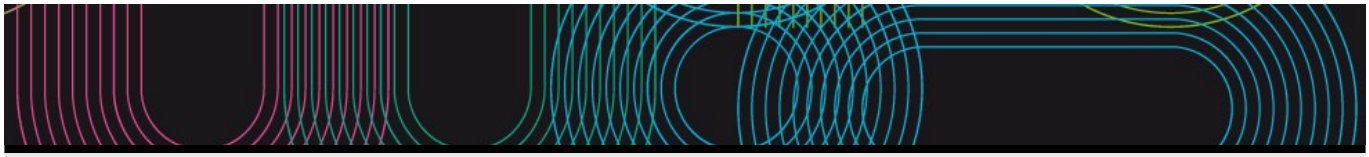

IDENTIFYING DATA				
Alternative fuels technology				
Subject	Alternative fuels technology			
Code	V09G290V01703			
Study programme	Degree in Energy Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	4th	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Yañez Diaz, Maria Remedios			
Lecturers	Yañez Diaz, Maria Remedios			
E-mail	reme@uvigo.es			
Web				
General description	English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies	
Code	
C24	Capacity to design and manage applied experimentation procedures, particularly in order to determine thermodynamics and transport properties, and modelling of phenomena and systems within the scope of chemical engineering, fluid flow systems, heat transmission, material transfer operations, kinetics of chemical reactions and reactors.
C25	Knowledge of material and energy balances, biotechnology, material transfer, separation operations, chemical reaction engineering, reactor design, and assessment and transformation of raw materials and energy resources.
D1	Capacity to interrelate all the acquired knowledge and interpret it as components in a body of knowledge with a clear structure and strong internal coherence
D3	Propose and develop practical solutions, which develop suitable strategies based on theoretical knowledge, for problem phenomena and situations that arise as everyday realities in engineering
D5	Know what sources are available for ongoing and continual updating of all the information required to undertake their work, with access to all the current and future tools for seeking information and adapting it in the light of technological and social changes
D6	Know and handle legislation applicable to the sector, know the social and business environment and know how to work together with the Administration and use acquired knowledge to draw up engineering projects and develop any of the aspects of professional work required
D7	Capacity to organise, interpret, assimilate, create and manage all the information needed to organise their work, handling the I.T., mathematical, physical and other tools required
D8	Conceive engineering within a framework of sustainable development with an awareness of environmental issues

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Acquire basic knowledges to understand the physical processes that occur in the ocean.		
Knowledge about the technological concepts supporting the biofuels manufacturing prrocesses.	C25	D1 D3 D8
Learn the basic principles of the fermentation processes.	C25	D5 D6 D8
Understand the basic aspects of of the hydrogen and fuel cells technology.	C24	D7 D8

Knowledge about technological innovations to the development of second and third generation biofuels.	C25	D1 D5 D8

Contents	
Topic	
Current energetic panorama	The current energetic model. Consumption of energy and forecasts of future. Distribution of the energetic consumption by sectors. Main sources of energy. Main fuels employed in the transport. Dependency of the energy of the transport on the oil.
Fuels derived of the biomass	Definition of biomass. The possibilities that offers the biomass like source of energetic resources. Types of biomass. Chemical composition of the biomass. Upgrading alternatives for biomass. Thermochemical Processes: combustion, pyrolysis, liquefaction and gasification. Biomass biorefyneries. Life cycle assessment of fuels.
Bioetanol	Definition. Characteristics and properties. Raw Materials used for its production. Processes for the production of bioethanol from amylaceous and lignocellulosic materials.
Biodiesel	Definition. Characteristics and Properties. Raw material used for its production. Biodiesel of first, second and third generation. Transesterification Reaction. Processes for the production of biodiesel. Glycerol. Applications of the Glycerol.
Green fuels	Biobutanol Production. Fermentation: ABE process (Acetone-Butanol-Ethanol). Properties and applications of the biobutanol. Production of biometanol. Properties and applications of the biometanol. Hydrobiodiesel or Green diesel.
Synthetic fuels	Processes and products BTL, CTL and GTL. Gasification, pyrolysis and liquefaction. Bergius Process Karrick Process Mobil Process STG+ Process Fischer-Tropsch Process

The Hydrogen	Hydrogen Economy. Hydrogen as a energetic vector. Characteristic of hydrogen as a fuel Hydrogen production from biomass. Reformed with steam. Partial oxidation. Autothermal Reforming. Hhydrogen production from coal and biomass. Hydrogen production from water: Principles of electrolysis Types of electrolyzers. Thermal Methods. Thermal Cycles. Biological Methods. Hydrogen Storage.
Fuel cells	Definition. General diagram. Types of fuel cells, components, operation diagrams and applications. Thermodynamic basis of fuel cells. Kinetic of electrochemical reactions. Fuel cells stacks.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	30	60	90
Seminars	8	26	34
Mentored work	16	40	56
Laboratory practical	25	20	45

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Exhibition in class of key concepts and procedures for the learning of the subject contents. It will employ multimedia support.
Seminars	Resolution of cases and exercises with the help of the professor and autonomously.
Mentored work	They will work on different topics throughout the whole semester, that they will present in class and/or will deliver in the TEMA platform.
Laboratory practical	Application of the acquired knowledge employing available laboratory equipment. They will make four practices: 1.- Biodiesel production by transesterification. 2.- Determination of some properties of biodiesel. 3.- Bioethanol production from agroindustrial by-products. 4.- Determination of some properties of bioethanol.

