Course unit title:	Vehicle Internal Combustion Engines		
Course unit code:	AU302		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	3		
Semester when the unit is delivered:	5 (Fall)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr. Charalambos Chasos		
Learning outcomes of the course unit:	1. Describe the geometry and operation of four-stroke and two-stroke internal combustion engines (ICE). Explain the differences in geometrical parameters and operation of spark-ignition (SI) and compression ignition (CI) engines. 2. Describe the engine performance parameters and calculate engine performance characteristics. Explain factors that influence the engine performance and use engine performance graphs. Describe the experimental characterisation of the performance of an ICE and explain special classic and modern techniques for the characterisation of engine performance. 3. Define the volumetric efficiency of the engine and identify how it is affected by technical and operation parameters of the engine. Describe the engine timing mechanism, and flow characteristics through the inlet and exhaust valves of four stroke engines. 4. Use energy balance in internal combustion engines and explain the relevant losses due to friction and gas flow losses. Compare the internal combustion engines real cycles with the ideal thermodynamic cycles and explain the losses and differences in efficiency. 5. Distinguish the combustion initiation for Spark Ignition (SI) and Compression Ignition (CI). Characterise combustion according to mixture composition either premixed or homogeneous or stratified. Use chemical formulas of fuels and chemical equations and define the stoichiometric air-fuel composition and air-fuel ratio. 6. Describe the various types of fuel injection systems including indirect injectors for port-fuel injection (PFI), and direct gasoline injector systems for SI engines. Explain supercharging technologies and compare turbochargers and mechanical compressors. Describe developments in internal combustion engines and explain alternative types of internal combustion engines. 7. Design and carry out engine measurements and analyse the measurements. Compare experimental data with theory.		
Mode of delivery:	Face-to-face		
Prerequisites:	ME200, ME202	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	**Four stroke cycle:** SI engines and CI engines theory and operation **Two stroke cycle:** Theory and operation **Engine output and efficiency:** torque, brake power, friction power, indicated power **Performance characteristics:** speed, fuel consumption, volumetric efficiency, thermal efficiency, exhaust emissions, brake power, performance maps **Factors influencing performance:** size of cylinder, speed, load, ignition timing,		

	compression ratio, air-fuel ratio, fuel injection, engine cooling, supercharging **Real cycles and the air standard cycle:** air standard cycles, fuel-air cycles, actual cycles and their losses **Properties of fuels and combustion process:** fuels for SI engines, knock rating of SI engines, Octane number requirement, Diesel fuels, Cetane number requirement, combustion process and flame development **Alternative forms of IC engines:** the Wankel rotary combustion engine, the variable compression ratio engine **Developments in IC engines:** fuel injection, supercharging **Laboratory Work:** Individual or small group experiments performed with the use of common vehicle engines and or single cylinder engines under certain loading conditions will be investigated. These results will be compared with engines manufacturer specifications and/or theoretical performance data. A selection from the following experiments is performed during the course: - Air and fuel consumption in ICE and estimation of the volumetric efficiency and air-fuel ratio. - Measurements of cylinder pressure history of ICE and construction of p-V and p-θ engine diagrams - Measurements of brake power and indicated power and estimation of the mechanical efficiency and thermal efficiency of an ICE - Cylinder pressure and torque measurements of an ICE and construction of performance graphs and consumption loop - Emissions measurements of a SI ICE engine - Emissions measurements of a Diesel ICE engine - Demonstration of dynamometer for ICE of light vehicles
Recommended and/or required reading:	Thermodynamics cycles and principles of fluid mechanics
Textbooks:	1. Colin Ferguson, Allan Kirkpatrick ***Internal Combustion Engines***, John Wiley and Sons, 2000. 2. Richard Stone ***Introduction to Internal Combustion Engines,*** Palgrave Macmillan, 1999 3. John L. Lumley, W. C. Reynolds ***Engines: An Introduction,*** Cambridge Univ 1999 4. Willard W. Pulkrabek ***Engineering Fundamentals of the Internal Combustion Engine,*** Prentice Hall, 1997
Planned learning activities and teaching methods:	The course is delivered to the students by means of lectures, conducted with the help of computer presentations, as well as demonstrations of ICE and ICE section models and components in the ICE Laboratory. Lecture notes and presentations are available through the web for students to use in combination with the textbooks.
Assessment methods and criteria:	• Assignments 10% • Laboratories 10% • Tests 20% • Final Exam 60%
Language of instruction:	English
Work placement(s):	No