ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

83000007 - Ship Dynamics

DEGREE PROGRAMME

08IN - Master Universitario En Ingenieria Naval Y Oceanica

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	83000007 - Ship Dynamics
No of credits	4 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
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 *
Javier Calderon Sanchez	El habitual	javier.calderon@upm.es	Sin horario. Ver horario general de tutorías
Antonio Souto Iglesias (Subject coordinator)	El habitual	antonio.souto@upm.es	Sin horario. Ver horario general de tutorías

Antonio Medina Manuel		antonio.medina.manuel@upm.es	Sin horario.
Francisco Mata Alvarez-Santullano	habitual	francisco.mata@upm.es	Sin horario. ver web etsin

* 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

(K2) - Conocimiento de la dinámica del buque y de las estructuras navales, y capacidad para realizar análisis de optimización de la estructura, de la integración de los sistemas a bordo, y del comportamiento del buque en la mar y de su maniobrabilidad.

CG1 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CG2 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios.

CG3 - Que los estudiantes sepan comunicar sus conclusiones- y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades.

CG4 - (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.

CTUPM03 - (S4) Liderazgo. Los estudiantes dirigen y coordinan personas para que trabajen con entusiasmo en la consecución de objetivos en pro del bien común.

CTUPM04 - (S5) Uso de la lengua inglesa. Los estudiantes establecen conversaciones con nativos sin tener problemas de comunicación adicionales tanto de forma oral como escrita.

CTUPM05 - (S6) Uso de las tecnologías de la información y comunicación (TIC). Los estudiantes aplican conocimientos tecnológicos necesarios de manera que les permitan desenvolverse cómodamente y afrontar los retos que la sociedad les va a imponer en su quehacer profesional empleando la informática.

CTUPM06 - (S7) Comunicación oral y escrita. Los estudiantes transmiten conocimientos y expresan ideas y argumentos de manera clara, rigurosa y convincente, tanto de forma oral como escrita, utilizando los recursos gráficos y los medios necesarios adecuadamente y adaptándose a las características de la situación y de la audiencia.

CTUPM08 - Trabajo en equipo. Los estudiantes desarrollan la capacidad para trabajar en equipo, integrarse y colaborar de forma activa en la consecución de objetivos comunes.

CTUPM09 - Resolución de problemas. Los estudiantes son capaces de identificar o proponer un problema, y tienen el conocimiento sobre diferentes alternativas metodológicas y estratégicas para resolverlo.

3.2. Learning outcomes

RA19 - C: Capacidad para la determinación numérica y experimental de funciones de transferencia

RA20 - H&D: Manejo de un código de simulación de maniobrabilidad

RA21 - H&D: Manejo de un código de simulación de resistencia añadida y movimientos en olas

* 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

Ship Dynamics (DB) continues the training in ship dynamics started in degree with Ship Hydrodynamics II in the GAN degree.

This course consists of two parts. In the part corresponding to manoeuvrability, the planar movements are studied, and the effect that the internal control elements have on these movements.

The second part deals with the problem of the ship's dynamics in the 6 degrees of freedom, as well as the study of the external agents that influence the ship's movements.

The classroom activities are designed for the conventional classroom and the computer room, given that support software will be used. The subject is also proposed with practices at ETSIN towing and wave tank, related to the contents of the subject.

The previous training for DB must include basic theory of potential flow, provided in the basic subject of Fluid Mechanics.

