ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

83000088 - Nuclear Energy In Surface Ships, Submarines, And Floating Artifacts

DEGREE PROGRAMME

08IN - Master Universitario En Ingenieria Naval Y Oceanica

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	83000088 - Nuclear Energy In Surface Ships, Submarines, And Floating Artifacts
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	Second year
Semester of tuition	Semester 3
Tuition period	September-January
Tuition languages	English
Degree programme	08IN - Master Universitario en Ingenieria Naval y Oceanica
Centre	08 - Escuela Tecnica Superior De Ingenieros Navales
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Diana Cuervo Gomez (Subject coordinator)	Despacho	d.cuervo@upm.es	Sin horario. Published in ETSIN website

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CE02 - Capacidad para analizar soluciones alternativas para la definición y optimización de las plantas de energía y propulsión de buques.

CTUPM13 - Trabajo en contextos internacionales. Los estudiantes son capaces de integrarse en un grupo o equipo, colaborando y cooperando con otros. Tienen la capacidad para trabajar con estudiantes de otras disciplinas y de aceptar la diversidad social y cultural.

3.2. Learning outcomes

RA56 - S1 Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo

RA69 - S5 - Uso de la lengua inglesa

RA59 - S7 Comunicación oral y escrita.

RA57 - S2 Creatividad

RA70 - S8 - Respeto al medio ambiente

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

This course aims to introduce students to the technology involved in nuclear installations in the marine environment, such as ship propulsion and offshore power generation.

It includes the fundamental concepts about Nuclear Physics and Reactor Physics that are needed to understand the behaivour of the nuclear reactors. Also, a detailed description of the Nuclear Technology is presented in order to understand the functioning of engineering equipment involved in this technology. In this way the students can understand how the nuclear reaction it is initiated, maintained and controlled by mean of different systems included in a nuclear reactor and also all the safety systems that are involved. Finally, specific characteristics of the nuclear installations for naval propulsion and off-shore energy production are also presented. Finally some fundamentals about nuclear submarines general arrangement, systems and buoyancy and stability will be studied.

4.2. Syllabus

1. Fundamentals
    1.1. Constitution of matter and nuclear energy
    1.2. Neutron interactions
    1.3. Nuclear fission
2. Reactor Physics
    2.1. The fission chain reaction
    2.2. Neutron moderation
    2.3. Neutron diffusion
    2.4. Reactivity coefficients
3. Nuclear reactors
    3.1. Fission nuclear reactors
    3.2. PWR nuclear reactors
    3.3. SMR reactors

3.4. Fast reactors

4. Development of maritime nuclear propulsion

4.1. Maritime nuclear propulsion history

4.2. Military nuclear propulsion

4.3. Civil nuclear propulsion

5. Characteristics of maritime nuclear propulsion installations

5.1. Characteristics of maritime nuclear propulsion systems

5.2. Nuclear propulsion: past, present and future reactors

5.3. Safety and radiological protection

5.4. Maritime safety for nuclear vessels

6. Other uses of nuclear energy off-shore

6.1. Floating power plants

6.2. Radioitotopes thermal generators

7. Fundamentals of nuclear submarines

7.1. General arrangement and services

7.2. Buoyancy, stability and drag resistance

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Part I** Duration: 04:00			
2	**Part I** Duration: 04:00			
3	**Part I** Duration: 03:00 **Part II** Duration: 01:00			
4	**Part II** Duration: 04:00			
5	**Part II** Duration: 04:00			
6	**Part II** Duration: 02:00			**Midterm exam** Progressive assessment Presential Duration: 02:00
7	**Part III** Duration: 04:00			
8	**Part III** Duration: 03:00 **Part IV** Duration: 01:00			
9	**Part IV** Duration: 02:00 **Part V** Duration: 02:00			

10	**Part V** Duration: 04:00			
11	**Part V** Duration: 03:00 **Part VI** Duration: 01:00 Research-based learning			
12	**Part VI** Duration: 02:00 Research-based learning			**Midterm exam** Progressive assessment Presential Duration: 02:00
13	**Part VI** Duration: 04:00 Research-based learning			
14	**Part VII** Duration: 04:00 Research-based learning			
15				**Presentations** Progressive assessment Presential Duration: 04:00
16				
17				**Exam** Global examination Presential Duration: 04:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
6	Midterm exam		Face-to-face	02:00	40%	4 / 10	CE02
12	Midterm exam		Face-to-face	02:00	40%	4 / 10	CE02
15	Presentations		Face-to-face	04:00	20%	4 / 10	CTUPM13

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Exam		Face-to-face	04:00	100%	5 / 10	CTUPM13 CE02

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exam		Face-to-face	04:00	100%	5 / 10	CTUPM13 CE02

6.2. Assessment criteria

Progressive evaluation

It is compulsory the regular attendance to lectures at least at 80% of the days and participation in the activities proposed at class.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
C.Ahnert, "Buques de Propulsión Nuclear", Ediciones ETSIN (2014)	Bibliography	Libro editado en la Escuela Técnica Superior de Ingenieros Navales con los apuntes del profesor
S. Glasstone, A. Sesonske, "Nuclear Reactor Engineering", Ed. Springer 1994	Bibliography	
Class materials	Web resource	Moodle
Material at Internet	Web resource	
Webcasts	Others	

8. Other information

8.1. Other information about the subject

This course is related with SDG7 "Affordable and clean energy" y con el SDG13 "Climate action"

The platforms that will be used to support teaching will be Moodle and Teams.