Course unit title:	Vehicle Crashworthiness		
Course unit code:	AU 404		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	4		
Semester when the unit is delivered:	8 (Spring)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr.-Ing. Loucas Papadakis		
Learning outcomes of the course unit:	1. Perform analyses of vehicle structures dynamics during crash. 2. Demonstrate methods for vehicle and component design to reduce accident injury levels. 3. Apply computation methods for analysing main vehicle structure components' behaviour during crash. 4. Evaluate and explain possible methods and techniques for active and passive safety. 5. Illustrate the interrelation between occupants and vehicle restraint systems 6. Investigate and reconstruct vehicle accidents 7. Generate a model to investigate the energy absorption and plasticisation behaviour of ductile materials 8. Summarize and defend the proposed models and critically appraise problematic regions.		
Mode of delivery:	Face-to-face		
Prerequisites:	AU 403	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	• **General Dynamics of Vehicle Impacts:** equations of motion; vehicle safety; materials crashworthiness requirements and goals; frontal, side, rear and rollover accidents; legislations and directives; vehicle accident and their consequences; accident investigation and reconstruction. • **Current Crashworthiness Design Practices:** lumped mass-spring system (LMS); FE-based crashworthiness, crash energy management. • **Design methodologies** by applying energy absorbing structures. • **Energy Absorbing Systems:** rings and rings systems; beam bending; axial crushing of circular, square and tapered vehicle structural members; top-hat behaviour under impact loading; inversion tubes and inverbucktubes; composite tubes. • **Vehicle and Occupant Analysis:** Restraint and airbag systems; head, neck and chest criteria; criteria for the lower extremities. • **Impact biomechanics,** injury mechanisms and human tolerance to impact. • **Model of the Human Body:** lumped mass-spring systems and FE based systems, dummies and their modelling, real human body modelling; multi-body models versus FE models. • **Crash Modelling of vehicle structures and accident reconstruction using industrial software:** LS-DYNA and PC-Carsh		

Recommended and/or required reading:	
Textbooks:	J. Happian-Smith, ***An Introduction to Modern Vehicle Design, Butterworth Heinemann***, 2001. P. Prasad and J. E. Belwafa, ***Vehicle Crashworthiness and Occupant protection***, American Iron and Steel Institute, Southfield, Michigan, USA, 2004. G. Lu and T. Yu, ***Energy Absorption of Structures and Materials, Woodhead Publishing Limited***, 2003. E. C. Chirwa, ***The International Journal of Crashworthiness***, vol 1 (1996) to current volumes. W. Johnson and A. G. Mamalis, ***Crashworthiness of Vehicles***, David Green Printers, Cambridge, 1978.
References:	R. R. Craig, ***Structural Dynamics an Introduction to Computer methods***, John Wiley & Sons, 1981. G. A. O. Davies, ***Virtual Work in Structural Analysis***, John Wiley & Sons, 1982.
Planned learning activities and teaching methods:	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 web for students to use in combination with the textbooks. Furthermore theoretical principles are explained by means of specific examples and solution of specific problems. Lectures are supplemented with computer laboratory work carried out with the supervision of a lab assistant. Here a demonstration of actual problems and computational 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 modelling tasks and evaluating simulation results.
Assessment methods and criteria:	• Assignments: 10% • Tests: 20% • Laboratory Work: 10% • Final Exam: 60%
Language of instruction:	English
Work placement(s):	No