SYLLABUS

1. Course title:

PROCESS MODELING IN ENGINES

2. Code:

3. Cycle of study:

I

4. ECTS credits:

6

5. Type of course:

Mandatory

6. Prerequisites:

None

7. Class restrictions:

None

8. Duration / semester(s):

1 VI

9. Weekly contact hours and student workload:

	Semester (1)	Semester (2)	(for two-semester courses)	Workload: (hours)	
	V				
9.1. Lectures	3			Classes:	45,00
9.2. Seminars	1			Individual work:	101,25
9.3. Laboratory / Practice classes	0			In total:	146,25

10. Faculty:

Faculty of Mechanical Engineering

11. Department/study program:

Energetics and Thermal-fluid engineering

12. Lecturer:

PhD, Fikret Alić, Full Professor

13. Course aims:

Acquiring knowledge in the area of process modeling in engines with emphasis on ICE, hydrogen engines and electric and hybrid engines. Getting to know the basic physical laws and process modeling of four-stroke Otto and Diesel engines as well as gas-powered engines is also one of the goals of this course. Acquired knowledge of hydrogen-powered engines,

electric and hybrid engines, directs students to modern directions of development of more environmentally friendly engines, their performance, weaknesses and superiority compared to existing engines.

14. Learning outcomes:

Ability to calculate and analyze engine parameters, knowledge of the basic design concept of the ICE engine and its auxiliary devices, knowledge required for the preparatory stages of designing or choosing an engine as a power unit. Ability to calculate kinematic and dynamic characteristics of piston mechanisms of ICE engines, determination and use of driving and dynamic characteristics. Identifies modern systems on vehicles and analyzes their functioning.

15. Course content:

1. Introduction. Division of ICE. Four-stroke and two-stroke engines.
2. Forces in the piston mechanism, torque, ignition sequence, influence of rotation speed and load.
3. Flywheel, with one and two masses. Basics of engine balancing.
4. Degree of filling, degrees of utility, mean pressure and power. Changing the working medium in a four-stroke engine.
5. Combustion in an Otto engine. Basic concepts about the preparation of the fuel mixture and the ignition of the Otto engine.
6. Combustion in a Diesel engine. Basic terms about fuel injection in a Diesel engine.
7. Knowledge test
8. Process modeling in ICE. Engine charging, turbo-compressors.
9. Cold start. Gaseous and particulate pollutants. Catalytic converters.
10. Cooling and lubrication of the ICE. Gas powered engines. Gas tanks.
11. Hydrogen powered engines. Hydrogen tanks and auxiliary devices.
12. Fuel cells. Electric vehicles.
13. Hybrid powered vehicles. Electric batteries.
14. Pneumatic and hydraulic motors.
15. Knowledge test.

16. Learning methods:

The following methods will be used in the course of the course in order to effectively conduct classes and achieve the set objectives of the course and student competencies:
• lectures with the use of multimedia tools with active participation and discussions of students,
• preparation and presentation of problems during auditory exercises and individual and team/group laboratory exercises,
• presentation in a real environment.

17. Assessment methods:

The concept of knowledge assessment is based on continuous work with students throughout the semester. Knowledge assessment methods include: assessment of both individual and group activities during the semester, preparation of a seminar paper, and final knowledge assessment in written and/or oral form. This ensures equal treatment (written and/or oral knowledge assessment) for all students with different affinities.

Grade	described	by letter	points
5 (five)	Does not meet minimum criteria	F;FX	<54
6 (six)	meets the minimum criteria	E	54 -64
7 (seven)	Generally good, but with significant flaws	D	65-74
8 (eight)	Average, with noticeable errors	C	75-84
9 (nine)	Above average, with some errors	B	85-94
10 (ten)	Exceptional success without mistakes or with minor mistakes	A	95-100

18. Assessment components:

The exam grade is based on the total number of points that the student has earned by completing the pre-exam requirements and taking the exam and contains a maximum of 100 points, according to the following scale
Student obligations
Points
Lecture attendance 5
Test I 25
Test II 25
Total pre-exam requirements 55
Final exam 25 - 45

19. Mandatory reading list:

1.Mahalec I., Lulić Z., Kozarac D. (2011) Motori sa unutrašnjim izgaranjem, Zagreb, FSB
2. G. Pistoia (2010) Electric and hybrid vehicles, Elsevier
3.M. Klell, H. Eichlseder, A. Trattner (2023) Hydrogen in Automotive Engineering, Springer Wiesbaden

20. Additional reading list:

21. Web sources:

22. Applicable from the academic year:

2025/26

23. Adopted in the Faculty/Academy session: