IPS Instituto Politécnico de Setúbal
Escola Superior de Tecnologia do Barreiro

Curriculum Unit Sheet

Emerging Energy Technologies

Academic Year:

2018/2019

Course	Master's degree on Chemical and Biological Engineering						
Scientific Area	Industrial and Chemical Engineering						
ECTS Credits	4	**Curriculum Unit code**	MEBQ005	**Year**	1	**Semester**	1	**Type**	Compulsory
Prerequisites							

Contact Hours

Lecture Sessions		**Lecture-Practical Sessions**	37,5	**Practical and Laboratory Sessions**	
Tutorial		**Placement**		**Seminar**	
Fieldwork		**Other**		**Autonomous Study**	70,5

Responsible	Ana Marta Paz	**Position**	Invited Assistant Professor
Lecturers	Ana Marta Paz	**Position**	Invited Assistant Professor

Learning Outcomes

Outline the key drivers of the search for alternative energy technologies and the policy and legislative frameworks.
Identify and describe energy scenarios and models.
Outline the main emerging technologies.
Explain advantages and disadvantages of different future energy technologies.
Describe the physical and chemical structures of biomass and their potential use for production of bioenergy, biomaterials and biochemicals.
Identify and describe biomass resources, their occurrence and application in a biorefinery concept.
Outline the principles of a biorefinery including chemical, biological and thermo-chemical conversion methods.
Present the idea of applying hydrogen as an energy carrier.
Describe the mode of operation of a fuel cell as well as the function of the individual components.
Understand and present the differences in function and application of different types of fuel cells.

Syllabus

1. Context of emerging energy technologies: present; main determinants of legislative politically and economically points of view; funding and support for emerging energy technologies. Infrastructures. Other factors that influence the development of energy technologies.
2. Energy Scenarios: Introduction; Scenarios for 2020 and 2050; models.
3. Key Emerging Technologies: Introduction; capture and storage of CO_2; renewable energy; distributed generation. Clean coal technologies. Hydrogen energy and fuel cells. Biofuels and biorefineries.
4. Energy Hydrogen and Fuel Cells: Hydrogen as energy vehicle; Types of Fuel Cells; Hydrogen storage; Fuel cell systems; Integration of components and energy balance. Applications.
5. Biofuels and biorefineries. Bioenergy and sustainability.

Teaching Methodologies

The theoretical contents of the curricular unit will be presented through lectures illustrated whenever possible with practical cases. Students are encouraged to apply the competences acquired through practical activities, including the analysis of case studies and exercises.

Evaluation

The assessment can be done by test, by exam in the normal season or by exam in the appeal season. The assessment by test/exam in the normal season consists of group coursework (40%) and a test/exam (60%). To obtain approval under this assessment scheme, the minimum score to obtain in the test/exam is 9,5 points. The assessment by exam in the appeal season consists in a comprehensive exam. The minimum score for approval is 9,5 points.

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes

The curricular unit program is aligned with the following general objectives:

- To provide an opportunity to the students to acquire relevant basic knowledge to develop an interdisciplinary view of energy topic (chapters 1-2).
- To enable students to acquire a basic knowledge in all emerging energy technologies (chapter 3).
- To enable students to acquire advance knowledge in emerging energy technologies (fuel cells, biofuels, biorefineries) related to the Chemical Engineering and Biotechnology specialization (chapters 4-5).

Evidence of the teaching methodologies coherence with the curricular unit's intended learning outcomes

Typology in theoretical / practical classes allows oral exposure of the theoretical contents via PowerPoint slides to be interleaved with solving practical application problems, under the supervision of the teacher.

Theoretical / practical classes are intended to convey to student the necessary knowledge to meet the goals of the curricular unit so that students acquire skills to understand, describe and relate knowledge.

The assessment and test scheme was established for an accompanied skill assessment throughout the semester. Evaluation by final exam also allows assessing whether the skills to integrate knowledge were achieved.

Bibliography

- Handbook of Fuel Cells, Fundamentals, Technology & Applications. Volumes 1-4, by W. Vielstich, A. Lamm and H. A. Gasteiger, John Wiley & Sons.
- Fundamentals of Engineering Thermodynamics. Moran, M.J., Shapiro, H.N., John Wiley & Sons.
- Renewable Energy Power for a Sustainable Future, by B. Godfrey, Oxford University Press.
- An Introduction to Combustion: Concept and Applications, Stephen R. Turns McGraw Hill Inc.
- Renewable Energy Engineering and Technology Principles and Practice Edited by V. V.N Kishore.
- Biofuels - Alternative Feedstocks and Conversion Processes, Edited by: Ashok Pandey, Christian Larroche, Steven C. Ricke, Claude-Gilles Dussap and Edgard Gnansounou, Elsevier.
- Biorefineries - Industrial Processes and Products, Edited by Birgit Kamm, Patrick R. Grubner, Michael Kamm, John Wiley & Sons.

Observations