4.2. Syllabus

1. Cualidades de Maniobrabilidad e Indices Representativos. // Manoeubravility Qualities and Representative Indices

2. Ecuaciones lineales del movimiento plano en Maniobrabilidad. // Linear equations of planar motions in Maneouvrability

3. Ecuaciones no lineales. Modelos modulares // Nonlinear equations. Modular models.

4. Timones. Aspectos geométricos e hidrodinámicos // Rudders: geometric and hydrodynamic aspects

5. Predicción de las Características de Maniobrabilidad del Buque. // Prediction of Maneouvrability Properties of Ships

6. Proyecto del timón. // Rudder design

7. Motion equations

   7.1. Encounter Frequency

   7.2. Diffraction-radiation problem with forward speed

   7.3. Linearised external forces: coefficients for a ship (simmetry y=0)

   7.4. Strip theory

   7.5. Motion spectrum accounting for encounter frequency influence

8. Nonlinearities: Added resistance in waves

9. Second generation criteria: surf-riding & broaching; parametric roll

10. Operability

11. Seakeeping: Rare events

12. Ship dynamics in harbours

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Course Introduction** Duration: 00:30 **Lesson 1** Duration: 01:30			
2	**Lesson 1** Duration: 01:00 **Lesson 2** Duration: 01:00			
3	**Lesson 2** Duration: 01:00 **Lesson 3** Duration: 01:00			
4	**Lesson 3** Duration: 01:00 **Lessons 4 & 5** Duration: 01:00	**Software training session** Duration: 02:00		**Task associated with the software used in this session.** Progressive assessment Presential Duration: 00:00
5	**Lessons 4 & 5** Duration: 02:00	**Software training session** Duration: 02:00		**Task associated with the software used in this session.** Progressive assessment Presential Duration: 00:00
6	**Lesson 6** Duration: 01:30 **Lesson 6** Duration: 00:30	**Software training session** Duration: 01:00		**Task associated with the software used in this session.** Progressive assessment Presential Duration: 00:00
7	**Tema 6 (problemas)** Duration: 01:00 **Midterm 1. Lessons 1-6** Duration: 01:00			**Midterm 1. Lessons 1-6** Progressive assessment Presential Duration: 00:00

8	**Lesson 7 (theory and problems)** Duration: 02:00 **Group work presentation, associated with 1-6 lessons** Duration: 00:30			**Group work presentation, associated with 1-6 lessons** Progressive assessment Presential Duration: 00:00
9	**Lesson 8** Duration: 01:00 **Lesson 8** Duration: 01:00			
10	**Lesson 8** Duration: 01:00 **Lesson 8** Duration: 01:00	**Lab practice** Duration: 01:00		**Attendance and Laboratory Practice report** Progressive assessment and Global Examination Presential Duration: 00:00
11	**Lesson 9** Duration: 01:00 **Lesson 9** Duration: 01:00	**Software training session** Duration: 02:00		**Task associated with the software used in this session.** Progressive assessment Presential Duration: 00:00
12	**Lesson 10** Duration: 01:00 **Lesson 10** Duration: 01:00			
13	**Lesson 11** Duration: 01:00 **Lesson 11** Duration: 01:00			
14	**Lesson 11** Duration: 01:00 **Lesson 11** Duration: 01:00	**Software training session** Duration: 01:00		**Task associated with the software used in this session.** Progressive assessment Presential Duration: 00:00
15	**Lesson 12** Duration: 01:00 **Lesson 12** Duration: 01:00 **Group work presentation, associated with 7-end lessons, specifically on added resistance in waves and movements in**			**Group work presentation, associated with 7-end lessons, specifically on added resistance in waves and movements in waves.** Progressive assessment Presential Duration: 00:00 **Total grade of the theory part in progressive evaluation (all but**

	waves. Duration: 00:30			**laboratories)** Progressive assessment Presential Duration: 00:00
16				
17	**"Global Assessment Examination"** Duration: 02:30			**Written test. Lessons 7 to end. This part is also part of the "Global Evaluation Grade", with the corresponding weight (see below).** Progressive assessment Presential Duration: 00:00 **"Global Assessment Examination" (42.5% Lessons 1-6 and 7-end). Duration refers to block 2 of topics.** Global examination Presential Duration: 00:00

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
4	Task associated with the software used in this session.		Face-to-face	00:00	2%	0 / 10	CTUPM08 CTUPM04 CTUPM05 (K2)
5	Task associated with the software used in this session.		Face-to-face	00:00	2%	0 / 10	CTUPM04 CTUPM05 CTUPM08 (K2)
6	Task associated with the software used in this session.		Face-to-face	00:00	1%	0 / 10	CTUPM08 CTUPM04 CTUPM05 (K2)
7	Midterm 1. Lessons 1-6		Face-to-face	00:00	23.5%	3 / 10	CG2 CG3 CG4 CTUPM09 CG1 CTUPM04 CTUPM06 (K2)
8	Group work presentation, associated with 1-6 lessons		Face-to-face	00:00	14.5%	0 / 10	CTUPM03 CTUPM08 CTUPM09 CG1 CG2 CG3 CG4 CTUPM04 CTUPM05 CTUPM06 (K2)
10	Attendance and Laboratory Practice report		Face-to-face	00:00	15%	5 / 10	(K2) CG3 CTUPM03 CTUPM04 CTUPM05 CTUPM06 CTUPM08

