Escola Superior Náutica Infante D. Henrique
Departament of Marine Engineering

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Bachelor of Engineering in Marine Engineering

(Syllabus)

ENIDH, February 2012

Bachelor of Engineering in Marine Engineering

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1st Year

	CH	ECTS		CH	ECTS
Mathematical Analysis I	5	6	Mathematical Analysis II	5	6
Linear Algebra	4	5	Electrical Circuits	5	6
General Physics	4	6	Applied Chemistry	4	6
Programming	4	5	Technical Drawing	4	5
Maritime Technology	4	4	Materials	4	4
English	3	4	Maritime Technical English	2	3
Totals	24	30	Totals	24	30

2nd Year

	CH	ECTS		CH	ECTS
Applied Mechanics	4	5	Mechanics of Materials	5	6
Thermodynamics	4	5	Heat Transfer	4	5
Fluid Mechanics	4	5	Workshop Practice	5	4
Electrical Machines and Drives	4	5	Electronics	4	6
Mechanical Technology	4	5	Probabilities and Statistics	4	5
Numerical Methods	4	5	Psycho Sociology	2	4
Totals	24	30	Totals	24	30

3rd Year

	CH	ECTS		CH	ECTS
Auxiliary Machinery I	4	6	Auxiliary Machinery II	5	6
Internal Combustion Engines	4	5	Marine Plant Operation	4	5
Control Systems	4	6	Automation	5	6
Ship Structure and Stability	4	5	Machine Design	4	5
Maritime Safety I	4	4	Maritime Safety II	4	5
Maintenance	4	4	Basic Health Care on Board	2	3
Totals	24	30	Totals	24	30

NOTES:
CH – Contact Hours
ECTS – European Credit Transfer System

MARITIME CERTIFICATION

Successful completion of all curricular units of the course in Marine Engineering (BEng degree), meets the mandatory requirements for certification of Marine Engineer Officers in watch service in the engine-room or designated duty engineers in a periodically unmanned engine-room, in ships powered by main propulsion machinery equal or higher than of 750 kW as provided in paragraph 2.3 of regulation III/1 of IMO/STCW 1978 Convention as amended in 1995 and as provided for in Decree N.º 280/2001 of 23 October as amended by Decree N.º 206/2005 of 29 November and by Decree N.º 226/2007 of 31 May.

The completion of this degree allows to obtain the relevant certificates of competence and the following qualification certificates and documentary evidence, according the Amendments to the STCW Convention, considering that are satisfied the remaining requirements for the issue of the certificate:

a) Certificate of basic safety (tables A-VI/1-1, A-VI/1-2, A-VI/1-3 and A-VI/1-4 of the STCW Code);

b) Certificate of qualification for the control of fire-fighting operations (table A-VI/3 of the STCW Code);

c) Certificate of qualification to provide medical first aid on board ships (paragraph 1 of table A-VI/4 of the STCW Code);

d) Certificate of proficiency in survival craft and rescue boats (paragraph 1 of table A-VI/2 of the STCW Code);

e) Certificate of proficiency in fast rescue boats (paragraph 2 of table A-VI/2 of the STCW Code);

f) Certificate of qualification to perform special duties on tankers (oil, chemical and liquefied gas tankers) (paragraph 1 of table A-V/1 of the STCW Code);

g) Certificate of familiarization on ro-ro passenger ships (paragraph 2 of section A-V/2 of the STCW Code);

h) Certificate of crowd management (paragraph 1 of section A-V/2 and A-V/3 of the STCW Code);

i) Certificate of safety for personnel providing direct service to passengers (paragraph 3 of section A-V/2 and A-V/3 of the STCW Code);

j) Certificate of familiarization on passenger ships (paragraph 2 of section A-V/3 of the STCW Code);

k) Certificate of passenger safety (paragraph 4 of section A-V/3 of the STCW Code);

l) GMDSS restricted operator's certificate (issued under the authority of the Portuguese Administration, in accordance with the provisions of the Radio Regulations of the International Telecommunication Union - RR / ITU)

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1st year of studies

1st semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Mathematical Analysis I		
Field:	Mathematics		
Course code:	3041	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	6	**Hours/week:**	75 h / TP
Name of lecturer:	Patrícia C. M. Engrácia		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The primary goal of the course is to develop a working knowledge of Mathematical Analysis with special emphasis in differential and integral calculus in R. This knowledge will allow the student to establish the mathematical models needed to analyse the physical problems of engineering.

Course contents:

1. Sequences and Series
Sequences. General notions. Limits and convergence.
Numerical series. Examples. Convergence criteria of a series. Power and function series. Convergence radius

2. Real Function of Real Variable.
Domain of a function. Limit and Continuity definitions. Asymptotes.
Differential Calculus in R. Derivatives and their applications. Determination of minima and maxima. Graphic representation of functions. Taylor's formula.

3. Integral Calculus in R.
Primitives. General notions and calculus methodology.
Integral Calculus. General notions and applications. Areas, lengths and volumes of revolution solids.
Improper Integral.

Recommended reading:

Análise Matemática I – Apontamentos de apoio à disciplina, Luís Cruz-Filipe & Patrícia Engrácia, ENIDH.
Introdução à Análise Matemática - J. Campos Ferreira, Ed. Calouste Gulbenkian.
Calculus, Vol. 1,2 – T. M. Apostol, Wiley International Edition.

Teaching methods:

The teaching methodology includes theoretical-practical lectures. It is also expected that the student prepare themselves by reading each topic in the recommended readings. In the lectures the students will be given brief exposition about the topics, followed by examples and exercises. The students are also given weekly exercises to solve at home.

Assessment methods:

The student can choose between two tests (ST1 and ST2) during the semester or a final exam (ES). The final score (FS) results from: FS= 0.5(ST1+ST2) or FS=ES.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Linear Algebra		
Field:	Mathematics		
Course code:	3042	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Luís Calhorda Cruz-Filipe		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Understanding and applying basic concepts of Linear Algebra necessary to other courses. Solving systems of linear equations by means of Gauss's Elimination Method, as well as problems leading to such systems. Mastering algebraic operations on matrices and calculus of determinants. Working with linear spaces and linear transformations and applying the lerned techniques to problem solving in Engineering. Solving optimization and aproximation problems by means of computing orthogonal projections.

Course contents:

1. Systems of linear equations:
Gauss's method, solving and classification of systems and their geometrical interpretation. Matrix calculus: algebraic operations and applications to the resolution of systems. Inversion, determinants and properties.

2. Linear spaces:
vector spaces as generalizations of IRn. Examples: matrix spaces and function spaces. Algebraic properties. Linear subspaces. Linear dependence and independence, linear space generated by a set of vectors, base, dimension, coordinates and choice of base.

3. Spaces related to a matrix:
Lines, columns, kernel. Relationship to the resolution of systems of linear equations. Euclidean spaces: inner product, norm, orthogonality, Gram—Schmidt method and applications.

4. Linear transformations:
Definition, properties, examples, algebraic operations and composition. Matrix representation. Properties of a transformation vs properties of its representations. Choice of base. Eigenvalues, eigenvectors and diagonalization.

Recommended reading:

Apontamentos de Álgebra Linear. Luís Cruz-Filipe & Patrícia Engrácia. Escola Superior Náutica Infante D. Henrique, September 2010.
Elementary Linear Algebra. H. Anton & C. Rorres, John Wiley, 2000.
Algebra Linear. Luis T. Magalhães. Texto Editora, 1996.

Teaching methods:

Classes include a brief theoretical exposition of each topic, practical examples of applicability and exercises. Students are given weekly exercise lists for home practice.

Assessment methods:

1. Continuous assessment, including:
(a) 12 assessment assignments, to be delivered weekly, allotted 10 minutes each, graded on a scale of 0 to 20, of which the arithmetic average of the 10 best is computed (ST). Each undelivered assignment is graded as 0 (zero).

(b) Final global test, allotted two hours, consisting of three question groups of which the student must choose two to answer, graded on a scale of 0 to 20 (FT).

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(c) The student will pass the course whenever FT>=8.0 and 0.3*ST+0.7*FT >= 9.5 simultaneously, the final grade being then computed as (0.3*ST+0.7*FT) and rounded to the nearest integer. (d) Students that deliver three assignments are considered to have chosen the continuous assessment method, and will not be allowed to change their choice before the semester's end. 2. Final exam, allotted three hours, containing three question groups and graded on a scale of 0 to 20 (E). The student will pass the course whenever E >= 9.5, the final grade being then computed as E rounded to the nearest integer.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	General Physics		
Field:	Applied Mechanics		
Course code:	3043	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	6	**Hours/week:**	60 h / TP
Name of lecturer:	Luis Carlos Freire / Mário Simão de Assunção		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The primary objective of the course is to provide the student with a clear and logical presentation of the basic concepts and principles of physics. Understand the concepts and principles through a broad range of real world applications. The student is motivated by practical examples that demonstrate the role of physics in other engineering subjects.

Course contents:

1. Physics and Measurements

What is physics science? Practical interests to study the physics phenomena Historical perspective. The several fields study in physics. Dimensions and measurements

Length, mass and time. Units prefix. Dimensions as algebric quantities – equations analysis. Units conversions. Scientific notation.

Vector calculus introduction: Coordinate systems. Scalar ad vector quantities. Vectors properties. Components of a vector and unit vectors.

Motion in one dimension: Position, displacement, velocity and speed. Instantaneous velocity and speed. Acceleration.

Motion in two dimensions: Position, displacement, velocity and acceleration vectors. Two-Dimensional Motion with constant Acceleration. Projectile Motion. Uniform Circular Motion. Tangential and Radial Acceleration.

2. Applied Mechanics

The Laws of Motion. The Concept of Force. Newton's Laws. Newton's Law of Gravitation.

Energy and Energy Transfer. Work Done by a Constant Force and the scalar Product of vectors. Kinetic Energy and the Work–Kinetic Energy Theorem. Conservation of Energy. Power. Efficiency.

Friction's Laws.

Potential Energy. Potential Energy of a System. The Isolated System–Conservation of Mechanical Energy. Conservative and Nonconservative Forces. Relationship Between Conservative Forces and Potential Energy.

Momentum, Linear Momentum and Collisions. Linear Momentum and Its Conservation. Collisions in One Dimension. Two-Dimensional Collisions. Angular Position, Velocity, and Acceleration. Rotational Motion with Constant Angular Acceleration. Angular and Linear Quantities

Angular Momentum. The Vector Product and Torque. Conservation of Angular Momentum.

Static Equilibrium. The Conditions for Equilibrium. Examples of Rigid Objects in Static Equilibrium.

3. Thermodynamics.

Temperature and the Zeroth Law of Thermodynamics. Thermal Equilibrium.

Thermal Expansion of Solids and Liquids.

Heat and Internal Energy. Specific Heat and Latent Heat. Work and Heat in Thermodynamic Processes. The First Law of Thermodynamics. Energy Transfer Mechanisms: convection, Thermal Conduction and Radiation.

Ideal Gas. Boltzmann constant and the Boyle's, Charles's and Gay-Lussac's laws.

4. Electromagnetism.

Electric Fields. Properties of Electric Charges. Coulomb's Law. Motion of Charged Particles in a Uniform Electric Field. Electric Flux. Potential Difference and Electric Potential.

Capacitance and Dielectrics. Calculating Capacitance and Combinations of Capacitors.

Current and Resistance. Electric Current. Resistance.

Magnetic Fields. Magnetic Forces. Motion of a Charged Particle in a Uniform magnetic Field.

Sources of the Magnetic Field. The Biot–Savart Law. Ampére's Law. The Magnetic Field of a Solenoid. Magnetic Flux.

Faraday's Law of Induction. Lenz's Law.

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Electromagnetic Waves and properties. Absorption and reflection of EM waves.	
Recommended reading:	
Serway, R. and Jewett, Physics for Scientists and Engineers, Thomson, 6th ed. Course notes	
Teaching methods:	
Lectures and practical exercises are comprised to achieve the course objectives. Each subject will be introduced and be followed by exercises. Various mechanisms will be used to help us all achieve these goals and to evaluate our levels of success. There will be homework with group and individual components with written and/or oral presentations and a set of basic competency exams and final exam.	
Assessment methods:	
Resolution of problem sets individually and outs of classes (NTP); Conducting three tests during the semester or a final exam (NE); The final (NF) is the result of: NF = 0.2×NTP+0.8×NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Programming		
Field:	Applied Mechanics		
Course code:	3044	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Luís Manuel Fernandes Mendonça		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

With this subject, one pretends to develop student's skills of systematization and generalization, crucial to model/algorithms development, required to be adequate and representative of a real problem.
It is equally an objective of this discipline, to focus the student attention for the limitations, models can present, either by student option or by development platform systems characteristics.
The accomplishment of these objectives is carried out through the study of different situations proposals, whose analysis enable the development and its implementation in the most adequate software platform.

Course contents:

1. Introduction
Programming historical introduction; high-level and low level languages. The programming and troubleshooting. Phases of program development. Application examples.

2. Algorithms
Algorithms; basics instructions for algorithms, arithmetic and logical expressions, structures of sequence, repetition and selection, implementation of algorithms, flowcharts. Programming control structures. Application examples.

3. Programming in MATLAB environment.
The work environment, variables, routines and functions, simulation of dynamic systems, Development of a Matlab program applied to engineering problems.

Recommended reading:

David McMahon, Matlab demystified, a self-teaching guide, McGrawHill Inc.
Andrew Knight, Basics of Matlab and Beyond, Chapman & Hall/CRC
Programação em MatLab para Engenheiros. Stephen Chapman, Thomson Learning.
Matlab – Language of Technical Computing, The Mathworks, Inc
Introdução ao Matlab. Lecture notes, Luis Mendonça.
Documentação utilizada pelos docentes nas aulas

Teaching methods:

The classes have a theoretical and practical character. At the end of each new topic taught are made examples of application, which may involve its implementation in computer application in question. The examples are always integrating nature of knowledge with the aim to prepare the student for the implementation of the final work.

Assessment methods:

1. ONGOING EVALUATION a) The frequency of lectures is mandatory. Thus the student to have advantage in the continuous evaluation should attend a minimum of 80% of theoretical. b) The student must make a written test and cannot have a score below 9.5. c) To pass the practical component, students should perform practical work and submit its report. The minimum should be 9.5. d) The final grade will be assigned in accordance with the following weighting: Final Grade = 0.5X + Rating Test Work 0.5xNota f) If the student wishes to earn a grade higher than 16, should undergo an oral examination.

2. FINAL EXAM FOR EVALUATION a) The student who has not performed the test, or has failed in its

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evaluation, may apply for one of the dates of final exam for a second season. The student who has failed the 1st time you run the test resource. The minimum score to be approved on the final exam is 9.5. b) The final grade will be assigned in accordance with the following weighting: Final Grade Final Exam = 0.5X + Note Work 0.5xNota c) If the student wishes to earn a grade higher than 16, should undergo an oral examination.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Maritime Technology		
Field:	Technical Mangement		
Course code:	3045	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	4	**Hours/week:**	60 h / TP
Name of lecturer:	Luis Filipe Baptista		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide a regulatory, legislative and administrative overview of the maritime activity. Promote the understanding of ships as production units with high autonomy. Teach the concepts about the nautical qualities, dimensions, and capacity of vessels. Identify the constructive aspects of the various types of ships according to their purposes. Characterize the main types of propulsion and auxiliary plants by identifying its components and their functions. Identify steering systems and their operation. Characterize the different systems for loading and unloading cargo. Develop navigation and manoeuvring skills with lifeboats and rescue boats, including berthing and unberthing manoeuvres, man overboard and towing, according with IMO-STCW Convention.

