

Course guide

280637 - 280637 - Mechanics and Strength of Materials

Last modified: 07/10/2024

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).

Academic year: 2024 **ECTS Credits:** 9.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: JAVIER MARTINEZ GARCIA

Others:

Primer quadrimestre:
JAVIER MARTINEZ GARCIA - GTM
PABLO LEONEL SIERRA HERMOSID - GTM

Segon quadrimestre:
JAVIER MARTINEZ GARCIA - GTM
FERMÍN ENRIQUE OTERO GRUER - GTM

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

GTM.CE21. Knowledge of the fundamentals of materials science and its application to real behavior of solid structures, facilities and marine equipment.

GTM.CE22. Knowledge of the theory of machines and mechanisms.

GTM.CE23. Knowledge of the strength of materials and ability to perform calculations of elements in the operation and use of naval systems.

Transversal:

AA N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

STCW:

ME.1. A-III/1-3. Function: Maintenance and repair at the operational level

ME.2. A-III/1-3.1 Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair on board

ME.3. A-III/1-KUP 3.1.1 Characteristics and limitations of materials used in construction and repair of ships and equipment

ME.4. A-III/1-3.2 Maintenance and repair of shipboard machinery and equipment

ME.5. A-III/1-KUP 3.2.5 Design characteristics and selection of materials in construction of equipment

TEACHING METHODOLOGY

Adquirir, comprendre i sintetitzar coneixements
Platejar i resoldre problemes
Realitzar treballs individualment
Analitzar resultats
Relacionar coneixements de disciplines diferents

LEARNING OBJECTIVES OF THE SUBJECT

Comprendre i aplicar la teoria de màquines i mecanismes.

Comprendre els conceptes de resistència de materials.

Aplicar els conceptes de resistència de materials pe a realitzar càlculs d'elements sotmesos a sol·licitacions diverses.

Dur a terme les tasques encomanades en el temps previst, d'acord a les pautes marcades pel professor o tutor. Identificar el progrés i el grau d'assoliment dels objectius de l'aprenentatge.

Detectar carències en el coneixement propi i superar-les mitjançant la reflexió crítica i l'elecció de la millor actuació per ampliar aquest coneixement.

On the other hand, one of the objectives of this subject is provide the knowledge, understanding and proficiency of the competencies "Characteristics and limitations of materials used in construction and repair of ships and equipment" and "Appropriate basic mechanical knowledge and skills", competencies required and defined in Section A-III/1 Mandatory minimum requirements for certification of officers in charge of an engineering watch in a manned engine-room or designated duty engineer in a periodically unmanned engine-room (propulsion power of 750 kW or more) of the Seafarers Training, Certification and Watchkeeping (STCW) International Code.

STUDY LOAD

Type	Hours	Percentage
Hours large group	90,0	40.00
Self study	135,0	60.00

Total learning time: 225 h

CONTENTS

1. Mass Geometry

Description:

Calculation of the basic geometric properties of mechanical parts: center of gravity, moments of inertia and product of inertia. Steiner's theorem. Axis rotation. Main axes of inertia.

Full-or-part-time: 13h

Theory classes: 2h

Practical classes: 3h

Self study : 8h

2. Kinematics of the Point and the Solid

Description:

General movement. Particular cases: translation and rotation. Speeds and accelerations. Intrinsic components.

Full-or-part-time: 7h

Theory classes: 2h

Practical classes: 1h

Self study : 4h

3. Study of Mechanisms

Description:

Analysis of plane and spatial mechanisms. Constituent elements and degrees of freedom. Instant center of rotation. Relative centers and theorem of the three centers.

Full-or-part-time: 13h

Theory classes: 2h

Practical classes: 3h

Self study : 8h

4. Speeds in Flat Mechanisms

Description:

Analytical method, axial component, rotational speeds. Relative velocities. Cinema method. Speeds in drag movements.

