UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
280659 - 280659 - Inspection and Non-Destructive Testing

Last modified: 24/07/2023

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: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JUAN ANTONIO MORENO MARTÍNEZ

Others: Primer quadrimestre:
JUAN ANTONIO MORENO MARTÍNEZ - DT, GESTN, GTM

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE33. Knowledge of inspection procedures and the functioning of the Classification Societies.

Transversal:
COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

STCW:
MCE.1. A-III/2-3. Function: Maintenance and repair at the management level
MCE.2. A-III/2-3.2 Detect and identify the cause of machinery malfunctions and correct faults
MCE.3. A-III/2-KUP 3.2.1 Practical knowledge: Detection of machinery malfunction, location of faults and action to prevent damage
MCE.4. A-III/2-KUP 3.2.2 Practical knowledge: Inspection and adjustment of equipment
MCE.5. A-III/2-KUP 3.2.3 Practical knowledge: Nondestructive examination
ME.1. A-III/1-3. Function: Maintenance and repair at the operational level
ME.2. A-III/1-3.2 Maintenance and repair of shipboard machinery and equipment
ME.3. A-III/1-KUP 3.2.4 The use of appropriate specialized tools and measuring instruments

TEACHING METHODOLOGY

- Lectures for theory (expository method) and laboratory sessions for practices (demonstration method).
- Use of ICT and teaching support platform ATENEA.
- Company visits

LEARNING OBJECTIVES OF THE SUBJECT

On the other hand, one of the objectives of this subject is provide the knowledge, understanding and proficiency of the competency ?NAME OF THE COMPETENCY STCW ATTACHED TABLE OF SUBJECTS?, competency 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
Self study	67,5	60.00
Hours small group	20,0	17.78
Hours large group	25,0	22.22

Total learning time: 112.5 h

CONTENTS

1

Description:
Presentation of the subject: Objectives, bibliography, theoretical contents, method of evaluation, definition of the practices of laboratory, prevention of risks and measures of environingingmental hygiene. ATENEA digital campus.
Introduction to non-destructive testing methods: Definition, classification, types, basic steps.

Related activities:
Visit to the NDT laboratory

Full-or-part-time: 7h 30m
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h 30m

3. PENETRANT TESTING EXAMINATION (PT)

Description:
UD1: INTRODUCTION TO THE TERMINOLOGY AND HISTORY OF END.

History. Purpose. Terminology. Product family. EN ISO 12706. Penetrants. Developer. Eliminator. Reference block example. Sensitivity level. Post-emulsifiable. Dual penetrant. Background.

UD2: PHYSICAL PRINCIPLES OF THE METHOD AND ASSOCIATED KNOWLEDGE

Applicable regulations: General principles. Goo. exudate. Flashpoint. Penetrant emulsification. Developer. Colored and fluorescent penetrant.

UD3: KNOWLEDGE ABOUT THE PRODUCT AND CAPACITY OF THE METHOD AND ITS DERIVED TECHNIQUES.

Typical defects according to the manufacturing process (forged, cast, rolled, welded products, etc.)

Unit4: TEAM.

Design and management of penetrant units and facilities. electrostatic systems. fluidized bed. Aerosol cans. Installation by immersion. Brushed. light sources. Measurement units and reference blocks (EN 3452-3 AND EN 3452-4). Observation conditions (EN ISO 3059)

UNIT5: PRE-TEST INFORMATION.

Verification according to written instructions that the object to be tested is in suitable conditions for it. Written instructions are given. Information about the test object, preparation of written instructions. Identification or designation. Material, dimensions, field of application. Product family type. Catalog of defects. Test conditions. Applicable standards and codes assigned to the test object.

U6: TESTING

Performing the assay according to written instructions. Preparation and performance of the test. Preparation of written instructions in accordance with EN 1371-1, EN 10228-2, EN 1289.

UD7: EVALUATION AND REPORT

Test report and test report verification. Test report Welding according to EN571-1; Castings according to EN 137 1- 1; Forgings in accordance with EN 10228-2; Laminated products. Report of simple imperfections of welded, forged, rolled and cast products Basis of the evaluation. Observation conditions according to EN ISO 3059. Reference blocks No. 1 and No. 2 according to EN ISO 3452-3. Other reference blocks used. Batch report of the calibration of the test units. Evaluation. Verification of the quality of the indication. Report of discontinuities according to EN 1289, EN 1371-1, EN 10228-2.

UNIT8: ASSESSMENT.

Evaluation of discontinuities. Depth, width, shape, position, orientation. Influence of manufacturing and material.