Course contents:

A. MARITIME TECHNOLOGY

1. Regulation of Maritime Transport

Characterization of national and international entities involved in maritime transport and port activity. Regulation and supervision of such activities. Classification, registration, certification and inspection of merchant ships. Regulatory training, certification and duties of seafarers.

2. Merchant Ships

Classification of ships according to the operation mode. Classification of ships regarding the cargo conditioning form; characterization of the main types. Other types of ships which provide specific services. Classification of ships according to its range.

3. General Structure of Steel Ships

Nomenclature and characteristics of bow's structure. Nomenclature and characteristics of the structure in the intermediate area of the hull. Nomenclature and characteristics of the stern's structure. Nomenclature and characteristics of the superstructure and accommodations. Partitioning of vessels.

4. Nautical qualities, positioning, geometric planes, dimensions and capacities of Ships

Nautical qualities of ships, main and auxiliary geometric planes. Interception lines. Length, beam, height. Register dimensions. Immersed volume and centre of buoyancy. Basic ship stability principles. Draught, trim and freeboard marks. Displacement and tonnage of ships. Load capacity. Units of tonnage.

5. Propulsion plants of Merchant Ships

Classification, use, composition and comparison of the main propulsion types. Classification and principles of operation of thermal machinery used in marine propulsion. General description and operation of power plants with steam turbines, gas turbines and diesel engines.

6. Ships' propulsion, manoeuvring and steering equipment

Direct and indirect propulsion systems. Main components of a ship propulsion system. Fixed and controllable pitch propellers (CPP). Constitution and operation of CPP propellers. Steering systems with rudders and nozzles. Bow and stern auxiliary thrusters.

7. Equipment for Mooring, Anchoring, Loading and Unloading of Ships

Capstans, mooring winches, windlasses, chains and anchors. Cargo handling equipment, including solid and liquid cargoes. Ro-Ro ships loading and unloading.

8. Ship's Auxiliary Systems

Electric power supply and distribution systems.-Ventilation and air conditioning systems. Compressed

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air and low pressure steam systems. Refrigeration systems for passengers and crew provisions. Fresh water supply and distribution systems. Sewage systems and sewage treatment plants. Incinerators. Ballast system. Fire and general service systems.

B. NAVIGATION

9. The terrestrial sphere

Shape and dimensions of the Earth, land lines and points in the earth sphere. Meridians and Equator. Arc measurements. Cardinal points. Latitude and longitude. Mile concept.

10. Direction at Sea

Heading and course, drift, knot concept. Measurement of distances and speeds. Odometer.

11. General information about Navigational Charts

Mercator Chart. Classification of charts. Chart Scales. Rhumb line and its plotting in the Mercator chart. Position lines, leading (range), alignment, bearing, bathymetric.

12. Terrestrial Magnetism

Variation and deviation, causes and consequences. Steering compass, table of deviations.

13. Coastal Navigation

Aids to navigation, lighthouses and buoys. General information on radar and its use in navigation. General information on sounding lines and echo sounders.

14. Estimated Navigation

Chartering and esteem. Tidal currents and wind. Determination of an estimated position. Navigation in restricted waters.

15. Marine Sextant

Nomenclature and optical principles. Reading the sextant. Sextant correction. Index error and its determination. Use of the sextant in the determination of vertical and horizontal angles.

16. Manoeuvres

Anchoring, berthing and unberthing. Man overboard and towing manoeuvres.

17. International Regulations for Preventing Collisions at Sea (COLREG)

18. Nautical meteorology

Earth atmosphere. Weather elements. General circulation of the atmosphere. Air masses. Frontal surfaces. Fronts. Weather charts basic analysis. Weather forecast on board. The weatherfax and navtex.

19. First aid principles

Recommended reading:

Arte Naval Moderna – Rogério Castro Silva
Tecnologia Della Nave – Alberto Lomeo
Merchant Ship Construction – Pursey H. J.
Merchant Ship Types – Munro Smith
O Navio – Landstrom, Bjorn

Teaching methods:

Theoretical-practical lectures, with short expositions about each subject, followed by practical examples. Solving of problems where students apply the knowledge acquired and consolidate the concepts needed.

Assessment methods:

This course consists of modules of marine technology and marine navigation. Evaluation during the semester will be carried out by at least one written test for each module. For the final classification of the unit, each module contributes with 50%. The final rating is determined by the arithmetic mean of scores in each module (minimum classification of each module is 9.5 points). If the student obtains an evaluation less than 9.5 in any of the modules, then complete the final exam. The assessment by final exam of each module will focus all the topics taught in it. Approval is obtained with a grade equal or higher than 10 points.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	English		
Field:	Technical Management		
Course code:	3046	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	1st
ECTS:	4	**Hours/week:**	45 h / TP
Name of lecturer:	Melany Ruth Alves Martins		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The objective of this course is to prepare students for developing the full knowledge, understanding and proficiency in English required by the STCW Code. To give students wide-ranging opportunities to practise communicating in English both written and oral for both maritime and general purposes at elementary to lower intermediate language level.

Course contents:

While getting acquainted with a number of technical/maritime vocabulary areas (dealing with the subjects listed below), it is also the purpose of this first Course to review the most important Grammar structures of the English language, namely:

1. Nouns, verbs, adjectives, adverbs, pronouns, propositions and conjunctions.
2. Verb Tenses; negatives and questions.
3. Non-regular and modal verbs.
4. Reported speech.
5. Prepositions and phrasal verbs.
6. Comparative, superlative and idiomatic comparisons.
7. Passive Voice.
8. Reading comprehension.
9. Speaking – role playing professional and personal settings.
10. Listening – different types if English accents.
11. Writing – report writing, translation and interpretation.

The technical maritime vocabulary areas to be learnt are the following:

1. Different activities in the maritime sector.
2. The types of ships - types of cargoes, stevedoring, unloading and loading; operations, and terminology of the different parts of the ship.
3. Organisation and responsibilities on board a ship.
4. Maritime terminology and vocabulary.
5. Dimensions of the ship, GRT, NRT, GT, etc.
6. Navigation concepts.
7. Regulations and conventions on security and the safety of life at sea.

Recommended reading:

Improve Your Written English- Fifth Edition, Maion Field
Basic English Grammar – Third Edition, Betty Schrampfer Azar and Stacy A. Hagen
Fundamental of English Grammar – Third Edition, Betty Schrampfer Azar
Improve your written English – Fifth Edition, Marion Field
Elements of Shipping – Eighth Edition, Alan E. Branch
English for Maritime Studies – Second Edition, T N Blakey
Notes and exercises, Melany Martins 2010, Escola Superior Náutica Infante D. Henrique

Teaching methods:

The teaching methodology includes theoretical-practical lectures. In the lectures the students will be given detailed explanations about the topics which will then be applied in practical examples and exercises. It is also expected and important that the students prepare themselves by self-studying and doing required assignments

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Assessment methods:	
The assessment consists of the following: Two tests - one at mid-semester and one at the end of the semester. Minimum score: 8 with an average 10 or >. Students can opt for only taking the final exam at the end of the semester. Minimum score 10.	
Language of instruction:	English

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1st year of studies

2nd semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Mathematical Analysis II		
Field:	Mathematics		
Course code:	3047	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	6	**Hours/week:**	75 h / TP
Name of lecturer:	Patrícia C. M. Engrácia		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The primary objective of the course is to develop a working knowledge of Mathematical Analysis with special emphasis in differential and integral calculus in R^n. This knowledge will allow the student to establish the mathematical models that are needed to analyse the physical problems of engineering.

Course contents:

1. Differential Calculus in $\Re^n$.

Scalar fields: limits, continuity, partial derivation, directed derivative, gradient, implicit function derivative, composite function derivative, free extremes and conditional extremes.
Vector fields: limits, continuity and derivatives: The Jacobian matrix, the Jacobian, divergence, rotational, Laplacian and invertiblity.

2. Integral Calculus.

Double and triple integrals. Application to area and volume calculation. Change of coordinates, Polar, cylindrical and spherical coordinates.
Line integrals. Conservative fields and path independence. Green's Theorem. Surface integrals. Divergence and Stokes theorems.

3. Differential Equations.

Introduction and terminology. Separable, linear and exact equations.

Recommended reading:

Calculus – H.Anton, I. Bivens, S. Davis, John Wiley & sons, 2002.

Teaching methods:

The teaching methodology includes theoretical-practical lectures. It is also expected that the student prepare themselves by reading each topic in the recommended readings. In the lectures the students will be given brief exposition about the topics, followed by examples and exercises. The students are also given weekly exercises to solve at home.

Assessment methods:

The student can choose between two tests (TS) during the semester or a final exam (ES). The final score (FS) results from: FS= 0.5(TS1+TS2) or FS=ES.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Applied Chemistry		
Field:	Thermal Installations		
Course code:	3048	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	6	**Hours/week:**	60 h / TP
Name of lecturer:	Luís António de Lemos Ramalho de Azevedo Coutinho		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Give students the fundamentals of chemistry with a view to understand the structure of matter and its atomic and molecular organization. Study the nature of the covalent chemical bond to ensure a multiple approach to these molecules (steriometry, electronic pairs isolated, polarities: binding and permanent chemical reactivity). To study the intermolecular forces as a complement tool for analysis of other properties (solubility, melting and boiling points).
In partial summary: It is expected that students are able to apply the knowledge and tools of analysis in terms of chemical and physical properties of any substance listed in the Dangerous Goods Code International Maritime Organization.
Meet the IUPAC nomenclature of hydrocarbons and organic compounds and physiological functions in order to identify whether the petroleum products, including polymers and fuel oils. In address the application of combustion reactions in the multiple perspective reports on molar and weight, and ratio fuel / air.
Introduce the concept of chemical equilibrium as the basis of acid-base equilibrium and oxidation-reduction in order to achieve practical levels as the electrochemical corrosion systems and corrosion protection (Cathodic protection current requirement, sacrificial anode and paint scheme painting). As Applied Chemistry understand and apply the knowledge of acid-base and oxidation-reduction to marine boilers. Skills in: Control and water treatment, water analysis and system treatment products. With laboratory practices intended to acquire their own perspectives: the interpretation of results in determining the levels of bad operation of the boiler and making decision on the type and extent of chemical treatment to be made.
It is further objective of the course to understand the fundamental concepts of Maritime Pollution to assure as important for students to know some of the instruments of regulation and procedure prescribed by MARPOL 73/78- Protocol to the International Convention for the Prevention of Pollution from Ships: Annex I (hydrocarbon from oil tankers), Annex II (noxious substances) and Appendices, Annex VI Technical Code NOx (air pollution from ships).

Course contents:

1. Electronic structure of atoms
Photoelectric effect. Photon. Wave-particle dualism. De Broglie hypothesis. Cell photo-electric. Electromagnetic spectrum. Electronic structure (quantum numbers, orbital). Periodic Table in the long form. Chemical and physical properties of elements. Electron configurations (of atoms and ions). Block elements.

2. Chemical Bond
Atomic properties. Ionization energy. Effective nuclear charge. Electron affinity. Electro-negativity. Oxidation numbers. Periodic trends. Covalent bond. Valence bond theory. Hetero-nuclear diatomic molecules. Hybridizations: sp3, sp2 and sp. Study of molecules: CH4, C2H4, C2H2, H2O, NH3. Molecular shape of molecules listed as Dangerous Goods (IMDG CODE). Bond polarity. Molecular polarity. Intermolecular forces. Cohesive force. Solubility.

3. Hydrocarbons and Organic Chemistry
General classification of hydrocarbons. IUPAC. General chemical-physical properties. Carbon chains. Isomerysm (formation, position and stereo-isomerism). Functional Groups. Organic functions. Raw materials. Petrochemicals. The product derived from the "crude oil". Fuels (including marine fuel oil). Polymers (polymerization and poly-condensation). Combustion reactions (excess of oxygen, stoichiometric, with disabilities and great deficiency of oxygen). Balance molar and weight. Ratio fuel / air. Applications to fuels (with emissions of NO x, SOx).

4. Chemical Equilibrium
The nature and characteristics of chemical equilibrium. Homogeneous and heterogeneous

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equilibrium. The equilibrium constants (KP, KC). Acid-base equilibrium. Protolysis and hydrolysis. Ionic product of water. Concepts of pH and pOH. pH scale. Oxidation-reduction equilibrium. Cells (galvanic, electrolytic). Standard electrode potential e0) Electrochemical series of metals. Electromotive force of a cell (e.m.f.). Thermodynamic equation of a cell. Span maximum work of a cell. Free energy (Gibbs). Free energy and the Nernst equation. Concentration differential cell. Water behaviour oxidation-reduction. Electrolysis. Laws of Faraday. Fuel cell. Lithium-ions battery.

5. Corrosion. Anti-corrosive systems (Cathodic Protection)

Forms of corrosion. Uniform and localized. Cavitation erosion. Centers of corrosion and corrosion rate. Factors influencing the corrosion. Inhibition of corrosion. Fundamentals of Cathodic Protection. Systems of cathodic protection: impressed-current, sacrificial anodes and paints. General basis of a draft cathodic protection. Calculation of the current strength of protection. Application for Hull. Galvanizing. Types of coating (plan painting). Applying the hull of a ship. Efficiency of an plan painting between dockage.

6. Treatment and analysis of water in marine installations

Composition of seawater. Water boiler feed and condensate. Purge (continuous and intermittent). Deposits (scale and sludge). Chemical reactions and products to avoid deposits. Boilers (low, medium and high pressure). Forms of corrosion. Chemical prevention of corrosion. Conditions of protection to create a boiler service. Protection of a boiler inactive. Protection against corrosion in pipelines of steam, condensate and feed. Control and water treatment. Group of chemical treatment. Alkalinity, pH and phosphate stock. Products of deaerification. Chemicals analysis. Interpretation of results. Defining levels of malfunction. Correction and adjust the quantities of the treatment. Laboratory testing of water from a boiler (with the aid kits). Contamination of steam (dragging, fermentation and foaming). Chemical and physical (purges) prevent. Treatment of cooling water marine engines (preventing corrosion). Analysis and treatment products.

7. Pollution

Concept of marine pollution according to the IMO (International Maritime Organization). Marine pollutants. Types of pollution: Chemicals (hydrocarbons, organic compounds, detergents, heavy metals, nutrients), Physical (heat, solid waste), Biological (bacteria, viruses). MARPOL73/78: Protocol of 1987 relating to the International Convention for the Prevention of Pollution from Ships. Annex I (oil pollution). Anti-pollution systems on ships (COW, SBT, through floor). Annex II (pollution of noxious liquid substances carried in bulk. List of substances and pollutants Categories: X, Y, Z). Standards prevention of air pollution for ships in accordance with Annex VI of MARPOL 73/78 , Technical Code NOx in order to meet the criteria and procedure for restraint to areas of SOx and NOx.