11	Task associated with the software used in this session.		Face-to-face	00:00	2%	0 / 10	CTUPM08 CTUPM04 CTUPM05 (K2)
14	Task associated with the software used in this session.		Face-to-face	00:00	2%	0 / 10	CTUPM08 CTUPM04 CTUPM05 (K2)
15	Group work presentation, associated with 7-end lessons, specifically on added resistance in waves and movements in waves.		Face-to-face	00:00	14.5%	0 / 10	CTUPM08 CG1 CG2 CG3 CTUPM03 CTUPM04 CTUPM05 CTUPM06 (K2)
15	Total grade of the theory part in progressive evaluation (all but laboratories)		Face-to-face	00:00	0%	5 / 10	(K2)
17	Written test. Lessons 7 to end. This part is also part of the "Global Evaluation Grade", with the corresponding weight (see below).		Face-to-face	00:00	23.5%	3 / 10	CTUPM09 CG1 CG3 CG4 CTUPM04 CTUPM06 (K2)

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
10	Attendance and Laboratory Practice report		Face-to-face	00:00	15%	5 / 10	(K2) CG3 CTUPM03 CTUPM04 CTUPM05 CTUPM06 CTUPM08
17	"Global Assessment Examination" (42.5% Lessons 1-6 and 7-end). Duration refers to block 2 of topics.		Face-to-face	00:00	85%	5 / 10	CTUPM03 CTUPM08 CTUPM09 CG1 CG2 CG3 CG4 CTUPM04 CTUPM05 CTUPM06 (K2)

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Examen Final + Práctica de Laboratorio: Esta convocatoria funciona como una repetición exacta de la convocatoria correspondiente a al "Prueba de Evaluación Global"		Face-to-face	02:30	100%	5 / 10	(K2) CG1 CG2 CG3 CG4 CTUPM03 CTUPM04 CTUPM05 CTUPM06 CTUPM08 CTUPM09

6.2. Assessment criteria

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A rubric is provided for group work, assessing:

Moodle thread: number of entries, quality, periodicity, documenting the context of the choice, references, etc., uploading files before the presentation 30%.

Defence, assessing the technical aspects of the work, its depth, the presentation file, quality of the defence, ability to answer the questions (all members of the group can answer them), etc... 70%

If the Head of Studies (at the request of a student) indicates that an absence from a practical is justified, the following measures will be taken:

1 First of all, this student will be formally withdrawn from the corresponding group.

2 A video will be shown to the person in question, some information will be given to him/her, and a short script of the practical will be given to him/her.

3. The person in question will have to make the corresponding analysis and practice report.

4. They will also be given an article from a scientific journal that has a connection with the internship and will be asked to summarise it in 600-800 words, highlighting the connections between the article and the topic of the internship.

If the Head of Studies considers that the absence is not justified in the ordinary exam session, you will fail the practicals for not attending, with all that this implies with respect to the ordinary exam session.

In this case, in the extraordinary exam, if the person indicates that they want to attend, they will be offered exactly the same proposal as if the absence were justified.

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In the global assessment test in the ordinary exam and in the final exam in the extraordinary exam, there will be NO minimum grade for the theory part. However, both in these two tests and in the progressive assessment, the minimum grade for the theory (everything except the lab practice) is 5/10 of that part, and the minimum grade for the laboratory practice is 5/10 of that part, i.e. theory and laboratory do not compensate each other: you have to pass both items.

The overall assessment test in the ordinary exam and the final exam in the extraordinary exam will consist of two

parts with the weight indicated above.

There will also be the simulation of considering the parts of the final as a progressive/continuous assessment with all that this implies.

The maximum of both will be taken.

