

SUBJECT DATASHEET

Course information	
Name	Fuels Technology
Code	DIM-OPT-627
Degree	Master's Degree in Industrial Engineering
Year	Second
Semester	Second (Spring)
ECTS credits	3
Type	Optional
Department	Mechanical Engineering
Area	Energy
Coordinator	José Ignacio Linares Hurtado

Instructor information	
Instructor	
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SPECIFIC SUBJECT DATASHEET

Subject contextualization	
Contribution to the professional profile of the Title	
<p>This course provides the student with a broad overview of fuel technology, comprising solid, gaseous and liquid fuels. The basic features of fuels are presented, with special attention to combustion and performance characteristics, as well as the standard test methods used to determine the main fuel properties.</p> <p>Detailed descriptions of fuels designed for specific automotive, marine or aviation applications are presented, together with the standard technical specifications which different fuels must meet.</p> <p>The new trends in design and production of synthetic fuels are presented, especially those of biofuel manufacture and shale processing. A chapter on fuel degradation and prevention measures is also included.</p>	
Prerequisites	
<p>There are not any prerequisites to study the subject. Nevertheless, a basic knowledge of chemistry and thermochemistry is recommended.</p>	

CHAPTER DISTRIBUTION AND CONTENTS

Contents – Chapter segments
CHAPTER 1: General
Unit 1: OVERVIEW
1.1 Introductory concepts. 1.2 Classification of fuels. Solid, liquid and gaseous fuels. Natural and synthetic fuels. 1.3 Historic outline. 1.4 Manufacturing and refining of fuels. 1.5 Thermochemistry of fuels. Combustion.
Unit 2: CHARACTERISTICS OF FUELS
2.1 Properties of fuels. Composition. Physical properties. Chemical properties. 2.2 Combustion characteristics of fuels. Performance properties. 2.3 Standard test methods.
CHAPTER 2: Solid fuels
Unit 3: SOLID FUELS
3.1 Natural solid fuels. Firewood. Coal. 3.2 Manufactured solid fuels.
CHAPTER 3: Gaseous fuels
Unit 4: GASEOUS FUELS
4.1 Natural gaseous fuels. 4.2 Manufactured gaseous fuels: gasification. Gaseous fuels from industrial processes.
CHAPTER 4: Liquid fuels
Unit 5: AUTOMOTIVE FUELS
5.1 Automotive fuels. Petrol. Diesel fuel. 5.2 Blended fuels: ethanol and FAME blends. 5.3 Technical specifications for automotive fuels.
Unit 6: MARINE FUELS
6.1 Marine fuels. Marine fuel classification. 6.2 Marine fuel oil. Marine turbine fuel. 6.3 Marine blended fuels. 6.4 Technical specifications for marine fuels.
Unit 7: AVIATION FUELS
7.1 Aviation fuels. 7.2 Aviation gasoline. Aviation turbine fuel. 7.3 Technical specifications for aviation fuels.
CHAPTER 5: Miscellaneous
Unit 8: NEW TRENDS IN FUEL MANUFACTURE
8.1 Synthetic fuels. Indirect conversion processes. Direct conversion processes. 8.2 Biofuels. Advantages and disadvantages of biofuels. 8.3 Oil sand and oil shale processing.
Unit 9: FUEL DEGRADATION AND PREVENTION
9.1 Microbiological contamination. 9.2 Contamination by lubricants. 9.3 Contamination by water. 9.4 Fuel treatment: additives.

Competences – Learning Outcomes

Competences

General Competences

CG1. To have appropriate knowledge about the scientific and technological aspects of: mathematical, analytical and numerical methods in engineering, electrical engineering, power engineering, chemical engineering, mechanical engineering, continuum mechanics, industrial electronics, automation, manufacturing, materials, quantitative methods management, industrial computing, planning, infrastructure, and so on.

General and Basic Competences

CB2. Knowing how to apply and integrate their knowledge, understanding these, its scientific basis and troubleshooting capabilities in new and imprecisely defined environments, including multidisciplinary contexts both researchers and highly skilled professionals.

Learning outcomes

At the end of the course students shall be able to:

- LO1. Have an overview of the various types of fuels and their main characteristics.
- LO2. Have an overview of the production processes of both natural and synthetic fuels.
- LO3. Know the main technical requirements imposed on automotive, marine and aviation fuels, and the technical characteristics of the fuels suited to meet these requirements.
- LO4. Know the international, European and American technical specifications of fluids and the standard methods used to test the fuel properties.
- LO5. Know the differences in properties between natural and synthetic fuels, and their impact upon fuel usage.
- LO6. Know the causes for fuel degradation, and the methods for preventing it.

TRAINING METHODOLOGY

Subject methodological aspects

In-class methodology: Activities	Competences
1. Lectures. The Professor will explain basic concepts for every Unit, highlighting and emphasizing relevant aspects. Special attention shall be paid to the practical aspects of fuel technology. (20 hours).	CG1
2. Team Assignment presentations. All Team Assignments shall be presented in class by the Team members. Quality presentations are expected. (2 hours).	CB2
3. In-class discussion. Students will discuss the cases proposed by the Professor (Assignment presentations shall be particularly well-suited for this purpose). (3 hours).	CB2
4. Tests. Several short end-of-chapter tests shall be proposed throughout the course, to be answered individually. (2 hours).	CB2

Off-class Methodology: Activities	Competences
<p>Off-class work's main target for the student is to be able to understand theoretical concepts and apply them to produce their own material.</p>	
<p>1. Self-learning on the concepts presented in class. Material to be used are class slides, multimedia files, personal class notes, recommended books, magazines and online sources. (8 hours).</p>	<p>CG1</p>
<p>2. Team Assignments. The Professor will propose topic for Team Assignments. Students must be able to structure the outline of their assignment topic, carry out bibliographic research, collate and analyze the available documentation and apply engineering judgment and accurate technical writing in order to present conclusions. (22 hours).</p>	<p>CB2</p>
<p>3. Test preparation. Students will prepare the tests by studying the material provided by the professor material and the adquired knowledge. (5 hours).</p>	<p>CB2</p>