Recommended reading:

Chemistry, molecules, matter and change, Peter Atkins and Loretta Jones, 3rd ed. W.H. Freeman and Company
Chemistry, Raymond Chang, 8th ed., 2005, McGraw Hill
Physical Chemistry, PW Atkins, 6th ed. , Oxford University Press
Chemistry. R. Morrison, R. Boyd, 6th ed. C. Gulbenkian Foundation
Petroleum & derivatives, Caret Fields and Leontsinis, 2nd ed. JR technical editor
Corrosion, Vicente Garcia, 3rd ed. Guanabara
Analysis of water for marine installations (teacher's notes)

Teaching methods:

The teaching will be done through theoretical and practical classes and practical classes and laboratory. The theoretical and practical work with brief presentations on each topic and where students can confront their bibliography, followed by practical examples, where you want students consolidate the concepts, methods exposed. Proceed to the resolution of exercises where students apply the knowledge acquired. The practical classes and laboratory water treatment plant sea correspond to times where the student can check the correspondence of the processes and methods studied to prevent and chemical analysis with improvement of skills.

Assessment methods:

3 reports (photoelectric cell, chemistry element and chemical study of a molecule listed in the Dangerous Goods Code): (Nchi). Conducting one laboratory work (7 tests) in groups (in water treatment facilities maritime) (NTP)
Realization of 1 test at the end of the semester, evaluating from the Chapter: Hydrocarbons and Organic Chemistry to the Chapter: Pollution (NT)
The final (NF) in continuous assessment is the result of NF = = 0.25x Nchi) +0.15 x (NTP) + 0.60 (NT)
On examination, the requirement for submission of 3 reports and the results of analysis of water.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Electrical Circuits		
Field:	Control Systems		
Course code:	3049	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	6	**Hours/week:**	75 h / TP
Name of lecturer:	José Manuel Dores Costa		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

This course serves as basic preparation for sequent courses in the area of electrical engineering and electrical machinery, electronics and automation and control.

Course contents:

1. Characterization of the electromagnetic field.
Electrical linear circuits in DC current. Ohm's law, electrical resistance and their associations. Joule's laws. Electrical energy and power.

2. Mesh and node analysis.
Voltage and current sources. Electromotive force. Kirchhoff's laws. Superposition principle. Thevenin and Norton theorems. Maximum power transfer.

3. Sine wave ac circuits.
Characterization of sinusoidal voltages and currents: amplitude, rms, period and frequency. Phasors. Inductors and capacitors. Reactance, impedance and admittance concepts. Active, reactive and apparent powers. Power factor and its compensation. Adapted load.

4. RLC resonant circuits.
Oscillator. Quality factor. Introduction of filters and frequency responses.

5. Circuits with magnetic coupling.
Faraday's induction law. Self and mutual inductances. The ideal transformer.

6. Three-phase systems and circuits.
Phase-to-neutral and phase-to-phase voltages. Common neutral and neutral conductor. Line currents and phase currents. Three-phase active, reactive and apparent steady-state powers.

7. Transients in electrical circuits.
Transient solution and steady-state. Time constant and establishment time.

Recommended reading:

Electricidade Aplicada para Engenheiros, L. Bessonov, Lopes da Silva Ed., 2000.
Basic Engineering Circuit Analysis, J. D. Irwin, Wiley Ed., 2002
Apontamentos de Electrotecnia, J. Dores Costa, ENIDH
Fichas de laboratório dos docentes da disciplina.

Teaching methods:

Class will consist primarily of presenting fundamental physics, maths and engineering concepts through working problems, and discussing in-class demonstrations. Key points will be highlighted by the choice of examples, and these points will be discussed in the context of the example and electric circuit's theory. Practical lab experiences are performed to demonstrate engineering applications and results are discussed in the context of the work.

Assessment methods:

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Grading is based on individual written tests (2) and several lab work reports which are mandatory. The final average will be computed as follows: 60% will be from lecture tests, 40% from lab works. Each component must have a grade not inferior to 7 values. The final exam is comprehensive.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Technical Drawing		
Field:	Applied Mechanics		
Course code:	3050	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Manuel Afonso da Fonte		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The objective is to learn the theory and practice skill for mechanical drawing in order to define a product for designing and manufacturing, as well as the interpretation of mechanical drawings according to the standard normalization.

Course contents:

1. Introduction.
Objectives of Technical Drawing and drawing tools.

2. Normalization.
Standard normalization according to ISO and EN. Objectives of the normalization. The drawing at different design steps.

3. Orthogonal projections.
Orthogonal projections. Orthogonal projection systems. European and American method. Choose of views. Occult zones. Lines representation. Orthogonal projections and interpretation. Basic rules for the freehand sketch on drawing orthogonal projections.

4. Sections and cutting views.
Definitions and objectives. Basic rules for the cutting on drawing. Sections – definition and objectives. Conventional representation for cutting and arrangement views. Applied examples.

5. Perspectives.
Fast and rigorous perspective. Arrangement of projections. Rules for the trace. Applying examples. Oblique and axonometric perspectives. Exploded perspective.

6. Dimensioning.
Dimension concept and assigning of dimensions applied to the mechanical drawing. Dimensioning elements. Standard methods for marking dimensions on mechanical drawings. Point-to-point dimensioning and datum dimensioning. How to put the numerical dimensions on a mechanical drawing. Choose and arrangement dimensions. Dimensioning of fundamental parts.

7. Dimensional tolerance and surface state.
Dimensional tolerance in mechanical engineering. Adjustments. Standard normalization for tolerance and adjustments. Rules for dimensioning. Surface state conditions. Functional dimensioning. Definition drawing of a finished product. Interpretation for geometric tolerances. Tolerance verifying. Practical exercises.

8. Freehand sketch for mechanical parts.

9. Computer aided drawing – CAD.
Practical exercises in CAD applied to modern drawing in 2D and 3D. General design in CAD and product definition. Introduction to solid modelling, assembling and design.

Recommended reading:

Desenho Técnico, Ed. Fundação Calouste Gulbenkian
Author: Veiga da Cunha, 1998.
Desenho Técnico Moderno, Ed. LIDEL.
Authors: Arlindo Silva/João Dias/ Luís Sousa, 2004

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Teaching methods:
The course will be done through the theoretical and practical lessons supported by practical exercises on paper using mechanical part models and starting from a drawing in perspective to draw the main orthogonal projections in different arrangement. After the skill in freehand sketch the students will use the modern CAD tools for the mechanical drawing.
Assessment methods:
Continuous Assessment: The approval in the discipline will be in continuous assessment according to the achievement of two tests: a theoretical and practical test for tolerances and hand-drawn (T1), a test design of orthogonal projections (T2) in CAD and solid modelling. Mandatory CAD work home (W). Attendance and participation in classes (A). The approval in the discipline will be according to the formula: 0.2 T1+ 0.2 T2 + 0,3 W + 0.1 A ≥ 10 values. Examination: theoretical and practical test (T) in CAD design, and mandatory delivery of the required home work (W). Approval according to the formula: 0.6 T + 0,4 W ≥ 10 values.

Language of instruction:	Portuguese/English.

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Materials		
Field:	Applied Mechanics		
Course code:	3051	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Pedro Miguel Ferreira Duarte		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The goal of this subject is to provide the knowledge about engineering materials, namely the traditional and new materials, such as metal alloys, polymers, ceramics and composite materials. Engineering students need the knowledge about engineering materials in design, according to their mechanical, chemical and physical properties.

Course contents:

1. Introduction to the materials science.
Generalities. Materials, science and engineering materials. Material classes, competition and trend among them.

2. Material structure.
Atomic structure. Atomic number and atomic mass. Electronic atomic structure. Atomic, chemical and molecular bonds. Ionic, covalent, metallic bonds. Mixed and secondary bonds.

3. Crystal structures and geometry of crystals.
Crystal systems. Main crystal structures on metals. Crystal directions and planes. Miller indices. Comparison among crystal structures, CCF, CFC and HC. Planar, volume and linear density on unitary cellules. Polymorphism and allotropy. Carbon and iron allotropy. Rx difractometer.

4. Solidification, crystal defects and diffusion in solids.
Metal alloys and solid solutions. Crystal defects. Point and linear defects. Grain boundaries and grain size. Optical microscope. SEM and TEM microscopes. Kinetic processes in solids. Atomic diffusion in solids. Stationary and non stationary diffusion. Temperature effect on solid diffusion. Industry diffusion applications.

5. Mechanical properties of metal alloys.
Stress and strain in metal alloys. Introduction to the uniaxial stress-strain testing and nominal stress-strain. Hardening testing. Plastic deformation of mono and policrystals. Introduction to the fatigue and fracture of metals, creep and fracture under tension.

6. Phase diagrams.
Non equilibrium solidification of metal alloys. Binary systems. Invariant reactions. Phase diagrams with intermediate composites. Iron carbon equilibrium diagram.

7. Engineering alloys.
Iron and steel production. Introduction to the metal alloys casting, laminating, extruding and forging. Grain flow forged. Residual stresses. Mechanical and surface treatments for steels. Heat treatment of steel alloys. Quenching, tempering, annealing and normalizing. Austempering and marquenching. TTT diagrams. Isothermal continuum transformation diagrams. Hardening and nitrogen treatment. Carbon steels and cast irons – normalization. HSLA steels.
The influence of alloy elements in steel alloys. Low steel alloys and steel alloys. Stain steels. Cast iron and steel castings for general applications. Heat treatments for cast iron. Non ferrous material alloys, namely copper and aluminium. Magnesium, titanium and nickel alloys. Metal alloys selection for engineering applications.

8. Polymer materials.
Industrial polymering processes. Elastomers. Plastic and thermoplastic processing. Structural thermoplastic materials. Thermo hardening plastics. Adhesive materials. Mechanical properties of polymer materials.

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9. Composite materials.
Non metallic materials. Reinforced fibres for plastic materials. Mechanical properties. Reinforced plastic by fibres. Laminated composites and sandwich materials. Metallic matrix composites and ceramic matrix composites.

10. Ceramic materials.
Ceramic processing. Traditional ceramics and advanced ceramics. Mechanical properties of ceramic materials.

Recommended reading:

Principles of Materials Science and Engineering, W. F. Smith, McGraw-Hill.
ISQ, Ensaios Mecânicos.
Engineering Materials Vol. I-II, Martin S. Ray. Pergamon Press.
Materials Science and Engineering: An Introduction- 6th edition - W. D. Callister, LTC

Teaching methods:

The subject will be done according to the recommended reading using the data show and lessons will have the support of the materials laboratory and questionnaires will be given to the students for consolidating the progress.

Assessment methods:

Continuum and periodic: two tests per semester, questionnaires, study visits, seminars, and laboratory experiments.
Final examination: one test, mandatory questionnaires and participations on laboratory experiments.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Maritime Technical English		
Field:	Technical Management		
Course code:	3052	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	1st	**Semester:**	2nd
ECTS:	4	**Hours/week:**	30 h / TP
Name of lecturer:	Melany Ruth Alves Martins		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The objective of this course is to prepare students for developing the full knowledge, understanding and proficiency in English required by the STCW Code. To give students wide-ranging opportunities to practise communicating in English both written and oral for both maritime and general purposes at elementary to lower intermediate language level.

Course contents:

Along with the introduction of the technical vocabulary topics (listed below), that a prospective merchant marine engineer will have to deal with aboard a merchant marine vessel, the different translation techniques are also considered, with special emphasis on the following items:

1. The vocabulary areas

- Word order, equivalents, untranslatable, anglicisms and use of English words in Portuguese;
- Comparisons, passives and other idiomatic constructions;
- Connectors;
- False meanings;
- Different systems of weights and measures;
- 'Cause and effect' relationships and links;
- Describing machinery: How to make presentations;
- Meetings: discussing technical issues;
- Communication and professional relationships: Socializing;
- Business letter and report writing; and
- Telephoning: How to make an appointment and noting messages.

2. The vocabulary areas to be learnt are as follows:

- Propulsion plants: different types of marine engines, their advantages and disadvantages; two-stroke and four-stroke cycles; boilers; unmanned engine rooms; engine pressure indicators, etc.
- Auxiliary machinery: pumps, generators and refrigeration equipment; automatic systems; valves and other machinery components; welding.
- Bunker fuels and lubricants: fuel and lubricant grades; fuel and lubricant contamination; fuel tanks and purifiers.
- Ship Repair: different examples of averages and breakdowns and their respective repairs; maintenance and overhauling at sea and in shipyards; repair contracts; meetings and reports.

3.Radio transmission:

- Internal and emergency communications; procedures, vocabulary and equipment.

Recommended reading:

Introduction to Marine Engineering – Second Edition, D. A. Taylor
Handbook of Correspondence , Oxford University Press, A. Ashely
MarEng Software
Lecture Notes and exercises, Melany Martins 2010, Escola Superior Náutica Infante D. Henrique

Teaching methods:

The teaching methodology includes theoretical-practical lectures. In the lectures the students will be given detailed explanations about the topics which will then be applied in practical examples and exercises. It is also expected and important that the students prepare themselves by self-studying and

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doing required assignments.	
Assessment methods:	
The assessment consists of the following: Two tests - one at mid-semester and one at the end of the semester. Minimum score: 8 with an average 10 or >. Students can opt for only taking the final exam at the end of the semester. Minimum score 10.	
Language of instruction:	English

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2nd year of studies

1st semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Applied Mechanics		
Field:	Applied Mechanics		
Course code:	3053	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Pedro Miguel Ferreira Duarte		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The main objective is to develop in the engineering student the ability to analyse the mechanical concepts and Mechanics of Rigid Body tools which are used in the structures modelling.
It is also expected that students can learn the mechanical concept applications as a tool in engineering system analysis, which can develop their knowledge and skills in order to study multibody systems.
The aim is to introduce the students to the fundamental concepts of equilibrium and mechanical interactions among bodies, which forms the bases for understanding complex models used in structures analysis.

Course contents:

1. Statics of particles
Vectors. Resultant of forces. Equilibrium of a particle. Free-body diagrams. Forces in space.

2. Equilibrium of rigid bodies
Equivalent forces. Moment of a force about a point. Moment of a couple. Equivalent systems of forces. Free-body diagram. Reactions at supports and connections. Equilibrium in two and three dimensions.

3. Centroids and centers of gravity
Center of gravity of a two-dimensional body. Centroids of areas. First moments of areas. Distributed loads. Center of gravity of a three-dimensional body.

4. Analysis of structures
Statically determinate and indeterminate structures. Analysis of trusses, frames and machines. Introduction to the study of gear transmissions.

5. Friction
The laws of dry friction. Coefficients of friction. Study of wedges, square-threaded screws, journal bearings, thrust bearings and belts.

6. Dynamics
Kinematics of particles. Kinetics of particles Newton's Second Law. Kinematics of rigid bodies. Fundamental equations. Moments of inertia. Plane motion of rigid bodies: forces and accelerations; energy method. Kinetic energy. Conservation of mechanical energy. Lift equipments. Pulleys. Angular momentum. Conservation of angular momentum.

7. Introduction to the vibration analysis
Free vibration and forced vibration of a system without damping and with viscous damping. Definition of natural frequency, resonance and transmissibility.