Personalized assistance

Methodologies	Description
Lecturing	The students will receive personalized attention to solve all doubts of the subject. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.
Laboratory practical	Academic activity carried out in small groups, that will allow to attend the needs of the student and provide essential supports for learning.
Seminars	Academic activity carried out in small groups, that will allow to attend the needs of the student and provide essential supports for learning.
Mentored work	The works will be supervised by the teacher and will make throughout the whole semester.

Assessment

	Description	Qualification	Training and Learning Results

Lecturing	Multiple choice questions test. Results of learning: Know the technological basis of biofuels production processes. Know the main principles of the fermentation processes. Understand the fundamental aspects of the hydrogen technology and fuel cells. Know the necessary technological innovations for the development of second generation biofuels.	35	C24 C25	D1 D3 D5 D6 D7 D8
Seminars	Problems-based exam or case study exam. Results of learning: Know the technological basis of biofuels production processes. Know the main principles of the fermentation processes. Understand the fundamental aspects of the hydrogen technology and fuel cells	35	C24 C25	D1 D3 D5 D6 D7 D8
Mentored work	Delivery a report of the works. Oral presentation of the works. Results of learning: Know the technological basis of biofuels production processes. Know the main principles of the fermentation processes. Understand the fundamental aspects of the hydrogen technology and fuel cells.	20	C24 C25	D1 D3 D5 D6 D7 D8
Laboratory practical	Delivery a report (including the results and the analysis of them) in the TEMA platform, oral presentation of the most important results obtained and assistance. Results of learning: Know the technological basis of biofuels production processes. Know the main principles of the fermentation processes. Understand the fundamental aspects of the hydrogen technology and fuel cells.	10	C25	D1 D3 D5 D6 D8

Other comments on the Evaluation

First call

The score will be calculated taking into account the evaluation of the lecturing, practices of laboratory, seminars and supervised works, according to the percentages collected in the section of assessment. To pass the course, the score in each part of the final exam (theory and problems) has to reach a minimum of 4. In case that the average score is ≥ 5, but the grade of any of the parts is inferior to 4, it would be that limiting score, that could not be considered to calculate the average grade, the one appearing in the final record.

Second call.In the second call the same criteria apply.
In relation to the July exam, grades of the "supervised works" and "practices" are maintained, and students only have to repeat the final exam.
If, at the 1st call, a student failed one of the parts of the final exam (theory or problems) and pass the other part with a grade ≥ 6, on the July exam, they only need to repeat the failed part.

Students who no can follow continuous assessment, will make a final exam of theory and problems that will be worth 90% of the final grade, and a exam of practices that will be worth 10% of the final grade. In any case, to pass the course, the student must achieve 50% of the maximum score in each of the constituent parts of the subject, ie, theory, problems and practices.

Exam calendar.

Verify/consult the web page:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

GUPTA, R. B.,, **Hydrogen Fuel: Production, Transport and Storage**, CRC Press, 2008

VERTÈS,A., QURESHI, N., BLASCHEK, H. P., YUKAWA, H., **BIOMASS TO BIOFUELS**, Wiley, 2010

Complementary Bibliography

KLASS, D.L., **Biomass for renewable energy, fuels and chemicals**, ACADEMIC PRESS, 1998

REIJNDERS, L. , HUIJBREGTS, M. A.,, **Biofuels for Road Transportation**, SPRINGER, 2009

O'Hayre R., Cha S-W., Colella W., Prinz F.B., **Fuel cell Fundamentals**, Wiley, 2016

Recommendations

Subjects that are recommended to be taken simultaneously

Environmental technology/V09G290V01402
Renewable energy installations/V09G290V01604

Subjects that it is recommended to have taken before

Thermodynamics and heat transfer/V09G290V01302
Basic operations and processes of refining, petrochemicals and carbo-chemicals/V09G290V01502
Electrical technology I/V09G290V01504

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

1. Semi-presential modality
Once the semi-presential teaching is required, it would mean a reduction of the capacity of the teaching spaces used in the face-to-face modality. Therefore, as the first measure of the centre, the capacity of the teaching spaces would be reformulated and informed to the teachers, in order to proceed to reorganize the formative activities for the rest of the semester. It should be noted that the reorganization will depend on the moment throughout the semester in which this semi-presential modality is activated. For the reorganization of the teaching activities, the following guidelines would be followed:

Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

Once some of the students have carried out experimental or computer laboratory practices in the face-to-face modality, if it is possible, the rest of the students will have the possibility to perform the same or equivalent activities in the same modality.

For the rest of the activities until the end of the semester, it should be done a proper identification of those formative activities which can be done under face-to-face modality and those which will be carried out remotely.

Regarding the potential tools to be applied for the formative activities during the online mode, CampusRemoto and the FaiTIC platform will be used.

2. Online modality
In the event that the non-face-to-face teaching modality is required (suspension of all face-to-face formative and assessment activities), the tools currently available at the University of Vigo, CampusRemoto and the FaiTIC platform will be used. The reorganization will depend on the moment throughout the semester in which this online modality is activated. In the reorganization of the teaching activities, the following guidelines would be followed:

2.1. Communication
Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

2.2. Adaptation and / or modification of teaching methodologies
As the teaching methodologies have been conceived for the face-to-face teaching modality, the teaching methodologies that would be kept and those which would be modified or replaced in the online modality are indicated below.

The teaching methodologies that would be kept are the following: lecturing, seminars and mentored work, since they can be used in face-to-face and online teaching mode

The teaching methodologies that would be modified are the following: Laboratory practical. These will be replaced by the

design or resolution of practical cases in the corresponding topics.

2.3. Adaptation of tutorial sessions and personalized attention
The tutorial sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

2.4. Evaluation
The type of assessment tests and the weight in the final grade will not be modified)