COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	EN0900	**SEMESTER**	8th
COURSE TITLE	Internal Combustion Engines		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	
Laboratory	1	
	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Special background, Specialized general knowledge, Skills development
PREREQUISITE COURSES:	There are no prerequisite courses. It is recommended that students who are interested in attending the course have completed successfully the following courses: Thermodynamics I & II, Fluid Mechanics I & II, Heat Transfer.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek - English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18430&lang=en

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B Guidelines for writing Learning Outcomes*

After completing this course the student should be able to:

- explain how and why an IC engine works. Recognize the basic types of engines and basic differences in their characteristics.
- understand the mechanics and dynamics of the powertrain. Understand the flow in the cylinder, flow through valves and ports, the role of turbulence.
- Understand the basics of combustion (pre-mixed and diffusion flames in the various types of engine combustion chambers).
- recognize the importance of minimizing the various types of friction losses in an ICE and increase its efficiency. Understand the heat transfer in water and air cooled engines and be able to perform component thermal loading calculations.
- select an appropriate type of engine for a particular application.
- be introduced to more advanced engineering work involving engine thermodynamics, fluid mechanics and heat transfer (e.g., design, development).
- Understand the basic operation of engine management systems.
- Understand the basic requirements on engine exhaust emissions abatement.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, the use of the necessary technology
Project planning and management with Respect for difference and multiculturalism
Adapting to new situations
Respect for the natural environment

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* .....

- Search for, analysis and synthesis of data and information
- Understanding 3D layout of machines
- Working independently
- Team work
- Performing calculations of machine performance

(3) SYLLABUS

1. Introduction: Basic Principles. Historic evolution of Internal Combustion Engine. Reciprocating engine cycles.
2. Design, construction, materials of engine components – subsystems. Main categories of reciprocating engines. Vehicle engines. Naval engines. Static engines. Airplane engines.
3. Engine design and operation parameters. Thermochemistry of flammable air-fuel mixtures. Thermophysical properties software. A/F calculation based on exhaust gas composition.
4. Engine breathing processes. Flow through valves – ports. Supercharging. Mixture preparation in SI engines.
5. Flow in the cylinder. Combustion in Spark-Ignition engines. Thermodynamic Analysis, computation of fuel burning rates by analysis of indicator diagram. Flame structure, propagation, engine knock.
6. Combustion in diesel engines. IDI and DI combustion chambers. Diesel fuel injection systems. Fuel jet behavior, droplet distribution. Droplet vaporization – ignition. Ignition delay. Gasoline Direct Injection Engines (GDI).
7. Heat transfer in reciprocating engine cooling systems. Computation of thermal loading of engine components (piston, cylinder head, cylinder liners, exhaust valves.
8. Diesel engine simulation. SI engine simulation.
9. Engine friction and lubrication. Introduction to tribology.
10. Pollutant formation and control in SI and Diesel engines.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face –to- face, e-class.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class communication with students, Lab. exercises. Engine modeling software.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	50
laboratory	10
Study and analysis	40
Projects and exercises	50
Course total	150

STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, shortanswer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek, English Method of evaluation: summative Final exam: 2-3 problems with shorter questions Problem solving, written work, Lab. report

(5) **ATTACHED BIBLIOGRAPHY**

- Suggested bibliography:

- Colin Ferguson - A. Kirkpatrick: Μηχανές Εσωτερικής Καύσης - Ενεργειακή Συμπεριφορά. Εκδόσεις Grapholine Θεσσαλονίκη 2008
- John B. Heywood: Internal Combustion Engine Fundamentals. McGraw Hill Intl Editions, 1988.
- John Lumley-Engines-An Introduction. Cambridge University Press (1999)
- Walter Pflaum und Klaus Mollenhauer: Waermeuebergang in der Verbrennungskraftmaschine. Springer Verlag Wien, NY 1977. ISBN 3-211-81837-X
- N. Watson and M.S. Janota: Turbocharging the Internal Combustion Engine. Macmillan 1982
- H. Mettig: Die Konstruktion schnelllaufender Verbrennungsmotoren. Walter de Gruyter, Berlin 1973. ISBN 3 11 0039214

- Related academic journals:

- SAE Transactions, Motortechnisches Zeitschrift (MTZ)