Course guide
280645 - 280645 - Fluid Mechanics

Last modified: 15/01/2025

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 742 - CEN - Department of Nautical Sciences and Engineering.

Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: PAU TRUBAT CASAL

Others: PAU TRUBAT CASAL - GESTN, GSDT, GTDT, GTM
ANNA MUJAL COLILLES - GESTN, GSDT, GTDT, GTM
MONTSERRAT DOLZ RIPOLLÈS- GESTN, GSDT, GTDT, GTM

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE19. Knowledge of the fundamental concepts of fluid mechanics and its application to the operation and use of naval systems.
GESTN.CE7. Knowledge of the fundamental concepts of fluid mechanics and its application to the hulls of ships and artifacts, and machines, equipment and naval systems.

STCW:
ME.1. A-III/1-1. Function: Marine engineering at the operational level
ME.2. A-III/1-1.5 Operate fuel, lubrication, ballast and other pumping Systems and associated control systems
ME.3. A-III/1-KUP 1.5.1 Operational characteristics of pumps and piping systems, including control systems
ME.4. A-III/1-KUP 1.5.2 Operation of pumping systems: .1 routine pumping operations, .2 operation of bilge, ballast and cargo pumping systems
ME.5. A-III/1-KUP 1.5.3 Oilywater separators (or similar equipment) requirements and operation

TEACHING METHODOLOGY

· To adquire, understand and synthesize knowledge
· Settting-up and resolution of problems
· To carry works out individually and in group
· To apply computer analysis techniques

LEARNING OBJECTIVES OF THE SUBJECT

To adquire knowledge about the theory and concepts of the fluid mechanics.
To know and be able to apply the basis of the fluid mechanics to the analysis of machinery, equipment and naval systems.
To use the computer analysis resources to solve problems in fluid mechanics.

STUDY LOAD

Type	Hours	Percentage
Hours small group	6,0	4.00
Self study	90,0	60.00
Hours large group	54,0	36.00

Total learning time: 150 h

CONTENTS

1. Introduction to Fluid Mechanics

Description:
Concept of fluid. Properties of the velocity field. Thermo-dynamic properties of a fluid. Viscosity and other properties. Description of the flow.

Related competencies :
A31-1.5.3. A-III/1-KUP 1.5.3 Oilywater separators (or similar equipment) requirements and operation

Full-or-part-time: 20h
Theory classes: 10h
Self study : 10h

2. Hydrostatics

Description:
Concept of hydrostatics. Pressure distribution in hydrostatics. Hydrostatics forces. Floatability and stability. Pressure distribution in rigid body motion.

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 4h
Guided activities: 2h
Self study : 12h

3. Basic equations of fluid mechanics

Description:
Basic physical laws of fluid mechanics. The Reynolds Transport theorem. Conservation of mass. Linear momentum equation. Angular momentum equation. Energy equation. Frictionless flow: the Bernouilli equation. Introduction to potential flow.

Full-or-part-time: 34h
Theory classes: 8h
Laboratory classes: 4h
Guided activities: 4h
Self study : 18h

4. Dimensional analysis and similarity

Description:
The principle of dimensional homogeneity. The Pi theorem. Nondimensionalization of the basic equations. Reynolds number.

Full-or-part-time: 22h
Theory classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 12h

5. Viscous flow in ducts

Description:
Flow in a circular pipe. Flow in non-circular ducts. Minor losses in pipe systems. Multiple-pipe systems.

Related competencies :
A31-1.5.2. A-III/1-KUP 1.5.2 Operation of pumping systems: .1 routine pumping operations, .2 operation of bilge, ballast and cargo pumping systems
A31-1.5.1. A-III/1-KUP 1.5.1 Operational characteristics of pumps and piping systems, including control systems

Full-or-part-time: 24h
Theory classes: 6h
Laboratory classes: 4h
Guided activities: 2h
Self study : 12h

6. Free surface flows

Description:
Wave theory. Wave properties. Boundary value problem.

Full-or-part-time: 24h
Theory classes: 6h
Laboratory classes: 4h
Guided activities: 2h
Self study : 12h

ACTIVITIES

Course exercise presentation

Description:
Along the course, students in groups of three must present and solve a class exercise proposed by the teacher. Students must make a short presentation and summary of the theory applied to solve the problem.

Specific objectives:
To learn fluid mechanics practical applications
Work with other students
Learn to present oral works

Material:
Cclass exercises and teaching material

Related competencies :
CE7.GESTN. Knowledge of the fundamental concepts of fluid mechanics and its application to the hulls of ships and artifacts, and machines, equipment and naval systems.
CE19.GEM. Knowledge of the fundamental concepts of fluid mechanics and its application to the operation and use of naval systems.

CFD laboratory

Description:
Practices will be carried out in the computer room on CDF using different software. CFD practice will be related to the training received in these hours in the laboratory.