Week	IN-CLASS ACTIVITIES			DISTANCE ACTIVITIES			Learning Outcomes			
	h/s	Lectures and problem solving	Presentations	Assessment	h/s	Self-learning of concepts presented in class	Cases study	Team works	Learning Outcomes	Description
1	2	Unit 1 (2 hours)			2	Unit 1 (2 hours)			LO1	To have an overview of what a fuel is, and fuel classification according to various criteria.
2	2	Unit 2 (2 hours)			2	Unit 2 (2 hours)			LO2	Understand the physicochemical properties of fuels, their combustion characteristics, and their performance properties, as assessed by standardized test methods.
3	2	Unit 3 (2 hours)			2	Unit 3 (2 hours)		Distribution of assignment topics to students.	LO2	Learn about solid fuels, their origin and classification. Learn about the characteristics of manufactured solid fuels.
4	2	Unit 4 (2 hours)			3	Unit 4 (2 hours)		Work on assignment outline (1 hour)	LO2	Learn about gaseous fuels, their origin and classification. Learn about the characteristics and uses of manufactured gaseous fuels.
5	2	Unit 4 (1 hour); Unit 5 (1 hour)			4	Unit 4 (1 hour); Unit 5 (1 hour)		Work on assignment outline (1 hour)	LO2 LO3	Learn about automotive fuels, their use, classification and properties. Learn about fuel blends (ethanol and FAME). Know the main technical specifications for automotive fuels.
6	2	Unit 5 (2 hours)			4	Unit 5 (2 hours)		Work on assignment outline (2 hours)	LO2 LO3	Learn about marine fuels, their use, classification and properties. Learn about marine fuel blends. Know the main technical specifications for marine fuels.
7	2	Unit 6 (2 hours)			2	Unit 6 (2 hours)		Assignment outline submission deadline.	LO2	Learn about marine fuels, their use, classification and properties. Learn about marine fuel blends. Know the main technical specifications for marine fuels.
8	2	Unit 6 (1 hour); Unit 7 (1 hour)			6	Unit 6 (1 hour); Unit 7 (1 hour)		Work on assignment report (3 hours)	LO2	Learn about aviation fuels, their use, classification and properties. Learn about aviation fuel blends. Know the main technical specifications for aviation fuels.
9	2	Unit 7 (2 hours)			5	Unit 7 (2 hours)		Work on assignment report (3 hours)	LO4	Learn about the stages of the nuclear fuel cycle, understanding the main options
10	2	Unit 8 (2 hours)			5	Unit 8 (2 hours)		Work on assignment report (3 hours)	LO4	To know about the stages of the nuclear fuel cycle, understanding the main options for closing the nuclear fuel cycle and the management of the used nuclear fuel, including the technological fundamentals of the radioactive waste management.
11	2	Unit 8 (1 hour); Unit 9 (1 hour)			2	Unit 8 (1 hour); Unit 9 (1 hour)		Assignment report submission deadline.	LO4	To know about the stages of the nuclear fuel cycle, understanding the main options for closing the nuclear fuel cycle and the management of the used nuclear fuel, including the technological fundamentals of the radioactive waste management.
12	2	Unit 9 (2 hours)			5	Unit 9 (2 hours)		Work on classroom presentation (3 hours)	LO5	To know about the basics of protection against ionizing radiation.
13	2				8				LO5	To know about the basics of protection against ionizing radiation.
14	2		Assignment presentations (2 hours)		5					
15	2				5					

ASSESSMENT AND SCORING CRITERIA

Assessment activities	Criteria	Weight
Examinations: <ul style="list-style-type: none"> • End-of-chapter tests (4-5) 	<ul style="list-style-type: none"> - Concept understanding. - Concept application. - Analysis and interpretation of results. 	See below
Team Assignment: <ul style="list-style-type: none"> • Outline • Report • Presentation 	<ul style="list-style-type: none"> - Concept development. - Bibliographic research. - Engineering judgment. - Expression of ideas. - Technical writing skills. - Oral skills. 	See below

Scoring

Ordinary term grading:

- End-of-chapter tests, 30%
- Team assignment, 70%, broken down as follows:
 - Report, 40%
 - Presentation, 20%
 - Outline, 10%

Extraordinary grading

- End-of-term grading, 20%
- Extraordinary test, 80%.

Attendance: The absence of more than 15% of the total amount of classes will result in being failed in the ordinary grading.

WORKING SCHEDULE

In-class and distance activities	Do date	Delivery date
<ul style="list-style-type: none"> • Self-learning of concepts presented in class 	Daily	
<ul style="list-style-type: none"> • Test 	After Unit	
<ul style="list-style-type: none"> • Team assignment outline 	After task assignment	One month after topic allocation
<ul style="list-style-type: none"> • Team assignment report 	After task assignment	Two weeks before course end
<ul style="list-style-type: none"> • Team assignment presentation 	After task assignment	One week before course end

STUDENT SCHEDULE SUMMARY (HOURS)			
IN-CLASS			
Lectures	Case discussion	Presentations	Tests
20	3	2	2
OFF-CLASS			
Self-study	Team Assignment	Test preparation	
20	25	5	
ECTS:			3 (77 hours)

BIBLIOGRAPHY AND RESOURCES

Basic literature
Notes and Slides
<ul style="list-style-type: none"> • Class slides, available at the Moodle platform.
Additional literature
Books, magazine articles and reports
<ul style="list-style-type: none"> • Recommended books. • Magazine articles, communications and presentations to symposia. • Online references.