Bachelor in Mining Exploitation and Energy Resources Engineering

Course information

Year 2018-19

GENERAL SPECIFICATIONS				
English name				
Nuclear Technology				
Spanish name				
Tecnología Nuclear				
Code		**Type**		
606810223		Compulsory		
Time distribution				
	Total	**In class**	**Out class**	
Working hours	150	60	90	
ECTS: 6				
Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
4.14	0.36	1.5	0	0
Departments		**Knowledge areas**		
Integrated Sciences		Applied Physics		
Year		**Semester**		
3rd		1st		

TEACHING STAFF			
Name	**E-Mail**	**Telephone**	**Office**
*Sánchez Benítez, Ángel Miguel	angel.sanchez@dfaie.uhu.es	959219799	EX P3-N1-08
Aguado Casas, Juan Luis	aguado@uhu.es	959219781	EX P3-N1-09

SPECIFIC INFORMATION OF THE COURSE
1. Contents description
1.1. In English:
Fundamentals and applications of nuclear technologies. Nuclear Fuel cycle. Basic nuclear reactors descriptions. Nuclear safety. Nuclear wastes. Energy production.
1.2. In Spanish
−Fundamentos de la Ingeniería Nuclear y protección radiológica. -Aplicaciones de la Ingeniería Nuclear. -Fundamentos de logística y distribución energética.
2. Background
2.1.Situation within the Degree:
This subject, which is taught in the third year of the Degree, will complete the Energy Technology competencies that are acquired throughout the degree.

2.2. Recommendations:

It is highly recommended that the student had passed the Mathematics and Physics subjects of the degree, although the subject is approachable even if you have not passed the aforementioned subjects.

3. Objectives (as result of teaching):

The main objective of the module is to acquire basic knowledge about Nuclear Technology. Nowadays, recommendations about the energy mix of advanced societies are based on an appropriate combination of renewable sources and nuclear energy with the objective of reducing CO2 emissions to environment. In addition, the module is focused on showing the latest advances in this technology. These advances are aimed, not only at achieving greater efficiency, but to improve the safety levels if necessary and, on the other hand, minimize the production of low, medium and high activity wastes.

4. Skills to be acquired

4.1. Specific Skills:

•ER06: Nuclear engineering and radiation protection
•ER07: Logistics and energy distribution

4.2. General Skills:

•CB1: Demonstrate to understand and have acquired knowledge about an area of study that starts from basic Secondary Education, and is often supported by advanced textbooks, but also includes some aspects that involve knowledge related to the forefront of their field of study.

•CB2: Know how to apply their knowledge to their work or vocation in a professional way. They should also possess the skills that are usually demonstrated through the elaboration and defense of arguments and in problem solving within their area of study.

•CB3: Gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

•CG01: Problems solving ability

•CG04: Ability of applying to practice acquired knowledge.

•CG07: Ability of problem analysis and synthesis.

•TC01. Manage the acquired information adequately showing advanced knowledge in a scientific and technological research or highly specialized context and demonstrating a detailed and well-founded understanding of theoretical and practical aspects and of the work methodology in the field.

•TC02. Master the academic and professional project with enough autonomy to participate in research projects and scientific or technological collaborations within its thematic area, in interdisciplinary contexts and in some cases with a high component of knowledge transfer.

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Lectures on the contents of the program.
- Laboratory sessions.
- Individual and group tutoring.
- Problem-solving sessions.
- Practice sessions as an approach to the local industrial environment

5.2. Teaching Methods:

- Master classes, encouraging student participation.
- Group work in lab sessions.
- Group work in practice and experimental sessions.
- Follow up of the understanding of the course contents in problem sessions
- Individual and group tutoring.
- Outline, realization, tutoring and presentation of works in specific topics.
- Conferences and seminars.
- Written exams.

5.3. Development and Justification:

Master classes on theory and problems. Exposition of the theoretical contents of the course in 1.5 hours lasting sessions. It will be also considered 1 hour sessions in small groups where available problems in Moodle will be discussed.
Laboratory. Laboratory sessions will last 2.5 h each. Students will get familiar with nuclear instrumentation and specific software. Reports will be delivered and evaluated.
Guided visits to industrial facilities. Depending upon availability, one of the lab sessions will consist of visiting a radioactive and/or nuclear facility.

6. Detailed Contents:

Chapter 1: Introduction. Preliminary concepts.
Nuclear structure. Nuclear bonding energy. Nuclear stability. Radioactivity. Nuclear reactions.