Recommended reading:

Vector Mechanics for Engineers – Vol. I – Statics, Vol. II Dynamics F. P. Beer e E. R. Johnston Jr., McGraw-Hill.
Engineering Mechanics – Vol. I – Statics, Vol. II Dynamics, R. C. Hibbeler, Prentice-Hall.
Mechanical Vibrations: International 4th edition, S. S. Rao, Prentice-Hall.
Vibrações Mecânicas - Introdução, Textos de apoio, Victor Franco, ENIDH (in Portuguese).

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Teaching methods:	
Theoretical and theoretical-practical lectures. Presentations on each topic, followed by practical examples. Some of these lectures involve experimental work.	
Assessment methods:	
Two laboratory exercises, mandatory (NL). Two tests with a minimum classification (8) in each of them or a final exam (NE). Evaluation: NF = 0.15 × NL + 0.85 NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Thermodynamics		
Field:	Thermal Installations		
Course code:	3054	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Manuel Duarte Dias Mendes Nogueira		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

To provide to the student the knowledge in applied engineering thermodynamics that will be necessary in different courses of engineering science and of specially, according with IMO-STCW Convention.

Course contents:

1. Thermodynamics properties data and diagrams of fluids.
Thermodynamics properties data and diagrams of water. Diagrams of ideal and real gases.

2. First law of thermodynamic.
Corollaries. Close systems processes. First law of thermodynamics applied to open systems.

3. Second law of thermodynamic.
Planck and Clausius statements. Reversible and irreversible processes. Kelvin temperature scale and entropy characteristics. Corollaries. Carnot cycles and efficiency parameters. Energy concept. Applications.

4. Thermodynamic relations.
Pfaff's relations and exact differentials. Maxwell relations. Graphical and analytical determination of enthalpy and entropy. Isentropic efficiency concept. Applications to processes.

5. Vapour power cycles.
Rankine cycles. Efficiency, work and specific steam consumption. Preheat, superheat and reheat. Regenerative cycle. Back-pressure and extraction turbines. Nuclear power plant. Binary cycles. Ideal working fluid.

6. Gas power cycles.
Open and close cycles. Efficiency and specific power. Joule cycle. Simple gas turbine cycle and with heat exchanger. Compression and expansion by stages with intercooling and reheating. Otto, Diesel and mixed cycles. Mean effective pressure.

7. Refrigeration and heat pump cycles.
Reversed Carnot cycle. Coefficient of performance, efficiency and specific power. Practical refrigeration cycles: throttle valve, compression by stages, flash chamber, etc.. Water refrigerators. Absorption refrigerators. Gas cycles.

Recommended reading:

Course notes
Michael J. Moran, Howard N. Shapiro; Fundamentals of Engineering Thermodynamics; 2nd Edition, SI Version, 1993, John Wiley & Sons, Inc..
Rogers, G. F. C., Mayhew, Y. R.; Engineering Thermodynamics, Work and Heat Transfer; 4th Edition, 1992, Longman Inc., New York, U. S. A..
Faires, V. M., Simmang, C. M.; Thermodynamics; 6th Edition, 1978, Collier Macmillan, New York, U. S. A..
Cengel, Y. A., Boles, M. A.; Termodinâmica; 2001, McGraw-Hill

Teaching methods:

Lessons have a theoretical-practical character.

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Will be done a practical laboratory work in a refrigeration plant with two evaporation temperatures.	
Assessment methods:	
1 practical laboratory work (NTP); 2 tests during semester or 1 final examination (NE); Final classification (NF) is obtained by: NF = 0.2×NTP+0.8×NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Fluid Mechanics		
Field:	Thermal Installations		
Course code:	3055	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Mário F. Vital Melo		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Introduce the main basic concepts about Fluids ant the way they move (fluid flow) as well their characterization. The fundamental Fluid Mechanics equations will be presented (Continuity, Navier-Stokes and Kinetic Energy Equations) and the meaning and importance of their main terms explained. Applications of several simple flow as a way to show some interviewing factors (convective versus diffusive role). Comprehension of the pressure concept and the importance of hydrostatic laws. Study of compressible flow.

Course contents:

1. Introduction and Basic Concepts.
A brief historic survey on Fluid Mechanics. Fluid concept and properties. Mean velocity and flow concepts. Fluid flow classification. Dimensional analysis. Similarity theory. Application problems.

2. Fundamental Equations.
Introduction. Control Volume concept. Continuity, Navier-Stokes and Kinetic Energy Equations. Physical meaning of the equations. Differential and integral expressions of the main equations. Bernoulli Equation. Application problems.

3. Fluid Statics.
Introduction. Definition of pressure. Equilibrium of a fluid element. Hydrostatic pressure distribution. Compressible and incompressible fluids. Hydrostatic forces on submerged surfaces. Plane, curved and closed surfaces.

4. Incompressible Flow in Ducts.
Introduction. Type of flow regime. Laminar and turbulent flow. Reynolds number. Boundary layer concept. Viscosity effect. Head losses in ducts. Distributed and concentrated type losses. Flow in ducts. Applications.

5. Pipes and valves.
Design and materials for pipes. Valves. Description and characteristics of the main type of valves.

6. Compressible Flow.
Introduction. The normal shock wave. Adiabatic reversible flow. Converging diverging nozzle. Friction flow in constant section ducts. Adiabatic and isentropic flows.

Recommended reading:

Fluid Mechanics - White, Frank, McGraw-Hill.
Hidráulica Geral - Lencastre, A., Edição do autor.
Mecânica dos Fluidos, Oliveira & Lopes, ETEP, 2006.
Mecânica dos Fluidos - Streter, Victor L., McGraw-Hill.
Hidráulica - Quintela, A., Fundação Calouste Gulbenkian.
Mechanics of Fluids - Massey, B.S., Fundação Calouste Gulbenkian.
Guia do ensaio de Mecânica dos Fluidos, Pinto Correia, I.F., ENIDH.

Teaching methods:

The teaching methodology includes theoretical-practical and practical lectures. It is also expected that the student prepare themselves by reading each topic in the recommended readings. In theoretical-

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practical lectures the students will be given brief exposition about the topics which will then be applied in practical examples. In the practical lectures the students will apply the concepts in proposed exercises. There will be a hands-on activity in the Fluid Mechanic Laboratory, which typically will be graded beyond keeping a record of participation.	
Assessment methods:	
The student can choose between two tests (NT) and a written laboratory exercise (NTP) with discussion during the semester or a final exam (NE). The final score (NF) results from: NF= 0.45(NT1+NT2)+0.1NA or NF=NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Electrical Machines and Drives		
Field:	Control Systems		
Course code:	3056	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	José Manuel Dores Costa		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Give to the students the fundamentals of transformers, conventional electrical machines and their startup circuits, control and regulation. They are given the fundamentals of the distribution systems of electrical and electromechanical conversion of energy. Interpretation of normalized wiring diagrams.
Provide the basis preparation about sequent study areas of electrical installations and automation and control.

Course contents:

1. Review of polyphase systems.
Rotating magnetic fields. Electromechanical energy conversion. Power flow and efficiency.

2. Power transformers and measurement.
Electric models. Open circuit and short-circuit tests. Industrial applications in the distribution of electricity.

3. DC machine fundamentals.
DC machine working as a motor and as a generator. Start-up circuits, regulation and speed control methods. Electromechanical characteristics of DC machines.

4. Three-phase asynchronous machines.
Rotational speed and slip. Squirrel cage and wound rotor machines. Start up circuits for asynchronous machines. Speed and torque control methods and circuits. Asynchronous machine as a generator. Equivalent electrical circuits. Open circuit and blocked rotor tests. Power flow and efficiency. Electromagnetic and mechanical torque.

5. Synchronous machine.
Synchronous machine no load operation. Permanent magnet and brushless excited alternators. Open load and short-circuit tests. Synchronous reactance. Power, voltage and frequency control. Infinite grid tied alternator. Voltage and frequency regulation circuits.
Alternators running in parallel. Synchronization methods and generators switchboards.
Circuits and equipment for control and protection of electrical machines.

6. Conventional electromechanical and electronic drives. Standard schemes and contactors.

7. Step motors. Variable reluctance motors. Linear motors.

Recommended reading:

Fitzgerald, A.E.; Kingsley Jr., C.; Kusko, "Máquinas eléctricas - conversão electromecânica da energia processos, dispositivos e sistemas", McGraw-Hill.

Syed A. Nasar, "Electric Energy systems", Prentice Hall Editions.
Laboratory exercises of the course teachers.

Teaching methods:

The teaching will be done through lectures and laboratory. The lectures are for the fundamental concepts, the theoretical exposition of the material and the motivation of personal work. The laboratory is intended to carry out practical experiments where the student can verify compliance with the theory,

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and give practical experience of establishment and management of electrical equipment.	
Assessment methods:	
Performing laboratory work in groups and solving problem sets individually and outlaws classes (NTP); Conducting 2 tests during the semester or 1 final examination (NE); The final (NF) is the result of: NF=0.4xNTP+0.6xNE. Minimum grade of components: 7 values.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Numerical Methods		
Field:	Mathematics		
Course code:	3057	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Luís Calhorda Cruz-Filipe		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Recognizing, predicting and estimating errors affecting the numerical results of executing a generic algorithm, resulting from simplification of the method or limitations inherent to information processing. Understanding, choosing and applying numerical methods to compute approximate solutions to specific families of problems in Engineering, in contexts where analytical methods are not a viable option due to the complexity of the problem at hand or to computation limitations.

Course contents:

1. Error theory.
Operations, errors, kinds of error, error propagation, conditioning and stability.

2. Numerical resolution of non-linear equations in one variable.
Methods: bisection, false position, Newton–Raphson, secant and fixed-point. Aitken acceleration. Zeroes of polynomials. Reference to the resolution of systems of linear equations.

3. Approximation of functions.
Least Square method: algebraic justification and computational formulas. Polynomial interpolation: motivation and Weierstrass's Theorem. Formulation as a system of linear equations, Lagrange's formula, divided differences and Newton's formulas. Chebyshev polynomials. Hermite interpolation and splines. Truncation errors. Applications to numerical integration: Newton—Côtes formulas, rectangle, trapeze, Simpson and three-eights rules.

4. Numerical resolution of First-order Differential Equations.
One-step methods: Euler's method and Runge—Kutta methods.

Recommended reading:

Numerical Analysis, Richard L. Burden, J. Douglas Faires, Brooks Cole, 7th Edition
Numerical Methods for Engineers, S. Chapra, R. Canale, McGraw-Hill, 4th Edition
Métodos Numéricos, Heitor Pina, McGraw-Hill
Matlab – Language of Technical Computing, The Mathworks Inc

Teaching methods:

Classes include a brief theoretical exposition of each topic, practical examples of applicability and exercises.

Assessment methods:

Project to be executed in groups of three students including a final discussion (P) and a final test (T). The student will pass the course when T>=8.0 and (0.3*P+0.7*T)>=9.5, the final grade being computed as 0.3*P+0.7*T rounded to the nearest integer. The final grade is computed as indicated in every assessment opportunity.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Mechanical Technology		
Field:	Applied Mechanics		
Course code:	3058	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Victor Franco Correia; Manuel Afonso da Fonte		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Fundaments of the mechanical properties of materials and material testing. Materials processing. Metal cutting theory. Welding processes.

Course contents:

1. Material properties and mechanical testing of materials

Material properties: physical, chemical and mechanical.
Elasticity, plasticity, mechanical strength. Elastic and plastic deformation.
Tensile tests. Yield strength limit. Tensile Strength. Elongation to rupture and area reduction. Young modulus.
Hardness concept. Hardness tests.
Fracture of metals. Ductility and brittle materials. Temperature effect.
Impact tests: Charpy and Izod. Impact energy.
Metal fatigue. Fatigue testing.
Creep behavior and creep testing.

2. Metal machining

Cutting machines. Cutting tools. Computer numerical control (CNC) introduction.
Study of the cutting process based on the orthogonal and three-dimensional models.

3. Welding and thermal cutting processes

Thermal cutting: Oxy-fuel cutting; plasma cutting; Laser cutting. Advanced cutting processes: water jet cutting.
Welding technology; Welding symbology; Welding machines type; Electric arch physics; Welding processes: SMAW, TIG, MIG/MAG, FCAW, Electrogas welding, SAW, Plasma welding, Laser welding, Friction welding, FSW, Resistance welding.
Welding defects. Heat input from welding processes. Heat affected zone. Weldability of steels: Carbon equivalent parameters. Residual stresses in welding joints. Quality control of welding.

4. Other technologic processes of metals manufacturing

Sheet bending. Sheet forming. Shear rolling. Shear cutting.
Electro-erosion process.

Recommended reading:

- Ensaios Mecânicos, Publicações ISQ - Instituto de Soldadura e Qualidade, 1992.
- Apontamentos sobre corte por arranque de apara, ENIDH.
- Metal Machining – Theory and Applications, Childs, Maekawa, Obikawa, Yamane, 2000.
- Oliveira Santos J.F., Quintino L, "Processos de Soldadura", Publicações ISQ - Instituto de Soldadura e Qualidade, 1998.
- Principles of Welding – Processes, Physics, Chemistry and Metallurgy, R. Messler Jr., Wiley-VCH Verlag, 2004.
- SAF - Guia do Utilizador de Soldadura Manual. 1ª Ed, 1981.
- Principles of Metal Manufacturing Processes, J. Beddoes & M. Bibby, Elsevier, 2003.

Teaching methods:

Theoretical and practical classes.
Laboratory tests: Tensile test; Brinnel and Rockweel hardness test.

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Study visits to companies.	
Assessment methods:	
2 tests during the semester or a final exam (NE). 2 laboratory works mandatory (NL). Evaluation: NF = 0.15 × NL +0.85 NE.	
Language of instruction:	Portuguese / English

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2nd year of studies

2nd semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Mechanics of Materials		
Field:	Applied Mechanics		
Course code:	3059	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	6	**Hours/week:**	75 h / TP
Name of lecturer:	Victor Franco Correia		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

To develop a working knowledge of the relations between the loads applied to a deformable body and the resulting deformations of the body. To understand and know how to apply the fundamental aspects of the elasticity theory. To develop a clear insight into the relations between stress and strain for a wide variety of boundary conditions and materials. To develop adequate procedures for finding the required dimensions of components of a specified material subject to specifications of stress or deflections. To demonstrate a basic working knowledge of the fundamental concepts and problem-solving techniques associated with stress, strain, simple constitutive theory and with applications involving axial, torsion and bending loading, including introductory-level statically indeterminate systems.

Course contents:

1. Basic concepts of the Elasticity Theory
Equilibrium of a deformable body. Analysis of internal forces. Normal Stresses. Shear stresses. Stress tensor. Strains. Stress-strain relationships. Hooke's law.

2. Axial loading and pure shear
Stresses and strains in axially loaded members. Statically indeterminate problems. Stress concentrations. Thermal effects.
Pure shear in pins and rivets.

3. Torsion
Stresses and distortion in a circular shaft subject to torsion. The elastic torsion formula. Statically indeterminate problems. Design of transmission shafts. Introduction to the torsion of non-circular sections.

4. Bending
Stresses and deformations in a symmetric beam. Shear and bending moment in beams. Eccentric axial loading in a plane of symmetry. General case of eccentric axial loading. Relations among load, shear and bending moment. Shear and bending moment diagrams and equations. The differential equation of the elastic curve. The application of the superposition method. Shear stresses in beams. Unsymmetrical bending.

