboratory work alone or in small groups of two with the lecturer's supervision. Additionally, during the computer laboratory sessions, students implement the principles taught in the lecture sessions on specific practical automotive structure design problems with the aid of computer-aided design tools.
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, videos and analytical solutions of specific problems. Lectures are supplemented with computer laboratory work carried out with the supervision of the lecturer. Here a demonstration of practical problems and design methods takes place. Additionally, during computer laboratory sessions, students work on specific structural design problem in the form of short projects/assignments. Students perform the design project work

	alone or small groups of 2. By the end of each design task students are requested to present their proposed design and discuss their findings.
Bibliography	(a) Textbooks: • D. E. Malen, Fundamentals of Automobile Structure Design, 2nd edition, SAE, 2020. • S. T. Kumaran, T. J. Ko, S. S. Kumar and T. Varol, Materials for Lightweight Constructions, CRC Press, 2023 • G. Davies, Materials for Automobile Bodies, Butterworth-Heinemann, 2012 (b) References: • G. Genta and L. Morello, The Automotive Chassis: Volume 1: Components Design, Springer, 2nd edition, 2020 • V. Kobelev, Design and Analysis of Composite Structures for Automotive Applications, Willey, 2019 • D. C. Barton and J. D. Fieldhouse, Automotive Chassis Engineering, Springer, 2018 • R. Rana and S. B. Singh, Automotive Steels: Design, Metallurgy, Processing and Applications, Elsevier, 2016 • The Aluminium Automotive Manual: Body Structures and Body Components, European Aluminium Association, 2013 • M. Chiaberge, New Trends and Developments in Automotive Industry, IntechOpen, 2011 • O. Mohammed, Automotive Body Manufacturing Systems and Processes, John Wiley and sons, UK, 2011 • 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: *vehicle structure design, vehicle body components' analysis and dimensioning, shear panel method, energy method, vehicle structure types, materials used in automotive structure, high strength steels and aluminium alloys, composite materials, vehicle structural behaviour under loading, torsional and bending stiffness, factor of safety, profiles and corrugated structures, failure yield, fracture strength, fatigue, creep, manufacturing processes in the vehicle body production: forming, deep-drawing, hot-forming, casting, extrusion moulding, joining processes, body-in-white, riveting, welding, adhesive bonding, structural analysis of joints, FE analysis of vehicle frames, assembly, disassembly and recycling, Life-Cycle-Analysis (LCA).*
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. Mid-term exam: 20% Computer laboratory work and assignment reports: 20% Final Exam (written): 60%
Language	English