Bachelor in Mining Exploitation and Energy Resources Engineering

Course information

Year 2021-22

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**
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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, completes the Energy Technology competencies that are acquired throughout the degree.
2.2. Recommendations:
It is recommended that the student has 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 this subject is that students acquire basic knowledge about Nuclear Technology. At present, the recommendations on 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 subject has as a goal to show the latest advances in this technology aimed, not only at achieving greater efficiency, but to improve the safety levels if necessary and, on the other hand, minimize the production of waste of low, medium and high activity.

4. Skills to be acquired

4.1. Specific Skills:

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

4.2. General or cross 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.
• CT2: Development of a critical attitude in relation to the capacity for analysis and synthesis.
• CT3: Development of an attitude of inquiry that allows the permanent revision and advance of knowledge.

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Lectures on the contents of the program.
- Laboratory sessions.
- Individual and group tutoring.
- Problems 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 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 considered also 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 dedicated 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. Prelyminary 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 re lease, 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 (continua)
- Witten exam on the subject (50 %). Evaluation of skills CB1, CB2, CB3, CG01, CG07
- Written reports and subsequent defense of it (10 %): Average over the obtained marks in the reports of every session. Evaluation of skills CB3, CG01, CG04, CG07
- Written exam on the subjects addressed in lab sessions (20 %). Evaluation of skills CB3, CG01, CG04, CG07
- Work in small groups parts of the subject / Defense of written reports and assignments. Average of the solutions referred to different questions or

topics raised by the teacher in class that the student must submit in writing individually. Evaluation of skills CB2, CB3, CG01, CG04, CG07
- 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 UNIQUE EVALUATION:
The students will be able to benefit from a unique final evaluation that will consist of an exam in which 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 and CG07 are evaluated). They must also answer questions related to laboratory practices (the competences evaluated are: CB3, CG01, CG04 and G07). In this case, the weighting of each section will be 80% for the theoretical part and 20% for the laboratory part. To qualify for the final single evaluation, the student, in the first two weeks of the subject, or in the two weeks following enrollment if it has occurred after the beginning of the subject; communicate it by email to the faculty responsible for the subject. This will imply the express waiver of the other form of evaluation, with no possibility for the student to change the system.