Full-or-part-time: 20h

Theory classes: 3h

Practical classes: 5h

Self study : 12h

5. Accelerations in Flat Mechanisms

Description:

Acceleration of rotating solids points. Relative acceleration. Acceleration cinema. Acceleration in drag movements. Coriolis theorem. Pole of accelerations of a solid.

Full-or-part-time: 20h

Theory classes: 2h

Practical classes: 4h

Self study : 14h

6. Dynamics of Flat Motion

Description:

Flat mechanisms. General equations of plane motion. Equivalent systems in plane dynamics. Punctual masses.

Full-or-part-time: 14h

Theory classes: 2h

Practical classes: 3h

Self study : 9h

7. Inertia Forces of Flat Motion

Description:

Inertial force of a particle and a solid. D'Alembert's principle. Analysis of forces in a plane mechanism. Particular cases: translation, rotation and general movement.

Full-or-part-time: 13h

Theory classes: 2h

Practical classes: 3h

Self study : 8h

8. Balancing of Rotors

Description:

Inertial forces of a rotor. Static balance. Dynamic balance. Balanced rotors with two counterweights.

Full-or-part-time: 9h

Theory classes: 2h

Practical classes: 2h

Self study : 5h

9. Dynamics of the Systems of a Degree of Freedom

Description:

Kinetic energy of a mechanism. Equation of kinetic energy. Mass reduced to one point. Reduced force. Reduced force-reduced mass ratio. Systems equivalent to a particle.

Full-or-part-time: 14h

Theory classes: 2h

Practical classes: 3h

Self study : 9h

10. Point Balance

Description:

Description of the forces acting on a system. Free solid diagram. Equilibrium equations of the point.

Full-or-part-time: 10h

Theory classes: 2h

Practical classes: 2h

Self study : 6h

11. Equilibrium of the Solid

Description:

Description of the moments acting in a system. Pair of forces. Free solid diagram. Equilibrium equations of the solid. Application to mechanisms. Flat reticulated structures.

Full-or-part-time: 24h

Theory classes: 4h

Practical classes: 6h

Self study : 14h

12. Efforts in the Solid

Description:

Characterization of the stresses that affect the solid. Isostatic and hyperstatic structures. Calculation of stresses in isostatic structures. Representation of efforts in diagrams.

Full-or-part-time: 31h

Theory classes: 4h

Practical classes: 9h

Self study : 18h

13. Stresses and Deformations by Normal Stresses

Description:

Concept of stress and strain. Calculation of stresses and strains by axillary stresses. Calculation of stresses and strains due to bending stresses. Calculation of combined axil-flexion stresses.

Full-or-part-time: 22h

Theory classes: 4h

Practical classes: 6h

Self study : 12h

14. Stresses and Deformations by Tangential Stresses

Description:

Calculation of stresses and strains due to shear stresses. Calculation of stresses and strains due to torsional stresses.

Full-or-part-time: 15h

Theory classes: 2h

Practical classes: 5h

Self study : 8h

GRADING SYSTEM

La qualificació final és la suma de les qualificacions parcials següents:

$$N_{\text{final}} = 0.60 \cdot N_{\text{pf}} + 0.20 \cdot N_{\text{pp}} + 0.20 \cdot N_{\text{ec}}$$

N_{final} : Qualificació final

N_{pf} : Qualificació prova final

N_{pp} : Qualificació prova parcial

N_{ec} : Qualificació dels exercicis de curs (avaluació continuada)

REVALUACIÓ

La prova de reavaluació consistirà en un únic examen final on s'avaluaran els coneixements de la totalitat de l'assignatura. La nota final de la prova de reavaluació correspondrà únicament a la nota obtinguda de l'examen.

EXAMINATION RULES.

L'alumne que no es presenti a la prova final constarà com a "no presentat" a l'assignatura.

Es podrà dur un formulari amb un màxim de 5 fulls per a la realització de les proves de curs.