5. Combined loads
Stresses in cylindrical and spherical pressure vessels. Plane stress and plane strain states.
Stresses due to the combined bending, torsion and axial loads.
Generalized Hooke's law for isotropic materials.
Stress transformations. Principal stresses and maximum shear stress.
Mohr's circle for plane stress and plane strains situations.

6. Introduction to Buckling of columns
Euler's formula for pin-ended columns. Critical loads and critical stresses. Effects of other end conditions. Eccentric load.

Recommended reading:

Mechanics of Materials, F. P. Beer and E. R. Jonhston, McGraw-Hill.
Mechanics of Materials, R.C.Hibbeler, Prentice-Hall.
Engineering Mechanics of Solids, Egor Popov, Prentice-Hall.

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Teaching methods:	
Theoretical and theoretical-practical lectures. Presentations on each topic, followed by practical examples. Some of these lectures involve experimental work.	
Assessment methods:	
2 tests during the semester or a final exam (NE). 3 laboratory works mandatory (NL). Evaluation: NF = 0.2 × NL +0.8 NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Heat Transfer		
Field:	Thermal Installations		
Course code:	3060	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Manuel Duarte Dias Mendes Nogueira		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Write the fundamental equations, boundary conditions and simplifying assumptions, needed to solve typical conduction, convective and irradiative heat transfer problems. Approximate or rigorous solution methods to solve typical heat transfer engineering problems.

Course contents:

1. Heat transfer by conduction. Basic concepts.
Fundamental equations. Fourier's law. Thermal conductivity. Thermal properties of materials. Heat conduction equation. Boundary conditions. Nondimensional parameters.

2. Steay conduction. One-dimensional model.
One-dimensional heat conduction without heat generation and with heat generation. Equivalent thermal circuit. Critical insulation radius. One-dimensional heat transfer from finned surfaces.

3. Transient heat conduction.
Solid with negligible internal temperature gradients. Spatial effects. Exact solution and approximate solution.

4. Heat transfer by convection.
Natural and forced convection without boiling and condensing. Internal and external forced convection. Nondimensionalized correlations. Application to heat exchangers.

5. Heat transfer by radiation. Basic concepts.
Fundamentals of thermal radiation. Radiation intensity and irradiative properties. Radiation laws.

6. Radiation in non-absorbing medium.
The view factor. Radiosity equations. Radiation exchange between difuse, gray surface in an enclosure. Equivalent thermal circuit.

Recommended reading:

Çengel, Y. A.; Heat Transfer – A Practical Approach; 2sd Edition, SI Version, 2003, McGraw-Hill
F.P. Incropera, D.P. de Witt, T.L Bergman e A.S. Lavine, Introduction to Heat Transfer, 2006, John Wiley & Sons
Ozisik M. N., Heat Transfer – A Basic Approach, 1985, McGraw-Hill

Teaching methods:

Theoretical lectures and practical activities.

Assessment methods:

The assessment can be made by one of two ways:
a) - two written tests;
   - two lab reports;
b) - final exam;
   - two lab reports.

The minimum classification in the tests or exam is 7 in 20.

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Exemption from final examination is obtained with minimum weighted average of 10 in the tests and laboratory report. The weights assigned to each component of the evaluation are: - Average written test / final exam - 70%; - Lab reports - 15% each.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Workshop Practice		
Field:	Applied Mechanics		
Course code:	3061	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	4	**Hours/week:**	60 h / PL
Name of lecturer:	Manuel Afonso da Fonte		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Providing to the students the knowledge and practical training to enable them the repairing and the manufacture of mechanical components of marine engineering facilities as well as acquire practical skills in the standards of hygiene and safety in metalworking, machine tools and welding.

Course contents:

1. Metrology

Measurement and comparison. Measuring instruments and verification. Metric scales, calipers and micrometers. Tolerances and adjustments. Meter gauges. Techniques of use.

2. Workbench

Hand tools - Description and classification. Cutting tools. Drill bits and cylindrical boring. Works involving the opening of male and female threads.

Execution of flat pieces of mild steel, according to the proposed design, which involves different techniques, such as cutting with a mechanical saw and manual; checking perpendicularity, parallelism, adjustment, measurement and verification; tapping metric and english threads, with male and female threads; finish gridding with different tools; sharpening of cutting tools.

3. Machine tools

Nomenclature and machine tool operations. Mechanical saws, boring machine, lathe and milling machine. Machining parameters. Demonstrations of the use of machine tools. Sharpening drills. Health and safety Rules.

4. Lathe Works

Execution of cylindrical pieces of mild steel, according to the proposed design, which involves different techniques such as face milling and drilling, cylindrical and conical turning; execution of metric and english threads; practical demonstration of rectangular and trapezoidal threads.

5. Milling works

Demonstrations on the use of the splitter plate. Operation techniques; demonstration of execution of keyways; general milling of steel pieces.

6. Arc welding

General welding equipments, use and operation. Welding power sources. Characteristic curves of welding machines. Type of equipments and its nameplates. Welding equipment rates. Choosing of welding equipments. Shielded metal arc welding: electrodes and fluxes; standard codification. Gas protection in welding. Choosing welding parameters and its control. Welding heat input. Dilution rate. Direct and inverse polarity in welding. Welding magnetic effects. Gas-shielded metal arc welding - MIG/MAG. TIG welds. Welding of aluminium alloys and other no ferrous materials. Plasma cutting and technical operations. Types of grooves and weld joints. Factors to consider when selecting electrodes. Electrodes, wires and fluxes. Welding normalisation. Joint preparation. Weld defects. Root defects. Welding positions and welder qualifications. Welding metals. Causes and cures of common welding troubles. Welding symbols. Safety precautions. Quality control in welding. Welding design normalization. Health and safety equipment for welding. Smoke exhausted system.

7. Welding and brazing oxy-acetylene

Acetylene equipment, kit of acetylene oxy-welding. Protective equipment. Power of the torches and their regulation. Gases and their properties. Gas flame regulation. Temperature and heat output of the acetylene flame. Properties of the flame oxy-acetylene. Handling of gas bottles and its maintenance. razing and braze welding. Properties and function of *brazing flux*. Health and safety rules.

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8. Welding and brazing. Practical exercises

Individual works that address the theoretical issues about welding joints and brazing. Weld seams to the horizontal position. Weld seams up and down. Weld joints inner and outer corner plates. Plasma cutting. Welding TIG and MIG / MAG processes. Oxygen-cutting. Oxyacetylene welding.
Melting lines in plates of 1 mm made of steel. Weld seams carried on steel sheet, of 1 mm. Brazing with steel wires. Use of brazing flux. Brazing of copper tubing.

Recommended reading:

Metal Machining – Theory and Applications; Childs, Maekawa, Obikawa, Yamane, 2000.
Tecnologia Mecânica, J.M. Freire, Vol. 1-6, Biblioteca da Escola Náutica
Tecnologia do Corte, J.M. Freire, Biblioteca da Escola Náutica
Abertura de Roscas ao Torno, segundo Estevez. Biblioteca da Escola Náutica
Processos de Soldadura – Instituto de Soldadura e Qualidade, José O. Santos e Luísa Quintino, 1999.
Processos de Soldadura I e II, edição do ISQ, Biblioteca da Escola Náutica.
Metalurgia da Soldadura, edição do ISQ.

Teaching methods:

The teaching will be done through practical lessons where the student intends to seize the practical techniques for each manufacturing operation and maintenance of mechanical components of ships. Complementary activities in the discipline:
Seminars. Study visits to the ISQ, Welding and Quality Institute, in particular the Laboratory of Welding, Mechanical Testing, and Metallurgical Quality Control.
Demonstrations of surgical techniques in welding and brazing, riveting for discharge of capacitors, mechanical connections for POP rivets, filling shafts of metallic particles by splashing cold, protection of metal surfaces by polymers, carried out by firms invited, with the use of materials and equipment they sell.

Assessment methods:

Continuous assessment:
Carrying out work bench and tool machines, according to the technical design proposed; performing welding and brazing (W). Report of the work (R).
Carrying out a questionnaire (Q) on welding and brazing. Mandatory attendance at classes 90%, mandatory attendance at study visits, demonstrations and seminars (S).
The final evaluation (NF) is the result of: NF = 0.5 W Q +0.1 +0.2 +0.2 R S ≥ 10 values.
Final Examination:
The examination will include a practical (W) (2 hours), one theoretical test (T) (30 min) about the welding engineering subject. Mandatory continuous assessment, particularly in study visits, practical demonstrations and seminars. The final evaluation (NF) is the result of: NF = 0.7 W + 0.3 T ≥ 10 values.

Language of instruction:	Portuguese / English.

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Electronics		
Field:	Control Systems		
Course code:	3062	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	6	**Hours/week:**	75 h / TP+PL
Name of lecturer:	Victor Semedo Gonçalves		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The aim of this course is to provide students with basic knowledge about the operation of semiconductor devices: diodes, transistors, operational amplifiers and thyristors. To analyse and design circuits based on these devices: rectifiers, stabilizers (including the 78xx and 79xx voltage regulators series), amplifier circuits, basic instrumentation circuits and power control circuits. Besides the theoretical data, the course is supported by a laboratory component and is aimed at asserting the compliance with the requirements of the industry in general and marine propulsion plants in particular, according with IMO-STCW Convention.

Course contents:

1. Diodes. Diode circuits
Introduction. The p-n junction. The diode I-V characteristic. Analysis of diode circuits. The Zener diode. Limiter circuits. Rectifier circuits. Capacitive filters. Voltage regulators. Monolithic integrated voltage regulators.

2. The bipolar junction transistor (BJT)
Introduction. NPN and PNP transistors. Operation areas. DC analysis of BJT circuits. Basic configurations: common emitter, common collector and common base circuits. Input and output characteristics. Transistor logic circuits.

3. The BJT at low frequencies
The hybrid model. The h parameters. Transistor circuit analysis. *The differential pair.*

4. The operational amplifier. Operational amplifier Circuits
The ideal operational amplifier. Operational amplifier characteristics. Voltage follower. The inverting amplifier. The non-inverting amplifier. The summing amplifier. The integrator. The differentiator. The difference amplifier. The instrumentation amplifier. The programmable gain amplifier. Analog comparators.

5. Multivibrator circuits
Concept of multivibrator. The *Timer* 555. Astable operation. Monostable operation. 555 applications.

6. Introduction to power electronics
Thyristors. SCRs, Diacs and Triacs. Typical characteristics. Operation modes. *DC power control circuits*: DC motor control (*linear and pulse width modulation* - PWM - modes). *AC power control circuits.* AC motor control. Power supplies.

Recommended reading:

A. Sedra, *Microelectronic Circuits*, 5th Ed, Oxford University Press, 2004
M. Silva, *Circuits com Transístores Bipolares e MOS,* F. Calouste Glubenkian, Lisboa, 1999
Muhammad H. Rashid., *Electrónica de potência, circuitos dispositivos e aplicações*, Makron Books.
L. Mendonça, Lab guides
V. Gonçalves, *Electrónica*, PowerPoint presentations

Teaching methods:

Theoretical lectures and lab practice.

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Assessment methods:	
Two tests and continuous assessment based on laboratory classes (carrying out of work and reporting). Note least eight values in both tests and laboratory component. Weight of the theoretical component (arithmetic test) in the final standings: 70%. Weight laboratory component: 30%. The theoretical component can be assessed by exam, instead of tests, and also in this case required the approval of the laboratory component. When the adoption is in the final exam, we have: Weight of the theoretical component (final examination) in the final standings: 70% Weight of the laboratory component: 30%.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Probabilities and Statistics		
Field:	Mathematics		
Course code:	3063	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Luís Calhorda Cruz-Filipe		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Knowing and applying the basic techniques of Statistics, Statistical Inference and Correlation Theory. Understanding the theoretical grounding of these areas on Probability Theory. Getting acquainted with and applying some of the main probabilistic models and estimating and testing the parameters needed to their application. Applying these concepts and methodologies to problem solving in Engineering.

Course contents:

1. Statistics
Data representation in charts and tables, statistical measures for central tendency, disperson, assymetry and moments. Counting techniques.

2. Probability Theory. Basic concepts
Random experiment, outcome space and event. Axioms. Independence, conditional probability and Bayes' Theorem. Random variables: definition, discreet, continuous and mixed random variable. Distribution function and probability density function. Some theoretical distributions: discreet uniform, Bernoulli, binomial, geometric, hypergeometric, Poisson, continuous discreet, Gaussian, exponential and chi-square. Central Limit Theorem and applications.

3. Statistical Inference.
Goals, population, sample and random sample. Sampling distributions. Parameter estimation: maximum likelihood method. Confidence intervals and hypothesis testing: methodology and examples (intervals/tests for expected value, difference between expected values, variance).

4. Correlation and regression
General notions of Multivariate Statistics. Correlation measures. Linear regression and method of least squares.

Recommended reading:

Textos de apoio às aulas teórico-práticas, Maria Elisa Cunha
Introduction to probability and statistics, W. Mendenhall, R. Beaver & B. Beaver. Duxbury Press, 1999
Estatística, R. C. Guimarães & J. S. Cabral. McGrawill, 1997.
Exercícios de Estatística Vol I e II, J. Fonseca & D. Torres. Edições Sílabo, 2000.

Teaching methods:

Classes include a brief theoretical exposition of each topic, practical examples of applicability and exercises. Students are given weekly exercise lists for home practice.

Assessment methods:

Three tests (T1, T2 and T3) throughout the semester graded on a scale from 0 to 20. The student will pass the course when two of (T1 >= 8.0, T2>=8.0 and T3>=8.0) are met, and also (0.2*T1+0.4*T2+0.4*T3>=9.5). The final graded is computed as (0.2*T1+0.4*T2+0.4*T3) rounded to the nearest integer.
A student who does not pass the course may repeat the second test on the day of the regular exam.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Psycho Sociology		
Field:	Technical Management		
Course code:	3064	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	2nd	**Semester:**	2nd
ECTS:	4	**Hours/week:**	30 h / TP
Name of lecturer:	Fernando José da Cruz Gonçalves		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Assuming that the curricular unit of Psycho Sociology (Social Behavior) is provided under a degree in Marine Engineering course, we tried to adapt the basic knowledge that are the objects of scientific sociology and psychology to the analysis of organizational behavior, viewed from the standpoint of shipping assuming the need to meet the requirements of the IMO-STCW Convention.
Throughout the course students will develop skills in academic, technical and human, particularly focusing on the aspects of capacity for reflection, leadership and responsiveness in emergency situations.
At the end of the syllabus of the course students should be able to:
Identify the reasons for the behavior of an individual in an emergency;
Identify in advance the consequences of actions, policies or strategies that are intended to carry out;
Identify what the most effective measures to achieve the desired behavior, always in a perspective of integrated management of the group (vessel as a closed system).

Course contents:

1. Introduction to STCW
- Concept of Organization;
- The Vessel as a particular case of an organization (closed system);

2. Organizational Behavior:
- Objectives of the Study of Organizational Behavior;
- Levels of Analysis of Organizational Behavior.