UD9: QUALITY ASPECTS

Staff qualification. Personnel qualification (according to ISO 9712). Equipment verification. Written instructions. Document traceability. Review of the applicable standards for the product and the application of the END.

UD10: SAFETY AND ENVIRONMENTAL CONDITIONS

Elimination of chemical residues. Elimination of chemical residues. penetrating. Developer. Emulsifier. Eliminator of the excess of the process material. Safety data Sheet. Active carbon method, ultrafiltration method. UV radiation, danger of electric shock. Legislation.

UD11:INNOVATIONS

Special facilities. Automotive installations (examples).

Related activities:
Laboratory practice of Penetrating Liquids: Type I, II and III / A, B, C, D, E.

Full-or-part-time: 22h 30m
Theory classes: 6h
Laboratory classes: 3h
Self study : 13h 30m

3. MAGNETIC PARTICLE INSPECTION (MT)

Description:
UD1: INTRODUCTION TO THE TERMINOLOGY. HISTORY OF THE END.
Introduction. Presentation of the magnetic particle test. Applicability
and limits. History. Terminology (EN 1330-7).

UD2: PHYSICAL PRINCIPLES OF THE METHOD AND ASSOCIATED KNOWLEDGE
Basic physical phenomena. Electrical circuits, typical values, units.
Magnetic circuits, typical values, units. magnetic field created by
electrical circuits. Indefinite rectilinear conductor. Long magnetic coil.
Flat or short magnetizing coil. Passage of flux from a magnetic medium to a
non-magnetic medium. HT continuity. BN continuity. Magnetic flux of a magnetic discontinuity. Influence of the geometry (depth, thickness and orientation) and the orientation of a magnetic discontinuity in its detection. magnetic properties. Designation of alloys. non-magnetic materials. magnetic materials. Scope. Curie point.
Magnetization. Hysteresis loop and highlights. Properties
steel magnets. Applicable standards: EN ISO 9934-1 Principles
generals.

UD3: KNOWLEDGE ABOUT THE PRODUCT AND CAPACITY OF THE METHOD AND ITS DERIVED TECHNIQUES.
Typical discontinuities in welded, forged, cast and rolled products, their indications. Test parameters. Magnetization. Means of detection and testing of the means of detecting indications.

Unit4: TEAM
Magnetization equipment. Conditions of conservation. Measurement and calibration.
Demagnetization. Applicable standards: EN ISO 9934-2 and EN ISO 9934-3.
Portable electromagnet. Mobile. magnetic bench. Automatic and robotic with
automatic detection (magnetic leakage field). Light sources and conditions
of lighting. Accessories. Flow indicators and product indicators.
Field force measurement devices. Photometers and radiometers.
Equipment selection considerations (EN ISO 9934-2 and EN ISO 9934-
3). Elements to take into account, materials and components to control, areas to control. Objective of the essay. Place and environment. Selection of the type of technique.
Current type. Magnetic flux technique. (Open and closed circuit).
Current flow technique. Induced current flow. Combined system.
Multidirectional magnetization and Rotating field.

UNIT5: PRE-TEST INFORMATION.
Application of written instructions. Identification or designation of the material:
Type of manufacture; defect catalog; test conditions and application of the standard: accessibility infrastructure particular test condition application standards. Overview standards and codes assigned to test objects. Criteria of acceptance. Preparation of written instructions. Test according to the written instructions. Preparation of
the surface. Cleaning. Mechanized. Use of contrast paint. Magnetization, types and time of application. Application of the detection medium. Continuous technique. Magnetic remanence technique. Grid and coating. Control of magnetization conditions. Treatment of the components after the test. Residual field. Conditions requiring demagnetization. Residual field level. Basic principle of demagnetization.
Demagnetization. Industrial methods of demagnetization and influence of the magnetic field. Land. Cleaning of components.

UD7: EVALUATION AND REPORT.
Classification of indications: welding according to EN 1290; pieces
cast according to EN 1369; forgings according to EN 10228-1; rolled products. Essay report. Checking the report
trial. Basic aspects of evaluation. Observation conditions. (IN
ISO 3059) according to a reference block; other reference blocks
used; calibration of test units. Batch test report.
Evaluation and verification of the quality of the indication. Report
imperfections according to EN 1290. EN 1369, EN 10228-1

UNIT8: ASSESSMENT.
Assessment of the influence of manufacturing and material discontinuities.

UD9: QUALITY ASPECTS.
Personnel qualification (according to ISO 9712). Equipment verification.
Written instructions. Document traceability. Review of the rules of
products and application of the applicable NDTs.

UD10: SAFETY AND ENVIRONMENTAL CONDITIONS
Safety and hygiene. Danger of electrical hazards. Risks related to the products (magnetic inks). Risks related to ultraviolet radiation. Disposal of effluents and environmental conditions. (Concepts). Safety data Sheet.