BIBLIOGRAPHY

Basic:

- Riley, W.F.; Sturges, L.D. Ingeniería Mecánica. Vol. 1, Estática. Barcelona: Reverté, 1995. ISBN 842914255X.
- Beer, Ferdinand Pierre ... [i altres]. Ingeniería Mecánica. Vol. 2, Dinámica. México: McGraw-Hill, 2013. ISBN 8429142568.
- Riba i Romeva, Carles. Mecanismes i màquines [on line]. 3a ed. Barcelona: Edicions UPC, 2002 [Consultation: 31/01/2020]. Available on: <http://hdl.handle.net/2099.3/36254>. ISBN 8483013525 (O.C.).
- Hernández, Alfonso. Cinemática de mecanismos : análisis y diseño. Madrid: Síntesis, 2004. ISBN 8497562240.
- Gere, James M. Resistencia de Materiales. 5a ed. Madrid: International Thomson, 2002. ISBN 9788497320658.
- Cervera, M.; Blanco, E. Mecánica de Estructuras. Vol.1 : Resistencia de materiales [on line]. 2a ed. Barcelona: Edicions UPC, 2002 [Consultation: 06/07/2022]. Available on: <http://hdl.handle.net/2099.3/36196>. ISBN 8483016222.
- Beer, Ferdinand P. ; Johnston, E. Russell ; Mazurek, David F. Mecánica vectorial para ingenieros. Vol.1, Estática [on line]. 12a ed. México: McGraw-Hill Education, 2021 [Consultation: 01/03/2023]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=11980. ISBN 9781456289782.
- Beer, Ferdinand P.; Johnston, Russel E.; Cornwell, Philip J.; Self, Brian P. Mecánica vectorial para ingenieros. Vol. 2, Dinámica [on line]. 12a ed. México: McGraw-Hill Education, 2021 [Consultation: 01/03/2023]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=11979. ISBN 9781456289775.

Complementary:

- Meriam, J.L.; Kraige, L.G. Mecánica para ingenieros. Vol. 1, Estática [on line]. 3a ed. Barcelona: Reverté, 1999 [Consultation: 04/07/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/reader.action?docID=5635461>. ISBN 8429142576.
- Meriam, J.L.; Kraige, L.G. Mecánica para ingenieros. Vol. 2, Dinámica [on line]. 3a ed. Barcelona: Reverté, 1999 [Consultation: 04/07/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/reader.action?docID=5635461>. ISBN 8429142592.
- Vázquez Fernández, Manuel; Lopez Pérez, Eloisa. Mecánica para ingenieros. 7a ed. Madrid: Noela, 1998. ISBN 8488012039.
- Vázquez Fernández, Manuel. Resistencia de materiales. 4a ed. Madrid: Noela, 1999. ISBN 8488012055.
- Calero Pérez, Roque; Carta González, José Antonio. Fundamentos de mecanismos y máquinas para ingenieros. Madrid: McGraw-Hill, 1999. ISBN 844812099X.
- Cardona Foix, Salvador; Clos Costa, Daniel. Teoría de màquines [on line]. 2a ed. Barcelona: Edicions UPC, 2008 [Consultation: 29/10/2021]. Available on: <http://hdl.handle.net/2099.3/36644>. ISBN 9788483019634.
- Nieto Nieto, Justo. Síntesis de mecanismos. Madrid: AC, 1978. ISBN 8472880257.
- Cervera Ruiz, Miguel; Blanco Díaz, Elena. Mecánica de estructuras. Vol. 2, Métodos de análisis [on line]. 2a ed. Barcelona: UPC, 2002 [Consultation: 06/07/2022]. Available on: <http://hdl.handle.net/2099.3/36196>. ISBN 8483016354.

RESOURCES

Other resources:

The course exercises will be available on the virtual campus (Athena) and on the web: www.fnb.upc.edu/mecanica/