3. Training, Motivation and Recruitment of Seamen within the UE

4. Human Factor in Organizations
- Motivational Models;
- Application of Motivational Theories on Maritime Sector.

5. Crowd Control:
- Leadership (Personality traits and individual skills / management system of authority and command / Selection of "leaders");
- Communication (Barriers to satisfactory communication between crew / instructions to passengers / Guidance and assistance to passengers / Communication processes and information on board ships);
- Decision Making;
- Stress Management (Stress Management in Emergency situations / Conflict Management / Factors influencing the behavior of man in the sea / knowledge and procedures to be performed by crew in dangerous situations or emergency);

6. **Familiarization RO-RO** ships (Features / Special features RO-RO vessels / Cargo Handling / Opening, closing and locking openings in the hull).

7. **Passenger Safety** (Emergency Planning, procedures, and exercises / Emergency Response / Emergency Scenarios).

Recommended reading:

The notes and handouts will be provided by the teacher. It is also advisable for the deepening of some syllabuses consulting the following books:
- Chambel, Maria Jose / Corral, Luis; Social Psychology of Organizations; Text Editor 3. Edition, July

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2000;
- Ferreira, JM Carvalho / Abreu, José Neves Nunes / Caetano, Antonio; Social Psychology of Organizations, McGraw-Hill, 1996;
- Ferreira, JM Carvalho / Peixoto, John / Carvalho, Anabela Soriano / Raposo, Rita / Grace, John Carlos / Marques, Rafael; Sociology, McGraw-Hill, 1995;

Teaching methods:

The teaching methodology aims to active and dynamic, focusing on the contact teacher / student. In addition to the presentation of the syllabus, students will be encouraged to submit work groups (2-3 students) on Case Studies provided by Professor about real situations in maritime activity.

Assessment methods:

1 - An Assessment Test (95% - Final Note);
2 - Optional Work Individual or in group (preferably a group) on a topic related to the course syllabus. This work will be evaluated according to their content, capacity for reflection, degree of innovation, adaptation to the formalism and academic ability as evidenced by students in the presentation and discussion of the issue before their colleagues.
3 - Participation, which involves class participation, capacity for reflection, attendance and attitudes of students in class (5% - Final Note).
4 - All students who obtain a weighted average of the criteria set under the continuous assessment of less than 9.5 shall be subject to final examination of the discipline. The final exam of the course will consist of a written test (two hours, without consultation), that will be addressed in the main program content of the discipline.

Language of instruction:	Portuguese / English

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3rd year of studies

1st semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Auxiliary Machinery I		
Field:	Thermal Installations		
Course code:	3065	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	6	**Hours/week:**	60 h / TP+PL
Name of lecturer:	Alfredo Manuel Nobre Marques		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide students with the application of previously acquired knowledge, particularly of Thermodynamics and Fluid Mechanics, to the operation of volumetric and dynamic machinery (pumps, compressors, etc..), as recommended by the Convention IMO-STCW/95 (Tables A-III / 1 and A-III / 2) at function level of:
- Marine Engineering at operational level;
- Maintenance and repair at operational level;
- Marine Engineering at command level;
- Maintenance and repair at command level.

Course contents:

I. Ducts.
1. Generalities. Metallic and non metallic ducts. Selection of materials. Installation of dutc. Fluid flow in ducts. Association of ducts.

2. Valves. Generalities. Classification. Flow control valves. Pressure control valves. Automatic valves. Remote-controlled valves. Regulating valves. Materials used in the construction of valves.

II. Turbo machines
1. Introduction to turbo machinery. Classification. Thermodynamic relations. General equations.

2. Dimensional analysis. Theorem of Buckingham. Incompressible flow. Compressible flow.

3. Pumps, compressors and radial fans. Rotor. Diffuser. Analysis of flow in the rotor. Analysis of flow in the diffuser. Hydraulic performance. Volumetric efficiency, mechanical and global. Form of characteristic curves. Centrifugal pumps.

4. Axial turbo machines. Introduction of axial turbo machinery. Axial turbines. Compressors, axial fans and pumps.

5. Regulation of turbo machines. Regulation of gas turbines. Regulation of steam turbines. Regulation of radial and axial compressors.

III Volumetric machines
1. Positive displacement pumps. Constant flow positive displacement pumps. Variable-displacement pumps.

2. Displacement compressors. Reciprocating compressors. Rotary compressors.

Recommended reading:

Marques, A., Turbomáquinas, ENIDH, 2011
Marques, A., Condutas válvulas e acessórios, ENIDH, 2011
Hewitt, G. F., Shires, G. F., Bott, G. L., Process Heat Transfer, CRC Press, 1994
Tubular Exchanger Manufacturers Association-TEMA, 1988Kategurov, M., Marine Auxiliar Machinery and Systems, Peace Publishers, 1980
Dixon, S. l., Fluid Mechanics, Thermodynamics of Turbomachinery, Pergamon Press, 1978
Cherkassky, V. M., Pumps, Fans and Compressors, Mir Publishers, 1980

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Teaching methods:	
The teaching will be done through practical classes, and laboratory practices. By reading the literature, the student is introduced to each topic to be discussed. The theoretical and practical work is done with brief presentations on each topic, followed by practical examples, where students consolidate the concepts studied. Practical classes include the resolution of exercises where students apply the knowledge acquired. Some of these classes involve carrying out laboratory work, where students can check the consistency of the models studied with real problems.	
Assessment methods:	
Two laboratory work in group (NTP); Two tests during the semester or a final exam (NE); Final grade (NF) is the result of: NF = 0.3 +0.7 × NTP NE.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Internal Combustion Engines		
Field:	Thermal Installations		
Course code:	3066	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP+PL
Name of lecturer:	Jorge Manuel Fernandes Trindade		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide the material necessary for students to acquire the typical language of study and work of internal combustion engines in general, and marine diesel engines in particular, as well as the knowledge needed in order to analyze the thermodynamic and mechanical behavior during operation. Provide the students with the tools necessary to be able to detect and correct the causes of the anomalies resulting from changes in operating conditions of marine diesel engines so as to minimize the consequences and optimize its operation. Also intends to provide an easy integration of students after completion of the course at the Engine Department of merchant ships, as requested by the IMO-STCW Convention.

Course contents:

1.Classes

1. **Introduction.** History of the internal combustion engines. Engine operating principles and classifications. Main components. Definitions.

2. **Internal combustion engines cycles.** Ideal models. Efficiency. Fuel-air cycles, compared with ideal models. Properties of the working fluid. Inlet. Compression. Combustion. Expansion. Exhaust.

3. **Power, efficiency and operating characteristics**. Indicator diagrams. Indicated and brake power. Mechanical losses. Mechanical efficiency. Specific fuel consumption. Relationships between performance parameters. Engine design and performance diagrams.

4. **Scavenging and supercharging**. Types of scavenging on two-stroke engines. Scavenging parameters. Actual cylinder and manifold pressure evolution during scavenging process. Supercharging. Advantages. Mechanical supercharging and turbocharging. Consequences on power and efficiency.
   Partial load supercharging.

5. **Fuel injection and combustion.** Fuel-air mixing. Fuel injection systems. Main components. Injection pumps. High-pressure pipes. Injectors. Unit fuel injector-pump. Common-rail systems. Combustion chambers. Injection diagrams. Fuel spray. Consequences on engine operating parameters. Combustion diagrams. Ignition delay. Factors affecting the ignition delay.

6. **Engine main components.** Structure. Cylinders. Pistons. Connecting rod. Cross-head. Crankshaft. Bearings. Camshaft and timing gears. Valves.

7. **Auxiliary systems.** Cooling systems. Lubricating systems. Air supply. Exhaust and heat recovery systems. Fuel supply systems. Starting and reversing. Speed governors and safety systems.

8. **Pollutants emission.** Nature and extent of the problem. Legal requirements.

9. **Operation e maintenance.** Preparation. Care during operation. Operating conditions analysis. Periodic inspections.

2.Lab

PL01 - Engine test bench familiarization.
PL02 - Simulators familiarization.
PL03 - Diesel engines operating parameters.
PL04 - Torque, power and specific consumption diagrams.
PL05 - Evaluation of the mechanical efficiency of a diesel engine.
PL06 - Evaluation of the volumetric efficiency of a diesel engine.
PL07 - Indicated power (closed diagrams).

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PL08 - Influence of the injection timing on the cycle parameters. **PL09 - Fault diagnosis.**
Recommended reading:
Course Notes, Jorge Trindade, 2011. J.B. Heywood. Internal Combustion Engines Fundamentals. Mc-Graw-Hill, 1988. J. Martins. Motores de Combustão Interna, Publindústria, 2005. D. Giacosa. Motores Endotermicos. Ed. Dossat, 1979. K. Zinner. Supercharging of Internal Combustion Engines. Springer-Verlag, 1978. M. Burghardt and G. Kingsley. Marine Diesels. Prentice-Hall, 1981.
Teaching methods:
Exposure of the subject by the teacher, when possible followed by application examples, independent and group work by students.
Assessment methods:
Written tests and lab reports.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Control Systems		
Field:	Control Systems		
Course code:	3067	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	6	**Hours/week:**	60 h / TP+PL
Name of lecturer:	Olímpia Maria Rafael Òtão Pereira		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The main objectives of this course is to introduce the student to the fundamentals of:
- identify and characterize control systems and its elements;
- analyze and characterize the linear model of a physical systems in the frequency and time domains;
- design and analyze control systems using root locus methods and frequency response methods (including Bode and Nyquist methods);
- awareness of the performance limitations of all control systems

Course contents:

1. Introduction to Automated Control Systems
Types of control system. Representation of analogue control system (ACS) and digital: open and close loop control. The design process of feedback control system: case study. Computer-aided design: Matlab control systems toolbox and Simulink. Digital control system: advantages of DCS; A/D e D/A conversion; sample and hold devices; the sampling theorem; data reconstruction and filtering of sample signals; comparing un ACS with its equivalent discrete for several sampling frequencies.

2. Mathematical models of physic systems
Laplace Transform: Laplace Transform Table; Laplace Transform Theorems; Inverse Laplace Transform; Parcial-Fraction Expansion; Laplace Transform solution of a Differencial Equation LTI.
The transfer function (T.F.) and state-space representation (S.S.). Converting an T.F. to S.S. and S.S. to T.F. Linearization. Obtainment of model through of system's response to test input signal. Case studies.

3. Analyze of systems in time domain
Transient and steady-state response. Characterization of 1st and 2nd order systems in response to test input signal. Stability Routh-Hurwitz criterion. Root Locus (RL) and its design rules. Analyze the analogue control system using root locus method.

4. Analyze of systems in frequency domain
Bode and Nyquist diagrams and its design rules. Relative stability. Analyse the control system using Bode and Nyquist methods.

5. Transducers
Fundamental concepts. Signal conditioning. Linearization. Case studies.

6. Control methodologies
Introduction: Different control methodologies and its application domains. PID Controllers. Regulators optimum adjustment rules (Ziegler-Nichols). Study case at maritime and industry installations. Detection and fault diagnostic at feedback control and corrective actions. Compensation (lead, lag, lead-lag). Application domains. Relations between compensators and PID controllers. The design process of compensators via Root Locus and Bode methods. Introduction to linear state-feedback control (concepts of controllability e observability)

Recommended reading:

Modern Control Engineering - Katsuhiko Ogata; Pearson, Prentice Hall.
Control Systems Engineering - Norman S. Nise ; John Wiley & Sons, Inc.
Lecture Notes - Olímpia Ótão Pereira.

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Teaching methods:
Theoretical, practical e laboratorial classes. Theoretical classes will be followed by practical classes in which students will consolidate theoretical concepts. Practical e laboratorial classes will be used to problem solving and experimental verification of the controller design concepts.
Assessment methods:
There will be 4 to 6 laboratorial team work, but only three are due for delivery. There will be homework individual assignments (NPL); Final test at the end of semester or final examination (NT); Final grade (NF = 0.3 × NPL+0.7 × NT).

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Ship Structure and Stability		
Field:	Thermal Installations		
Course code:	3068	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Jorge Manuel Fernandes Trindade		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide students with theories and factors affecting stability and trim of a vessel, and the methods necessary to maintain stability and trim within safe limits. The acquisition of knowledge about the effect on stability and trim of a ship arising from hull damage, causing the flooding of watertight compartments, is another objective of the course. Last objective of the course is the acquisition of knowledge about the structural frames and construction of different types of merchant ships.

Course contents:

1. Geometry of the ship.
Main particulars and plans. Form coefficients. Calculation of the coordinates of the gravity center of a ship. Moments and center of area. Simpson's rules. Displacement, volume of displacement, center of buoyancy and area of wet surface. Tons per cm immersion and flotation center. Draft diagram.

2. Types of ships.
Specification of ship construction. Plans for construction and classification. Isometric plans. Structure of the ship. Freeboard. Structural characteristics and construction of various types of ship. General cargo ships. Reefer ships. Container ships. Ro-ro ships. Mother-ship. Bulk carriers. Tankers.

3. Buoyancy and stability.
Addition, removal, suspension and movement of weights. Stability for small angles. Metacentric radius and height. Positive, negative and indifferent stability. Effect of weight suspension on the stability. Effect of the free surface on the stability. Transverse movement of weights. Inclining experience. Stability at large angles of inclination. Righting arm. Cross stability curves. Static stability curve. Factors affecting the stability of a ship. Dynamic stability. IMO Recommendations on the stability of ships. Longitudinal Stability. Definition of trim. Moment to Trim One cm. Flotation center. Draft variation due to loading and unloading of cargo. Control of the trim of the ship. Vessel stability after hull failure.

Recommended reading:

Course Notes
Introduction to Naval Architecture, Eric C. Tupper, Elsevier, 2004
Basic Ship Theory, J. Rawson & E. C. Tupper, Elsevier, 2001
Arquitectura Naval, José P.F.S. Cabral, Centro de Livro Brasileiro, 1979

Teaching methods:

Exposure of the subject by the teacher, when possible followed by application examples, independent and group work by students.

Assessment methods:

Written tests and exam.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Maritime Safety I		
Field:	Technical Management		
Course code:	3069	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	4	**Hours/week:**	60 h / TP+PL
Name of lecturer:	João Emílio do Carmo Silva		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Identify risks associated with the ship and its activities; Provide knowledge about fire-fighting and prevention as well as techniques and equipment used in the detection, prevention and firefighting; Training on maintenance of safety equipment; Develop skills on techniques for actuation in emergency situations; Promote the creation of team spirit as a way to deal with emergency situations; Deliver knowledge and develop capacities for the use of individual and collective safety equipment; Provide training on organizational systems of safety on board; Promoting knowledge on organization and planning of emergency management, in terms of strategies for preparedness, response and recovery; Teaching methods and techniques of qualitative and quantitative risk analysis; Deliver knowledge about the harmfulness of chemicals related with is explosive and toxic potential; Teach and train students in the monitoring of atmospheric contaminants; Publicizing the administrative, legislative and regulatory framework of safe operation of ships, according with IMO-STCW Convention.

Course contents:

1. Conventions, Codes and Regulations
STCW Convention. SOLAS Convention. ISM Code.

2. Basics about hygiene and safety on board
Types and classification of risks. Safety factors. Substandard condition. Obligations of the company and crew.

3. Fundamental elements on fires and explosions
Fire prevention. Exercises and demonstrations with the fire lab. Theory of fire and explosion. Risks and spread of fire. Flammability characteristics and safety limits of flammable products. Types and ignition sources. Propagation and evolution of fires. Fire Classes. Fire extinction methods. Extinguishing agents. Types, effects and characteristics.