Specific objectives:
The student must be able to understand and apply the different methodologies to simulate fluid mechanics phenomena computationally.

Material:
Software CFD.

Delivery:
CFD Report

Related competencies :
CE7.GESTN. Knowledge of the fundamental concepts of fluid mechanics and its application to the hulls of ships and artifacts, and machines, equipment and naval systems.
CE19.GEM. Knowledge of the fundamental concepts of fluid mechanics and its application to the operation and use of naval systems.
A31-1.5.1. A-III/1-KUP 1.5.1 Operational characteristics of pumps and piping systems, including control systems
A31-1.5.2. A-III/1-KUP 1.5.2 Operation of pumping systems: .1 routine pumping operations, .2 operation of bilge, ballast and cargo pumping systems

Full-or-part-time: 4h 30m
Laboratory classes: 4h 30m

GRADING SYSTEM

Opció a) NF=0.35*P1+0.35*P2+0.3AC (Only if P1>=3.5)
Opció b) NF=0.5*P1+0.5*P2 (Only if P1>=3.5)
Opció c) NF = 0.7*Final + 0.3*AC
Opció d) NF = Final

AC = 0.8*CFD + 0.2*Div (CFD: CFD task, Div: Friday Presentation)

NF:= Final Grade
P1:= Parcial Exam 1
P2:= Parcial Exam 2
AC := Homework
Final:= Final Exam

EXAMINATION RULES.

Homework must be presented before the due date. Otherwise the grade of this task will be 0. The student not presenting to any of the activities of the course will be qualified as "not taken"

BIBLIOGRAPHY

Basic:
- White, Frank M. Fluid mechanics [on line]. 8th ed. New York: McGraw-Hill Education, 2016 [Consultation: 01/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6327616. ISBN 9780073398273.
- Streeter, Victor L.; Wylie, E. Benjamin; Bedford, Keith W. Mecánica de los fluidos. 9a ed. Madrid: McGraw-Hill, 2000. ISBN 9586009874.
- Fox, Robert W.; McDonald, Alan T. Introducción a la mecánica de fluidos. 2a ed. México: Interamericana, 1983. ISBN 9682509440.
- Dean, Robert G.; Dalrymple, Robert A. Water wave mechanics for engineers and scientists. 2nd ed. Singapore: World Scientific, 1991. ISBN 9810204205.
- Fox, Robert W.; McDonald, Alan T. Introduction to fluid mechanics. 10th ed. Willey, 2020. ISBN 9781119665953.
- Chhabra, R. P; Shankar, V; Coulson, J. M. Fluid flow : fundamentals and applications [on line]. Seventh edition. Oxford, United Kingdom ; Cambridge, MA: Butterworth-Heinemann, an imprint of Elsevier, [2018] [Consultation: 01/09/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780081010990/coulson-and-richardsons-chemical-engineering. ISBN 9780128097465.
- Hinch, E. J. Think before you compute : a prelude to computational fluid dynamics [on line]. Cambridge, United Kingdom: Cambridge University Press, 2020 [Consultation: 23/10/2020]. Available on: https://doi.org/10.1017/9781108855297. ISBN 9781108855297.
- Bergadà Granyó, Josep M;. Mecánica de fluidos : problemas con resolución numérica [on line]. Primera edición. Barcelona: Iniciativa Digital Politècnica. Oficina de Publicacions Acadèmiques Digitals de la UPC, abril de 2021 [Consultation: 14/05/2021]. Available on: http://hdl.handle.net/2117/344632. ISBN 9788498809275.

Complementary:
- Moukalled, F.; Mangani, L.; Darwish, M. The Finite volume method in computational fluid dynamics : an advanced introduction with OpenFOAM® and Matlab [on line]. Cham: Springer International Publishing, 2016 [Consultation: 22/09/2020]. Available on: https://dx.doi.org/10.1007/978-3-319-16874-6 . ISBN 9783319168739 .
- Ladyzhenskaya, O. A. The Mathematical theory of viscous incompressible flow. Mansfield: Martino Publishing, 2014. ISBN 9781614276715.
- Bergadà Granyó, Josep M. Mecánica de fluidos : problemas resueltos [on line]. Barcelona: Iniciativa Digital Politècnica, 2011 [Consultation: 22/09/2020]. Available on: http://hdl.handle.net/2099.3/36662. ISBN 978-84-7653-915-6.
- Bergadà Granyó, Josep M. Mecánica de fluidos : breve introducción teórica con problemas resueltos [on line]. 3a ed. Barcelona: Iniciativa Digital Politècnica, 2017 [Consultation: 22/09/2020]. Available on: http://hdl.handle.net/2117/111266. ISBN 9788498805253.
- Ferziger, Joel H; Peric, M; Street, Robert L. Computational methods for fluid dynamics [on line]. Fourth edition. Cham, Switzerland: Springer, [2020] [Consultation: 30/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5940

868. ISBN 9783319996936.