Chapter 2: Interaction of radiation with matter.
Interaction of charged particles with matter. Interaction of photons with matter. Interaction of neutron with matter.

Chapter 3: Nuclear fission and nuclear fusion as sources of energy.
Nuclear fission: basics, energy release, fission products. Schematics of a basic fission-based nuclear reactor and nuclear fuel. Types of nuclear fission reactors: thermal and fast neutrons. Nuclear fuel cycle. Energy amplifier. Nuclear fusion.

Chapter 4: Radioactive waste.
Definition. Production. Management. New technologies.

Chapter 5: Radioprotection
Biological effects of radiation. Dosimetry. Magnitudes and units in radiology. Preventive measurements for limiting the dose.

Chapter 6: Applications of radioactivity
Industrial applications. Research. Medical applications.

7. Bibliography

7.1. Basic Bibliography

- John R. Lamarsh. INTRODUCTION TO NUCLEAR ENGINEERING. Ed Addison-Wesley. ISBN: 0201142007. 2a ed.,1983.

- S. Glasstone y A. Sesonske. INGENIERÍA DE REACTORES NUCLEARES. Ed. Reverté. ISBN: 84- 291-4035-2. Barcelona, 1990.

- X. Ortega y J. Jorba (eds.). LAS RADIACIONES IONIZANTES: SU UTILIZACIÓN Y RIESGOS. Edicions UPC. ISBN 84-7653-387-X. Barcelona, 1994.

- Egbert Boeker y Rienk van Grondelle. ENVIRONMENTAL PHYSICS. Ed Addison-Wesley. ISBN: 0471997803. 2o ed, 1999.

- María Shaw y Amalia Williart. PRÁCTICAS DE FÍSICA NUCLEAR. Universidad Nacional de Educación a Distancia. ISBN84-362-2919-3. Madrid, 1993.

7.2. Additional Bibliography:

- IAEA Publications: https://www.iaea.org/Publications

- UNSCEAR Publications: http://www.unscear.org/unscear/en/publications.html

- CONSEJO DE SEGURIDAD NUCLEAR: http://www.csn.es/index.php/es/publicaciones-6

- FORO NUCLEAR: http://www.foronuclear.org/es/

- SEPR (Sociedad Española de Protección Radiológica): http://www.sepr.es/

8. Systems and Assessment Criteria

8.1. System for Assessment:

- Written exam (theory and problems)
- Reports of laboratory sessions.
- Defense of the reports of lab sessions.
- Individual tutoring
- Written exam on laboratory.

8.2. Assessment Criteria and Marks:

According to the document "*Memoria de Verificación del Título*", the evaluation of the student will be performed by means of the following items (evaluated skills are quoted in each item):

EVALUATION THROUGHT THE TERM (continuous)
- *Written exam on the subject (50 %):* Evaluation of skills CB1, CB2, CB3, CG01, CG07 , TC01
- *Written and presentation of reports (10 %):* Average over the obtained marks in the reports of every session. Evaluation of skills CB3, CG01, CG04, CG07, TC02
- *Written exam on the subjects addressed in lab sessions (20 %):* Evaluation of skills CB3, CG01, CG04, CG07, TC01
- *Work in small groups parts of the subject / Defense of written reports and Individual Follow-up of the Student (5%):* An average of the student's attendance to theoretical sessions and / or practical sessions and / or visits to facilities and / or conferences / seminars organized to complement the content of the subject will be considered in this section; as well as the student's participation in the proposed activities in small groups. Evaluation of skills: CB1, CB2, CB3, CG01, CG07

NOTE. OPTIONAL FINAL SINGLE EVALUATION:
The students will be able to benefit from an unique final evaluation that will consist of: (1) a written exam where they will have to answer different theoretical questions to overcome the theoretical part of the subject (with this the competences CB1, CB2, CB3, CG01, CG04, CG07 and TC01 are evaluated). (2) Written exam about questions related to laboratory practices

(the competences evaluated are: CB3, CG01, CG04, G07 and TC01).
Weighting for different parts of this single evaluation are 80% for the theoretical part and 20% for the laboratory part. Every student is allowed to choose this evaluation during the first two weeks of the module or, alternatively, during the two weeks that follows enrollment (if it has occurred after the beginning of the module). Nevertheless, students choosing this assessment must communicate his choice by email to the teaching staff of the module. It is important to take account that this way of assessment will imply the express waiver of the other form of evaluation, with no possibility for the student to change the system.