4. Fire-fighting systems and equipment
Fire main system. Portable equipment. Types, characteristics and utilization techniques. Mobile equipment. Types, classification, characteristics and technical use. Fixed local protection and total flood systems. Inspection, testing and maintenance of equipment and systems.

5. Methods and fire-fighting procedures.
Firefighting in specific areas of the ship. Risk of fire-fighting procedures. Fire-fighting exercises with water and foam. Aftermath and recovery. Use, maintenance and inspection of fire extinguishers. Structural protection and containment.

6. Fire detection and fire alarm system.
Automatic fire detection system. Central alarm. Detectors and technologies used.

7. Risks associated with storage, handling and transportation of dangerous goods
Flammable, explosives, oxidizing, corrosive, reactive products, compressed gases, explosive dusts. Precautions regarding storage and stowage. Safety data sheets of products.

8. Non-breathable atmospheres
Composition of the atmosphere. Toxicity and asphyxiation. Contaminants. Monitoring and measurement of gases and vapours. Threshold Limit Value. Ceiling Limit. Time Weighted Average. Short-Term Exposure Limit. Use and maintenance of self-contained breathing apparatus. Use, maintenance and calibration of gas analyzers.

9. Entry, progression and rescue in confined spaces
Introduction, general concepts and definition on confined spaces. Specific hazards of confined

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spaces.
Tests and precautions. Procedures for entry and progression in confined spaces. Entry and work permits. Training of entry, progression and rescue in confined spaces.

10. Precautions before, during and after repair and maintenance work
Preparation. Insulation systems. Surveillance. Work with open flame.

11. Safety of the ship in port
Responsibility for operations. Coordination with ground fire services. Preparations for the departure from port if necessary. Evacuation of nonessential personnel.

12. Work at height
Definition of work at height. Fall risk assessment. Evaluation and risk hierarchy. Systems and anti-fall devices.

13. Control of fire-fighting operations on board
Risk analysis. Areas with risk of fire. Tactics and procedures for the control of fires on sea, in port and in dry-dock. Tactics and procedures for the control of fires on ships carrying dangerous cargoes. Fighting fire with water and consequences on stability. Corrective effects. Communications and coordination during firefighting operations. Control of ventilation, smoke extraction, fuel systems and electrical systems. Management and control of persons affected by fires. Coordination of emergency operations with shore teams.

14. Organization and training onboard
Training Manual. Fire control plans and muster list. Organization and methodologies for training crews. Strategies and methods for the control of fires in specific zones of the ship.

15. Inspection and maintenance of the equipment and combat systems and fire detection
Detection and alarm systems. Fire network, hydrants, hoses, nozzles, pumps, physical foam devices. Fixed equipment, portable and mobile, including towable accessories. Firefighter and other personal protective equipment (PPE). Rescue equipment and life support. Requirements for statutory inspections and classification.

16. Investigation and reporting of incidents involving fires
Fire research. Reporting. Case study analysis.

17. Crowd management
Life-saving appliances and control plans. Mustering procedures. Design and operational limitations. Procedures for opening, closing and securing hull openings. Legislation, codes and agreements affecting roro passenger ships. Assistance to passengers en route to assembly and embarkation stations. Stability and stress requirements and limitations. Procedures for the maintenance of special equipment on ro-ro passenger ships.

Recommended reading:

Lecture notes of Maritime Safety I, J. Emílio, ENIDH, 2010.
International Safety Guide for Oil Tankers & Terminals, International Chamber of Shipping.
Storage and Handling of Petroleum Liquids, Hughes and Swindells, 3rd Ed., 1987.
Lecture notes of Maritime Safety, A. Pais Lourenço, ENIDH.
A protecção contra incêndios em casas de máquinas de navios, M. Bouza Serrano, 1982.
SOLAS 1974-Protocolo 78 e posteriores Emendas (IMO)
ISM Code.
Code of safe working practices for the safety of merchant seamen, London.

Teaching methods:

The teaching will be conducted through lectures and practical classes. It is intended that by reading the literature the student is introduced to deal with each topic. The theoretical lectures include presentations of each topic followed by practical examples, in order to the student consolidate the studied concepts. In practical classes students execute exercises in order to apply the acquired knowledge.

Assessment methods:

Continuous assessment:
- 2 Theoretical tests (T1 and T2) (rating of 0 to 20);
- Individual work or group to perform mandatory (TRABS) (rating of 0 to 20);
- Questionnaire SOLAS - International Convention for the Safety of Life at Sea (SOLAS) (rating of 0 to 20)
- Practical exercises to perform mandatory (NOT SUITABLE or SUITABLE ratings)

The approval requires the continuous evaluation of cumulative satisfaction:
- Rating less than 7 at any values of tests;

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- Obtaining an average equal to or greater than 9.5 points; - The classification of APTO in all work and practical exercises. Classification of continuous assessment will be determined by the following expression: Final Average = 35% x T1 + 35% x T2 + 25% x Average TRABS + 5% x SOLAS **Final Exam:** Students who have not passed the assessment frequency, can only apply for the final exam if they have obtained the rank of SUITABLE practical exercises in all individual and group mentioned above. The final exam will focus on all of the course syllabus.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Maintenance		
Field:	Technical Management		
Course code:	3070	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	1st
ECTS:	4	**Hours/week:**	60 h / TP+PL
Name of lecturer:	Jorge Manuel Fernandes Trindade		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide the basic theoretical knowledge of maintenance to enable the student an easy integration into the engine room department. To sensitize students to the importance of the historical record of the maintenance work (repairs, inspections, lubrication, calibrations, etc..) and the connection with other maintenance activities (planning, preparation and programming). Provide the student to obtain knowledge enabling them to correctly interpret maintenance manuals for machinery and equipments of ships, select the materials for manufacture and repair of mechanical components, sealings, etc., and use equipment, tools and instruments appropriate measure to manufacturing operations, maintenance and test facilities normally conducted in marine machinery.

Course contents:

1. Fundamentals and organization of the maintenance
Basic concepts of maintenance. Types of maintenance. Organization and documentation of maintenance. Maintenance management software.

2. Appropriate use of tools in manufacturing and repair operations
Features and limitations of technological processes of manufacture and repair. Properties and parameters used in the manufacture and repair of systems and components. Proper identification of the most important parameters for the manufacture of the most common components. Manufacturing execution with the necessary tolerances. Implementation of safety standards in the workplace. Use of equipment and tools properly and safely.

3. Use of hand tools and measuring instruments in the disassembly operations, maintenance, repair and assembly of machines and other equipment of the ship.
Selection of materials to be used. Interpretation of drawings and technical manuals in English and Portuguese. Proper selection of tools, spare parts and measuring devices.

4. Materials and sealing components.
Joints, packings and mechanical seals. Valve grinding. Types and materials used for different fluids.

5. Maintenance of mechanical systems, including control systems.
Safe electrical and mechanical isolation of equipments.Execution of maintenance work, repair and test on the propulsion plant and auxiliary systems, in accordance with safety standards and the manufacturer's instructions.

6. Tribology.
Fundamental concepts. Lubricants. Radial bearings. Thrust bearings. Ball and roller bearings.

Recommended reading:

Course notes.

Teaching methods:

Lectures and practical exercises are comprised to achieve the course objectives. Each subject will be introduced and be followed by practical applications when possible. There will also be various hands-on activities, which typically will be graded beyond keeping a record of participation.

Assessment methods:

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Theoretical: a test or final exam; Practical: hands-on activities and lab reports.	
Language of instruction:	Portuguese / English

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3rd year of studies

2nd semester

Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Auxiliary Machinery II		
Field:	Thermal Installations		
Course code:	3071	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	6	**Hours/week:**	60 h / TP
Name of lecturer:	Alfredo Manuel Nobre Marques		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide students with the application of previously acquired knowledge, particularly of Thermodynamics, Heat Transfer and Fluid Mechanics to the operation of refrigeration plants, heat exchangers, mechanical separation systems of oil and other auxiliary systems on board, as recommended by the Convention IMO-STCW/95 (Tables A-III / 1 and A-III / 2):
- Marine Engineering at operational level;
- Maintenance and repair at operational level;
- Marine Engineering at command level
- Maintenance and repair at command level

Course contents:

Refrigeration.

1. Production of industrial refrigeration.
Production of systems for industrial refrigeration. Conservation of industrial refrigeration. Application of industrial refrigeration.

2. Refrigerants.
Primary coolant. Secondary coolants.

3. Vapor compression systems.
Ideal cycle. Practical cycle. Systems of more than one evaporation temperature. Multiple compression systems. Refrigerant lines.

4. Compressors.
Classification. Reciprocating compressors. Screw compressors. Dynamic compressors. Efficiency. Flow. Operating conditions. Open compressors, semi-open and hermetic.

5. Condensers.
Water-cooled condenser. Air cooled condensers. Evaporation condensers. Condenser capacity. Characteristic curves. Selection and sizing of condensers. Operation and maintenance of condensers.

6. Evaporators.
Dried evaporators. Flooded evaporators. Air coolers. Liquid coolants. Capacity of an evaporator. Characteristic curves. Thawing systems.

7. Flow control devices.
Capillary tube. Manual expansion valves. Automatic expansion valves. Thermostatic expansion valves. Injection thermostatic valves. Level regulators.

8. Protection, control and auxiliary devices.
Thermostats. Pressure regulation devices. Modulating valves. Non-modulating valves. Hygrostats. Pressure gauges and thermometers. Auxiliary devices.

9. Capacity control.
Capacity compressor control. Capacity condenser control. Capacity evaporator control. System equilibrium.

10. Thermal loads.

11. Operation and maintenance. Tests. Refrigerant charge. Reception. Operation. Anomalies, symptoms and causes. Maintenance.

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II. Heat exchangers

1. Classification and overview. Process of heat transfer. Direction and relative direction of flow. Mechanism of heat transfer. Functions. Design and geometry.

2. General equations. Energy balance. Overall coefficient of heat transmission. Temperature distribution. Dimensionless quantities. ε-NTU method. Heat exchangers association.

3. Thermal analysis and hydrodynamics. Coaxial tubes heat exchanger. Heat exchanger of tube bundle and cylindrical body. Plate heat exchanger.

4. Evaluation and scaling. Evaluation of characteristics. Scaling.

III. Mechanical separation

1. Heavy oils.

2. Lubricating oils.

3. Separation methods

3.1. Gravity separation.

3.2. Separation by centrifugation.

4. Heavy fuel oils treatment.

5. Centrifugation automation.

IV. Auxiliary vessel systems

1. Main engine and generators cooling system.

2. Lubricating oil cooling system.

3. Ballast systems.

4. Sewage systems.

5. Compressed air system.

6. Fire system.

7. Other auxiliary systems.

Recommended reading:

Marques, A., Refrigeração, ENIDH, 2003
Marques, A., Permutadores de calor, ENIDH, 2003
Marques, A., Separação mecânica, ENIDH, 2003
Hewitt, G. F., Shires, G. F., Bott, G. L., Process Heat Transfer, CRC Press, 1994
Tubular Exchanger Manufacturers Association-TEMA, 1988Kategurov, M., Marine Auxiliary Machinery and Systems, Peace Publishers, 1980
Le Noveau Pohlmann - Manuel Techniquwe do froid, PYC Edition, 1991

Teaching methods:

The teaching will be done through practical classes, and laboratory practices. By reading the literature, the student is introduced to each topic to be discussed. The theoretical and practical work is done with brief presentations on each topic, followed by practical examples, where students consolidate the concepts studied. Practical classes include the resolution of exercises where students apply the knowledge acquired. Some of these classes involve carrying out laboratory work, where students can check the consistency of the models studied with real problems.

Assessment methods:

Three laboratory work in group (NTP);
Two tests during the semester or a final exam (NE);
Final grade (NF) is the result of: NF = 0.3 +0.7 × × NTP NE.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Marine Plant Operation		
Field:	Thermal Installations		
Course code:	3072	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / PL
Name of lecturer:	Jorge Manuel Fernandes Trindade		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide students with knowledge of the lay-out of the different facilities of a ship, as well as training and acquisition of skills in the operation of a ship propulsion and auxiliary machinery systems, including power generation, pumping systems, separation systems for sewage and incineration of waste oil, freshwater production systems and purification of fuels and lubricating oils, as well as operating with boilers and steam turbines. Course goal is still also the learning of the routines included in engine room watchkeeping or UMS service.

Course contents:

1. Introduction.
Description of the simulators. Characterization of the simulated plants. Diesel propulsion plant. Propulsion plant with steam turbine. Reading and interpretation of functional schemes of maritime propulsion plants, including its symbology.

2. Engine department.
Organization of engine room services. Watchkeeping. UMS. Activities associated with the engine room watch transfer. Main duties and tasks to perform during the watch. Safety precautions that should be observed during a watch and immediate actions to be taken in case of fire or accident, especially those involving hydraulic systems. Engine Diary and Oil Record Book. Engine readiness. Stand-by. At sea. Finished with engines.

3. Production and consumption of electricity.
Shore connection. Generators. Emergency generator. Diesel generators. Shaft-Generators. Turbo-generators. Preparation and commissioning of generators. Operation of generators, including the coupling and switching alternators. Switchboards. Emergency switchboard. Main switchboard. Feeders and distribution panels. "Non-essential" group. Earths.

4. Auxiliary systems.
Propeller shaft seal. Ventilation of the engine room. Refrigerated rooms. Cooling systems. Circulation pumps and coolers. Freshwater and seawater systems. Compressed air systems. Start air system. Control air system. General Service air system. Bilge systems and waste treatment. Operation of bilge systems. Operation of bilge systems in the engine room, with oil separator and incinerator. Sewage treatment systems. Ship's ballast. Ship governing and manoeuvring equipment. Steering gear. Bow and stern thrusters. Deck machinery. Production of distilled water.

5. Boilers and steam generators.
Thermal oil boilers. Steam boilers. Steam boilers operation, including feed-water and combustion systems. Methods for checking the water level in boilers and actions to be taken in case of abnormal level. Exhaust boilers. Sootblowing. Steam/steam generators. Boiler bottom and surface blowdown.

6. Fuel handling and transfer.
Bunkering and fuel transfer. Fuel settling. Fuel separators.

7. Main engine operation.
Preparation and start of main engine. Command and control systems operation. Pitch control system. Main engine condition at sea. Registration and meaning of instruments readings. Safety and emergency procedures. Passage of all systems of the remote/automatic control mode to local/manual and vice versa.

8. Operation of steam turbines.
Propulsion plants. Main turbines. High-pressure boilers. Desuperheated and superheated steam

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systems. Boiler feedwater system. Fuel and air systems. Condensers. Bleeds. Ancillaries. Feed water turbo-pumps. Turbo-generators. Cargo and ballast turbo-pumps. **9. Cargo loading and unloading systems.**	
Recommended reading:	
Apontamentos e apresentações utilizadas nas aulas, Jorge Trindade, 2011. ERS MAN B&W 5L90MC-L11 Machinery & Operation MC90-IV, Kongsberg Maritime, 2005. ERS SP Dual Fuel Machinery & Operation, Kongsberg Maritime, 2007.	
Teaching methods:	
Teacher exposition/demonstration followed by individual and group work of students.	
Assessment methods:	
Written test and practical exercises with simulators.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Automation		
Field:	Control Systems		
Course code:	3073	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	6	**Hours/week:**	75 h / TP+PL
Name of lecturer:	Luis Filipe Baptista		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Introduce the fundamental concepts of logic circuits most used in maritime installations. Special focus is given to the pneumatic, oil-hydraulic, electric and electronic technologies. Provide the students with analysis and synthesis methods to project and develop both combinatorial and sequential circuits. Introduce the students to the basic programming concepts of Programmable Logic Controllers (PLC), according with IMO-STCW Convention.