The test corresponding to Midterm 1 taken in the "Global Assessment Test" will NOT be kept for the Extraordinary Examination.

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For the submission and defense of group works, several submission windows will be opened.

The Extraordinary Examination functions as an exact repetition of the Global Assessment Test in the Ordinary Examination.

The only exception is that the student may wish not to take the second midterm, in case he/she wants to keep that mark.

The mark of the first midterm in the ordinary final is not retained but the mark of the first midterm is retained during the course.

If one of the parts ("laboratory practicals" and "the rest") is failed, the student will get the mark corresponding to the

failed part. Therefore, the maximum mark in the global and progressive evaluation if one part is failed is the minimum of both parts.

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For assignments, a Moodle task will be enabled for uploading evidence of completion. Failure to do so within the established deadline cannot be remedied.

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A visit may be organized to an external lab (likely Harbour Laboratory of CEDEX). An maximum additional grade of 0.3-0.5 points may be obtained if coming to the visit and providing a related report, as requested per academic staff.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
"Comportamiento del Buque en la Mar, Fundamentos ", V04a, por José María González Álvarez-Campana, Servicio de Publicaciones de la ETSIN	Bibliography	
"Maniobrabilidad del Buque", por Antonio Baquero, Servicio de Publicaciones de la ETSIN (2013)	Bibliography	
"Principles of Naval Architecture", Editado por SNAME, (1988)	Bibliography	

"Design Workbook on Ship Manoeuvrability", Panel H-10 de SNAME, Technical & Research Bulletin 1-44, SNAME, (1993)	Bibliography	
"Ship Dynamic for Mariners", por I.C. Clark, The Nautical Institute, London (2005)	Bibliography	
"Dynamics of Marine Vehicles", por R. Bhattacharyya, Wiley Interscience Publications, John Wiley and Sons Inc	Bibliography	
"Sea Loads of ships and offshore structures". O.M. Faltinsen. Cambridge. Ocean Technology Series,1990	Bibliography	
Offshore Hydrodynamics. J.M.J Journée y W. W Massie. Delft University of Technology.2001	Bibliography	
Maxsurf Motions	Others	SW para Resistencia Añadida
MATLAB	Others	sw para cálculos de maniobrabilidad
Canal de Ensayos	Equipment	para prácticas de laboratorio
Aula de Ordenadores	Equipment	

8. Other information

8.1. Other information about the subject

The timetable follows a theoretical planning of the subject that may undergo modifications during the course.

Attendance sheets will be signed for the laboratory practicals, as well as for the different evaluable tasks.

The software sessions may take place at any class time or in the common time. They will be announced in advance.

For the papers, prior to the defence, the required files (presentation, software, etc.) will be handed in.

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Goals and targets (of the 2030 Agenda for Sustainable Development)

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, particularly women, indigenous peoples, family farmers, livestock keepers and fishers, including through secure and equitable access

to land, other productive resources and inputs, and knowledge, financial services, markets and opportunities for value addition and off-farm employment.

The course prepares students for better fishing vessel designs, which has an impact on this goal. In fact, the course coordinator has participated in 2023 in a UN-FAO project to improve the energy efficiency of artisanal fishing vessels for developing countries.

Goal 4. To ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

4.3 By 2030, ensure equal access for all men and women to quality technical, vocational and higher education, including university education

This objective is being pursued by seeking to train men and women equally in the technical training associated with the subject.

Goal 5. Achieve gender equality and empower all women and girls

5.1 End all forms of discrimination against all women and girls everywhere.

This objective is pursued by seeking to train men and women equally in the technical training associated with the subject.

5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life.

The participation of women in presentations as well as other activities, such as debates, with a public exposure component, will be promoted.

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

8.9 By 2030, develop and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products.

The nautical sector is of great importance for tourism in Spain. The challenges of the subject have an impact on the design of more sustainable recreational boats for tourist use.

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

14.b Facilitate artisanal fishermen's access to marine resources and markets.

The course prepares students for better fishing vessel designs, which has an impact on this goal. In fact, the course coordinator has participated in 2023 in a UN-FAO project to improve the energy efficiency of artisanal fishing vessels for developing countries.