

Automotive Engines

Code: MK3GEPMJ08JG20-EN

ECTS Credit Points: 8

Evaluation: mid-semester grade

Semester: 6th semester

Its prerequisite(s): Thermodynamics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 6+4

Topics:

Notion definitions and classifications of internal combustion engines. Historical overview of automotive engines. Systematization of internal combustion and heat engines. Operation of two-stroke and four-stroke, gasoline and diesel engines, valve timing pie chart. Application of Stirling- and Rankine-engines for vehicle drive. Operation of Wankel-engines.

Thermodynamics of internal combustion engines, comparative cycle-processes. Notion of ideal engine and its cycle-process. Main characteristics of engines: indicated and effective mean pressure, power, specific fuel consumption, torque, mean piston speed. Influencing factors of indicated parameters and losses. Mechanical losses of engines, their starters and starting systems. Notion of torque- and speed elasticity. Characteristics and heat balance of engines. Effects of environmental conditions to engine power, normal power.

Main dimensions and geometrical features of engines. Constructions, crank case and cylinder head. Construction, kinematics, dynamics of crank drive, equation of motion, mass balance and torsional vibration. Timing of charge exchange: solutions of valves and slots.

Cooling of engines, construction, components and control of cooling systems. Needs of lubrication, classification of lubrication systems. Wet and dry sump lubrication systems, oil filters. Monitoring of lubrication systems.

Fuels and lubricating oils of engines, gasoline and diesel fuels, alternative fuels.

Mixture generation systems of gasoline and diesel engines. Operation of carburetors. Multi-point and central injection systems. Fuel injection pumps of diesel engines, modern pump injection and common-rail injection systems. Energy transformation in internal combustion engines. Ignition and combustion in spark and compression ignition engines. Combustion procedures of gasoline and diesel engines, combustion chamber design and comparison. Abnormal combustion processes. Recording of indicator diagram, analysis of combustion processes. Generation of emissions from engines to the environment. Influencing factors of engine emissions. Emission reduction and after-treatment options.

Charge exchange processes of internal combustion engines. Valve timing, aerodynamic and acoustic design of intake and exhaust system. Air filtering in intake system. Rotation generation. Engine brake systems. Purpose and characteristics of charging. The interaction of chargers and engine. Turbocharging, mechanical and Comprex charging systems.

Laboratory and measuring:

Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: static characteristics, recording of shell curves, dynamic measurements, testing of standard vehicle cycles, fuel consumption and emission measurements. Investigation of injection systems: gasoline, diesel and common-rail systems. Practice of disassembly and assembly of internal combustion engines.

Writing measuring report of the tests.

Literature:

Compulsory:

- Richard Van Basshuysen (Editor), Fred Schafer (Editor): Internal Combustion Engine Handbook: Basics, Components, Systems, and Perspectives, SAE International, 2004. ISBN-13: 978-0768011395
- Hermann Hiereth, Peter Prenninger: Charging the Internal Combustion Engine, Springer, ISBN 978-3211471135
- Baumgarten, Carsten: Mixture Formation in Internal Combustion Engines, Springer, ISBN 978-3540308362
- D. Winterbone Ali Turan: Advanced Thermodynamics for Engineers, 2nd edition, Elsevier, ISBN: 9780444633736

Schedule

1st week Registration week

2nd week:

Lecture: Notion definitions and classifications of internal combustion engines. Historical overview of automotive engines. Systematization of internal combustion and heat engines. Operation of two-stroke and four-stroke, gasoline and diesel engines, valve timing pie chart. Application of Stirling- and Rankine-engines for vehicle drive. Operation of Wankel-engines. Thermodynamics of internal combustion engines, comparative cycle-processes. Notion of ideal engine and its cycle-process. Main characteristics of engines: indicated and effective mean pressure, power, specific fuel consumption, torque, mean piston speed.

Practice: Practice of disassembly and assembly of internal combustion engines.

4th week:

Lecture: Main dimensions and geometrical features of engines. Constructions, crank case and cylinder head.

3rd week:

Lecture: Influencing factors of indicated parameters and losses. Mechanical losses of engines, their starters and starting systems. Notion of torque- and speed elasticity. Characteristics and heat balance of engines. Effects of environmental conditions to engine power, normal power.

Practice: Practice of disassembly and assembly of internal combustion engines.

5th week:

Lecture: Construction, kinematics, dynamics of crank drive, equation of motion, mass balance and torsional

Practice: Practice of disassembly and assembly of internal combustion engines.

6th week:

Lecture: Cooling of engines, construction, components and control of cooling systems. Needs of lubrication, classification of lubrication systems. Wet and dry sump lubrication systems, oil filters. Monitoring of lubrication systems.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: static characteristics, recording of shell curves.

8th week: Mid-term test

9th week:

Lecture: Mixture generation systems of gasoline and diesel engines. Operation of carburetors. Multi-point and central injection systems.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: fuel consumption and emission measurements.

11th week:

Lecture: Combustion procedures of gasoline and diesel engines, combustion chamber design and comparison. Abnormal combustion processes. Recording of indicator diagram, analysis of combustion processes.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: testing of standard vehicle cycles.

13th week:

vibration. Timing of charge exchange: solutions of valves and slots.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: static characteristics, recording of shell curves.

7th week:

Lecture: Fuels and lubricating oils of engines, gasoline and diesel fuels, alternative fuels.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: dynamic measurements.

10th week:

Lecture: Fuel injection pumps of diesel engines, modern pump injection and common-rail injection systems. Energy transformation in internal combustion engines. Ignition and combustion in spark and compression ignition engines.

Practice: Measuring of gasoline and diesel internal combustion engines on dynamic engine test bench: fuel consumption and emission measurements.

12th week:

Lecture: Generation of emissions from engines to the environment. Influencing factors of engine emissions. Emission reduction and after-treatment options.

Practice: Investigation of injection systems: gasoline engine systems.

14th week:

Lecture: Charge exchange processes of internal combustion engines. Valve timing, aerodynamic and acoustic design of intake and exhaust system. Air filtering in intake system. Rotation generation. Engine brake systems.

Practice: Investigation of injection systems: diesel engine systems.

Lecture: Purpose and characteristics of charging. The interaction of chargers and engine. Turbocharging, mechanical and Comprex charging systems.

Practice: Investigation of injection systems: common-rail systems.

15th week: End-term test

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate their participation as an absence because of the lack of active participation in class.

Students have to **take part in laboratory measures** and submit the measuring reports minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:

The course ends with an **examination**. The exam grade is the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 50%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-69	satisfactory (3)
70-79	good (4)
80-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.