Course contents:

1. Introduction to Automation.
Automation objectives. Types and levels of automation. Technologies of control systems. Systems using analogue and digital. Application of control systems in industry and offshore facilities.

2. Boolean Algebra.
Basic logic functions. Truth table of a logic function. Postulates, theorems and properties of Boole algebra. Representation of logic functions. Simplification of functions. Algebraic simplification. Simplification of functions through the Karnaugh method.

3. Pneumatic and hydraulic oil, pneumatic systems.
Production of compressed air. Treatment, storage and distribution of compressed air. Elements of a pneumatic circuit: compressors, valves, cylinders and motors. Normalized CETOP ISO-1219 symbols. Analysis of pneumatic circuits. Hydraulic systems. Treatment and storage of hydraulic equipment. Elements of a hydraulic circuit: fixed displacement pump and variable displacement pumps. Directional control valves. Pressure and flow valves. Hydraulic actuators: cylinders and motors. Analysis of hydraulic circuits. General procedures for maintenance and safety practices used in marine installations.

4. Basic elements of a system of Logical command system.
Elements for dialog man / machine and sensors used in control circuits. Position Sensors: mechanical, electromechanical, inductive and capacitive. Basic logic elements performed with pneumatic, hydraulic, electrical and electronic technology. Normalized symbols for electrical and electronic circuits (IEC). Monostable and bistable memory devices: asynchronous and synchronous. Counters and timers. Analysis and simulation of pneumatic, hydraulic, electrical and electronic circuits using simulation programs (Bosch WebTrainer and Automation Studio).

5. Combinatorial Logic Command Systems.
The concept of combinatorial circuit. Methods of analysis and synthesis of combinatorial systems: analytical and based on Karnaugh maps. Synthesis of combinatorial control systems with electrical, pneumatic and electronic technology.

6. Bistable memories.
Bistable R / S asynchronous. Operating table. Typical applications. Bistable synchronous ("Flip-flops"). RST and D flip-flops. Operating tables. Typical applications. JK Flip-Flop. Operating table. Typical applications.

7. Sequential Logic Control Systems.
Definition of sequential control system. Asynchronous sequential systems, synchronous and mixed. Methods of analysis and synthesis of sequential systems. General method of synthesis of asynchronous sequential systems (Huffman). Simplified Method of Huffman. Fully graphical method applied to cycles with pneumatic cylinders.

8. GRAFCET Functional Diagram.

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Definition of the functional diagram Grafcet. Description of Grafcet. Level 1 and level 2. Elements of SFC. Steps and transitions. Jumping and taken step sequence. Sequences and multiple sequences simultaneously. Examples of application.

9. Programmable logic controllers.

Classification of a PLC. Architecture of a PLC. Input and output modules (I / O) of a PLC. Special I / O modules. Programming methodologies. PLC Programming through lists of instructions, contact diagrams (ladder diagrams), functional blocks and based on Grafcet. Application of PLC controllers to industrial and marine systems (digital and analog).

10. Examples of maritime control systems.

Steering gear. Controlled pitch propeller (CPP). Steam boiler. Refrigeration and air conditioning. Inert gas system. Deck machinery (winches, cranes).

Recommended reading:

Lecture notes of Automation; Luís F. Baptista, E.N.I.D.H, 2011
Powerpoint presentations of class lectures; Luís F. Baptista, E.N.I.D.H, 2011
Industrial Automation-Circuits, design and component, David W. Pessen, John Wiley and Sons, 1989.
Método sequencial para automatização electro-pneumática, José Novais, Fundação Calouste Gulbenkian.
Controlo de Processos - Tecnologia da Instrumentação, Curtis D. Johnson, Fundação Calouste Gulbenkian, 1991.
Sistemas Digitais, Mário Serafim Nunes, Editorial Presença.

Teaching methods:

The teaching methodology includes theory-practice lectures and laboratories. In theory-practice lectures, students will discuss the previously read concepts and project automated installations. In laboratories, the students will apply and discuss the application of the different theoretical concepts to a series of practical examples, mainly using laboratory equipment.

Assessment methods:

7 group laboratorial exercises where students apply the fundamental concepts lectured in the theoretical classes
Oral discussion about the lab reports (NL): minimal grade (9,5 points in scale 0-20 points)
2 tests during the semester or 1 final exam (NE): minimal grade in each test (7 points)
The final score (NF) is obtained by: NF = 0.4×NL+0.6×NE.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Machine Design		
Field:	Applied Mechanics		
Course code:	3074	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	5	**Hours/week:**	60 h / TP
Name of lecturer:	Victor Franco Correia		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

The course objectives are: (a) Knowledge on the mathematical tools and fundamental concepts involving: the design of machine components and structures; the adequate material selection for a given application; the fatigue phenomena and the design against fatigue failure; the basic concepts of the linear elastic fracture mechanics; the structural stress and deformation analysis by using the commercially available finite element packages; (b) Criteria for design/selection of specific components of mechanical systems.

Course contents:

1. Introduction to the design of mechanical systems and structures.
Basic concepts of Project specifications, Standards and Design Codes. Safety factor.

2. Review of stress analysis concepts
Generalized Hooke's law. Stres analysis in symmetric and non-symmetric bending of straight beams. Transverse shear stresses. Shear stresses in torsion of symmetric, non-symmetric sections and multicell thin-walled sections. Stress concentration effects. Stresses in thin-walled and thick pressure vessels. Failure criteria: Von-Mises, Tresca, Coulomb, Mohr. Failure due to static loading. Combined loads.

3. Materials used in mechanical design and maritime applications
Standards and commercial specifications for materials. Equivalency of standards. Material quality certificates. New materials as an alternative to classic materials in mechanical applications.

4. Fatigue of mechanical components
Fatigue failure of mechanical components and structures. S-N curve. Fatigue strength. Fatigue failure criteria. Design against fatigue. Cumulative fatigue damage criteria.

5. Introduction to the Linear Elastic Fracture Mechanics
Griffith and Irwin theories. Concept of stress intensity factor. Fracture toughness. Fatigue crack growth. Paris-Erdogan law.

6. Design of mechanical systems
Design of Bolted joints. Design of riveted joints. Design of Welded Joints. Helical springs. Bearings. Gears and gearbox selection criteria. Flexible and rigid mechanical elements. Clutches and Brakes.

7. Finite element method analysis
Basic introduction to the finite element method (FEM). Commercial software for stress and strain linear elastic analysis of structures. FEM applied to the design of mechanical systems.

Recommended reading:

Mechanical Engineering Design, Shigley & Mischke, McGraw-Hill, 2001.
Fundamentals of Machine Elements, B. Hamrock, B. Jacobson & S. Schmid, McGraw-Hill, 2000.
Mechanics of Materials – Volume 2 – E. J. Hearn, Butterworth Heinemann.
Fadiga de Estruturas Soldadas, C. Moura Branco, A. A. Fernandes, P. S. Tavares de Castro, Ed. Fundação Calouste Gulbenkian, 1986
Linear Elastic Fracture Mechanics for Engineers, Theory and Applications, L.P. Pook, WIT Press, 2000.
Orgãos de Máquinas, Textos de Apoio, Victor Franco, ENIDH (in Portuguese).

Teaching methods:

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Theoretical and practical classes.	
Assessment methods:	
Continuous assessment: Two written Tests and one Project with oral discussion. Final examination: One global test and one Project with oral discussion.	
Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Maritime Safety II		
Field:	Technical Management		
Course code:	3075	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	5	**Hours/week:**	75 h / TP+PL
Name of lecturer:	João Emílio do Carmo Silva		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Teach skills that permit students to identify, use and maintain the individual and collective safety equipment of the ship. Training students in maneuvering and command of survival craft and rescue boats. Provide knowledge on preventing and combating maritime pollution. Teach basic training on oil tankers, chemical tankers, gas tankers and other vessels with particular characteristics. Develop competences on industrial hygiene to avoid risks of contamination by hazardous chemical agents. Teach the administrative, legislative and regulatory framework of safe operation of ships. Deliver knowledge on radio-communications and provide training with communications equipment, according with IMO-STCW Convention.

Course contents:

1. Rescue and survival at sea

Collective and individual survival equipment. Lifeboats; types, construction and equipment. Survival training in the pool. Abandon ship. Planning, organizing and training on board. The muster list, meeting points and muster stations of abandonment. Survival at sea. Main dangers to the shipwrecked. Actions in survival craft. Essential elements of seamanship. Methods of rescue. Rescue boats and fast rescue boats. Types, construction and equipment. Launching and recovering of survival crafts and rescue boats, maneuver in adverse weather or rough seas. Maintenance and emergency repairs in the rescue boat. Manoeuver, and command of rescue boats.

2. Oil, chemical and liquefied gas tankers

Types and classification of ships. Tank cleaning and degassing. Ventilation of tanks and accommodation. Sounding and alarm systems. Properties of oils, chemicals and gases carried in bulk. Dangers to health and the environment. Electrostatic charges and their formation. Hazard analysis and control. Personal protective equipment. Actions after the collision, stranding and spill. Special equipment for firefighting. Emergency stop of loading. Storage and handling of cargo and monitoring. Characteristics of cryogenic fluids. Actions in case of failure of essential services. Liquid cargo handling simulator training.

3. Ro-ro passenger ships

Escape routes. Restrictions on the use of elevators and other systems dependent on energy sources. Assistance to passengers in emergency situations. Control of passengers on routes of escape. Procedures at muster and abandon stations. Instruction to prevent or minimize the panic. Procedures relating to the doors and bow and stern ramps. Requirements of stability and strength. Use of load calculators. Hazardous areas and their protection. Communication with passengers. Crisis management and human behavior.

4. Industrial hygiene - Chemical contamination

Classification of chemical agents. Physiological action. Personal protective equipment. Concepts of analytical hygiene. Concept of dose and dose-response relationship. Variables that determine the use of limit values for exposure. Fundamentals of sampling. Sampling systems, passive samplers, direct-reading instruments. Instrumental methods of analysis. Passive samplers. Direct reading instruments. Measurement, testing and calibration of gas analyzers.

5. Maritime communications

Knowledge of the basic features of the maritime mobile service. Detailed practical knowledge and ability to use the basic equipment of a ship station. Practical use of the basic equipment of a ship station. Digital Selective Calling (DSC). Operational procedures and detailed operation of GMDSS and respective subsystems. The Global Maritime Distress and Safety System (GMDSS). NAVTEX. Emergency Radio Beacons (EPIRBs). Radar transponder beacon locator (SART). Procedures for

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communication in situations of distress, urgency and safety within the GMDSS. Distress, urgency and safety communications on non-SOLAS vessels using only radio. Search and Rescue Operations (SAR). General capabilities and operational procedures for general communications. Ability to use the English language, both in the written and spoken way, in order to achieve a satisfactory exchange of communications relevant to the safety of life at sea. Mandatory practices and procedures for communications. Practical and theoretical knowledge of procedures for general communications.
Recommended reading:
Lecture notes, João Emílio. 1974-SOLAS Protocol and subsequente Amendments (IMO) "Life Saving Appliances" (LSA Code) – IMO London. "Tanker safety Guide" – International Chamber of Shipping – London 78 "IMDG Code" – IMO London. "ISM Code" – IMO London. IMO GMDSS Manual, 2009 International Telecommunication Union, Radio Regulations, Geneva, 2004 Maritime Communications and IMO SMCP, 2001 GMDSS Training, Abel Simões, 2011
Teaching methods:
The teaching will be done in theoretical-practical classes. Statements will be made with equipment and training in survival craft and rescue boats as well as in fast rescue boats. In practical demonstration classes will be using and training with personal protection equipment. This will be used in the laboratory and workshop. Basic training in simulator of load and discharge cargo operations with tankers (VLCC, Product Carrier, LPG and CHT) will be executed by students. Laboratory tests will be made for use, testing and calibration of gas measuring equipment and training with chemical protective suits.
Assessment methods:
Theoretical assessment: two tests and exam. Practice assessment: laboratory work and execution of practical safety exercises, in group and individual.

Language of instruction:	Portuguese / English

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Bachelor of Engineering in Marine Engineering

Description of individual course unit

Course title:	Basic Health Care on Board		
Field:	Technical Management		
Course code:	3076	**Type of course:**	Mandatory
From:	19 of September 2011		
Year of study:	3rd	**Semester:**	2nd
ECTS:	3	**Hours/week:**	30 h / TP+PL
Name of lecturer:	Teresa Cardoso Pinto		
Prerequisites:			

Objective of the course (expected learning outcomes and competences to be acquired):

Provide officials with theoretical and practical knowledge, so they can be able to deal with basic emergencies on board, according with IMO-STCW Convention.

Course contents:

1. TELEMEDICINE
1.1 CODU-MAR: Medical Advice Centre
1.2 Radio-medical contact - call simulation
1.3 The chain of survival
1.4 Organization of the Medical Emergency System
1.5 On board pharmacies
1.6 National and International Legislation on Health Care On board
1.7 Support Manuals

2. HUMAN ANATOMY AND PHYSIOLOGY
2.1 Cardio-circulatory System
2.2 Respiratory System
2.3 Locomotive System
2.4 Nervous System

3. CARDIO-PULMONARY RESUSCITATION
3.1 European algorithm of Basic Life Support
3.2 Practice of Basic Life Support - Ventilation and Chest Compressions
3.3 Airway obstruction

4. BLEEDING
4.1 Internal bleeding
4.2 External Bleeding
4.3 Techniques of bleeding control
4.4 Hypovolemic shock

5. TRAUMATOLOGIA
5.1 Trauma
5.2 Injuries: Types and treatment
5.3 Wounds: Classification and treatment
5.4 Joint injuries
5.4.1 Types and symptoms
5.4.2 Complications and treatment
5.5 Fractures
5.5.1 Classification, complication and treatment
5.6 Bandages

6. HEAT AND COLD INJURIES
6.1 Burns – types, symptoms and treatment

7. SUBMERSION ACCIDENTS
7.1 Drowning
7.2 Physiopathology, symptoms and immediate care

8. TOXICOLOLOGY
8.1 Poison Classification

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8.2 Contamination routes 8.3 Symptoms and treatment 8.4 Frequently poisoning 8.5 Portuguese Poison Centre 8.6 Addictions **9. SEXUALLY TRANSMITED DISEASES** 9.1 Hepatitis and AIDS 9.2 Treatment 9.3 Prevention **10. MEDICAL EMERGENCIES** 10.1 Heart diseases – angor pectoris and myocardial infarction 10.2 Stroke
Recommended reading:
International Medical Guide for Boats (WHO) Emergency Medical Technician Manual - Basic
Teaching methods:
Lectures, practical simulations.
Assessment methods:
Continuous assessment or final examination

Language of instruction:	Portuguese / English

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