UNIT11: PROGRESS
Special installation and equipment.

Related activities:
Laboratory Practices: Electromagnetic You, Coil and Contact Electrodes, Black, Red and Fluorescent Particles.

Full-or-part-time: 22h 30m
Theory classes: 6h
Laboratory classes: 3h
Self study : 13h 30m

4. ULTRASONIC TESTING (UT)

Description:
UD1. Introduction to NDT terminology and history
UD2.Physical principles of the method and associated knowledge: Physical definitions and typical parameters.
UD3.Knowledge about the product and capacity of the method and its derived techniques
UD4. Equipment
UD5.Pre-trial information
UD6.Essays
UD7.Evaluation and report
UD8.Quality aspects
Unit10. innovations

Related activities:
Laboratory Practices: Calibration and adjustment of equipment. Normal, bicrystalline and angular feeler. Application in thickness measurements and weld inspection. Inspection of metallic and composite materials.

Full-or-part-time: 45h
Theory classes: 12h
Laboratory classes: 6h
Self study : 27h

5.OTHER TESTS: INDUSTRIAL RADIOGRAPHY (RT), INFRARED THERMOGRAPHY (TT), VISUAL INSPECTION (IV)

Description:
INTRODUCTION

Related activities:
Visit to SGS for X-rays and radioactive isotopes.
Interpretation of radiographs with the negatoscope.
Visual inspection of welding tubes
Thermography camera

Full-or-part-time: 14h 50m
Theory classes: 3h
Guided activities: 6h
Self study : 5h 50m

GRADING SYSTEM

1 Exam per course (Continuous assessment): will allow, if necessary, pass per course and those students who pass it will NOT have to go to the final exam in January. The exam per course will consist of a multiple choice test of each test method seen in class, usually Penetrating Liquids, Magnetic Particles and Ultrasound (some questions may need to do some small calculation). The result of these tests will be averaged with the grade of the internship dossier. The internship dossier only averages with the exam per course.
Nfinal = 0.50 Np Theory + 0.50 Np Practices Lab
Nfinal = final grade
Np Theory = Qualification Tests
Np Internships = Lab internship dossier qualification.

2 Final exam January: In the case of not passing the course exam, the student will have to go to the final exam of January, also of test type AND ONLY IT WILL BE NECESSARY TO RECOVER THE PART OF THE SUSPENDED TEST.

3 Revaluation exam: In the case of not passing the final exam in January, those students who are in the conditions established by the Center will be able to go to the revaluation exam in February to be able to take the revaluation exam (it is necessary to the minimum grade is ? (3) must be submitted only from the suspended party.
Important note: You must bring a calculator. The use of a mobile phone and / or tablet or any other device that can take photographs will not be allowed, they must be disconnected and saved for the duration of the exam. Failure to comply with these rules will result in expulsion and zero rating.
I ask for your collaboration!

EXAMINATION RULES.

- If you do not do any of the activities of laboratory or continuous evaluation, it will be considered as unrated.
- Those students who are in the conditions established by the Center to be able to present themselves to the re-evaluation exam, will have to present only of the suspended part.
- Note: The student will be assigned to a group of laboratory practices at the time of enrollment and no changes will be allowed during the course. Only in exceptional cases will the responsible professor assign the groups.

BIBLIOGRAPHY

Basic:
- Ida, Nathan; Meyendorf, Norbert (ed). Handbook of advanced nondestructive evaluation [on line]. Cham: Springer International Publishing, 2019 [Consultation: 27/04/2020]. Available on: https://doi.org/10.1007/978-3-319-26553-7. ISBN 9783319265537.
- Ramírez Gómez, F. [et al.]. Métodos de ensayos no destructivos. 4a. Madrid: Instituto Nacional de Técnica Aerospacial, 1996-1998. ISBN 8492079886.
- ASM Handbook. Vol. 17. Nondestructive evaluation and quality control. Ohio (Estats Units d'Amèrica): ASM International, 1992-. ISBN 0871700239.
- Líquidos penetrantes : manuales de estudio niveles 1, 2 y 3. Madrid: AEND, 2007. ISBN 9788469063187.
- Partículas magnéticas : manual de estudio. 2a ed. Madrid: AEND [etc.], 2013. ISBN 9788461697373.
- Ultrasonidos : manuales de estudio. 2a ed. Madrid: AEND, 2013. ISBN 9788461697090.

RESOURCES

Other resources:
penetrating dye
electromagnetic yoke
equipment of tips and coil
Thermographic camera
UV light
microscopes