Polytechnic Institute of Coimbra (P COIMBRA 02)
Coimbra Institute of Engineering - ISEC
Chemical and Biological Engineering Department

ECTS CATALOGUE

The main language of instruction at Coimbra Institute of Engineering is Portuguese. However, some courses from degree and master programs can be offered in English and/or with a tutorial support in English.

The Master Course in Engineering and Management of Physical Assets is taught in Portuguese at the moment. Some of the subjects might have tutorial support in English or taught in English if there's a minimum of five enrolled foreign students.

The ECTS catalogue includes subject contents in English.
Students can choose subjects from this Catalogue to the study plan proposal (Learning Agreement) to be analyzed carefully by the Departmental Coordinators and to be adjusted if necessary.

This ECTS catalogue contains information which is valid for this academic year. ISEC reserves the right to adjust the courses offered during the academic year and is not responsible for typing errors or printing mistakes.

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Polytechnic Institute of Coimbra (P COIMBRA 02)
Coimbra Institute of Engineering - ISEC
Chemical and Biological Engineering Department

**ECTS CATALOGUE**

# MASTER Engineering and Management of Physical Assets

| Code | Title - Portuguese | Title - English | ECTS | Period |
|---|---|---|---|---|
| **1.º ano / 1st Year** | | | | |
| 61000816 | Análise e Tratamento de Dados | Data Analysis and Processing | 6 | Fall |
| 61000805 | Métodos de Apoio à Decisão | Support Decision Methods | 6 | Fall |
| 61000838 | Gestão Financeira | Financial Management | 6 | Fall |
| 61000827 | Logística | Logistics | 6 | Fall |
| 61000849 | Gestão de Energia | Energy Management | 6 | Fall |
| 61000873 | Actívos Físicos Especiais | Special Physical Assets | 6 | Spring |
| 61000862 | Gestão de Activos Físicos | Physical Asset Management | 6 | Spring |
| 61000851 | Metrologia | Metrology | 6 | Spring |
| 61000884 | Activos Físicos e Infecção | Physical Assets and Corss Infection | 6 | Spring |
| 61000890 | Organização e Gestão de Manutenção | Organization and Maintenance Management | 6 | Spring |
| | | | | |
| **2.º ano / 2nd Year** | | | | |
| 61000917 | Metodologias de Investigação | Research Methodologies | 6 | Fall |
| 61000906 | Tecnologias da Manutenção | Maintenance Technologies | 6 | Fall |
| 61000928 | Projeto | Project | 18 | Fall |
| 61000961 | Dissertação | Dissertation | 18 | Fall |
| 61000945 | Estágio | Internship | 18 | Fall |
| 61000972 | Dissertação* | Dissertation* | 30 | Spring |
| 61000939 | Projeto | Project | 30 | Spring |
| 61000972 | Estágio* | Internship* | 30 | Spring |

*ISEC accept student for works/researches related with these subjects without ECTS attribution. At the end of the work, student will receive an evaluation report within the total of working hours. The presentation and defense will be done at home university.

## 1.3. Study programme:

## ENGINEERING AND MANAGEMENT OF PHYSICAL ASSETS

**1.4. Degree:**

**Master (MSc)**

**1.5. Main scientific area of the study programme:**

Industrial Engineering and Management

**1.10. Specific entry requirements.**

a) Holders of a bachelor degree or equivalent, awarded by a national higher education institution, in the area of

Industrial Engineering and Management or in related areas of science and technology;

b) Holders of a foreign academic degree or equivalent, awarded following a 1st cycle of studies, organized according to the principles of the Bologna Process by a State adhering to this Process, in the area of Industrial

Engineering and Management or in related areas of science and technology;

c) Holders of a foreign or national academic degree recognized by the Technical and Scientific Council as meeting the objectives of the degree of bachelor in the area of Industrial Engineering and Management or in related areas of science and technology;

d) Holders of an academic, scientific or professional curriculum, recognized by the Technical and Scientific Council as attesting the capacity to carry out this cycle of studies.

**1.11.1. Course running**

The study cycle will take place on Fridays and Saturdays.

## 4.3 Study Plan

**Map III - MEGAF - 1st Year / 1st Semester**

4.3.1. Branch, option, profile, major/minor or other (if applicable):

MEGAF

4.3.2. 1st Year / 1st Semester

4.3.3 Study plan

| Curricular Unit | Scientific Area (1) | (2) | / Working Hours / Contact Hours (3) | ECTS (4) | Observations (5) |
|---|---|---|---|---|---|
| Support Decision Methods | M | Semiannual 156 | T - 15; TP - 15 | 6 | |
| Data Analysis and Processing | M | Semiannual 156 | T - 15; TP - 15 | 6 | |
| Logistics | EGI | Semiannual 156 | T - 15; TP - 15 | 6 | |
| Financial Management | EGI | Semiannual 156 | T - 15; TP - 15 | 6 | |
| Energy Management | EE | Semiannual 156 | T - 15; TP - 15 | 6 | |

**Map III - MEGAF - 1st Year / 2nd Semester**

4.3.1. Branch, option, profile, major/minor or other (if applicable):

MEGAF

4.3.2. - 1st Year / 2nd Semester

4.3.3 Study plan

| Curricular Unit | / Scientific Area (1) | (2) | Working Hours (3) | Contact Hours (4) | ECTS | Observations (5) |
|---|---|---|---|---|---|---|
| Metrology | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |
| Physical Asset Management | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |
| Special Physical Assets | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |
| Physical Assets and Cross Infection | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |
| Organization and Maintenance Management | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |

**Map III - MEGAF - 2nd Year / 1st Semester**

4.3.1. Branch, option, profile, major/minor or other (if applicable):

MEGAF

4.3.2. - 2nd Year / 1st Semester

4.3.3 Study plan

| Curricular Unit | / Scientific Area (1) | (2) | / Working Hours (3) | / Contact Hours (4) | ECTS | Observations (5) |
|---|---|---|---|---|---|---|
| Maintenance Technologies | EGI | Semiannual 156 | | T - 15; TP - 15 | 6 | |
| Research Methodologies | EGI | Semiannual 156 | | T - 15; S - 15 | 6 | |
| Project or Internship or Dissertation | EGI | Semiannual 468 | | OT - 45 | 18 | |

**Map III - MEGAF - 2nd Year / 2nd Semester**

4.3.1. Branch, option, profile, major/minor or other (if applicable):

MEGAF

4.3.2. - 2nd Year / 2nd Semester

4.3.3 Study plan

| Curricular Unit | Scientific Area (2) | Duration / Working Hours (3) | / Contact Hours (4) | ECTS | Observations (5) |
|---|---|---|---|---|---|
| | (1) | | | | |
| Project or Internship or Dissertation | EGI | Semiannual 780 | OT - 75 | 30 | |

## 4.4. Curricular Units

Map IV

**4.4.1.1. Title of curricular unit:**

**Decision Support Methods**

4.4.1.2. M

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2 Teacher: Maria do Céu Marques

4.4.3. Other teachers:

Deolinda Rasteiro

Jorge Alexandre Almeida

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students): To present the potential of decision support methods for linear, nonlinear and stochastic cases in the context of monitoring, research and operational management, with particular emphasis on formulation/troubleshooting decisions within the Industrial Engineering and Management, and also to introduce and work with the existent useful tools to obtain optimal solutions.

4.4.5. Syllabus:

I. Deterministic models: formulation and model development. Models based on linear programming. Sensitivity analysis. Analysis of large variations. Integer programming based models. Non-linear models. Formulation of problems. Optimization without restrictions on one or more variables. KKT conditions to nonlinear optimization with constraints. Programming: separable convex quadratic, non-convex. II. Nondeterministic models: decision theory. Probabilistic and non-probabilistic methods. Decision criteria in uncertainty. Value of information. Exponential utility functions. Utility, indifference and risk. Risk premium. Decision criteria with risk. III. Decision trees: decision nodes, states and alternatives. Selection, qualification and assessment of alternatives. Bayes analysis in estimating probabilities. Information value. Sensitivity analysis. Contingency plans. Utility theory.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The proposed program contents cover both a component of complements to the learning already acquired during the degree, as well as the introduction of new fundamental subjects for this master's degree. Complemented by the use of computational tools, these contents allow the students to have the necessary knowledge to perform a data analysis properly.

4.4.7. Teaching methodologies (including students' assessment):

The teaching methodologies are the followings: Lectures by the teacher; Practical exercises by students (whenever possible applied to Industrial Engineering and Management).

Evaluation consists of one written exam (70% weighting), with a minimum of 7 values out of 14, and one work with written report and oral presentation (30% weighting). Alternatively, the evaluation can be made through a final written exam (100%).

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: In the theoretical classes will be presented the concepts referred in the programmatic contents. These concepts are then applied and interpreted in theoretical-practical classes, using real data whenever possible.

The use of computational languages will facilitate this application.

4.4.9. References:

L. Valadares Tavares, “Investigação Operacional”, 1996, McGraw Hill.

F. Hillier, G. Lieberman, “Introduction to Operations Research”, 2004, McGraw Hill. Operations management, J. Heizer e B. Render, 5 Ed., Prentice Hall, 1999.

Management Decision Making, George E. Monahan, Cambridge Univ. Press, 2000

Carlos Henggeler Antunes, Luís Valadares Tavares, (coordenadores), Casos de Aplicação da Investigação Operacional, McGraw-Hill, 2000.

R. K. Ahuja, T. L. Magnanti, and J. B. Orlin, Network flows theory, algorithms, and applications, Upper Saddle River, Prentice-Hall, 1993.

Material de apoio (textos e exercícios práticos) disponibilizado no moodle.

**4.4.1.1. Title of curricular unit:**

**Data Analysis and Processing**

4.4.1.2. M

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Nuno Filipe Jorge Lavado

4.4.3. Other teachers:

Luís Margalho

Jorge Alexandre Almeida

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

Objectives

Understanding the basic concepts to perform data analysis, using computational tools. Competences

- Acquire the essential "language" related to data treatment and analysis allowing students to autonomously develop their future professional projects, as well as the capacity to integrate multidisciplinary teams of experts and clients.
- Know how to code using the programming languages and report results of data analysis.

4.4.5. Syllabus:

Introduction to data analysis – types of data. Statistic importance. Milestones of a statistical study. Design of experiments.

Descriptive statistics – Data summary and display. Indicators of central location and variability. Indicators of symmetry and skewness. Correlation and independence.

Statistical inference – Estimation and hypothesis testing. Inference on parameters of a Normal population and others.

Statistical models. Goodness of fit and independence.

Reliability – Basic concepts. Most relevant parametric models. Applications.

Regression models – Simple and multiple linear regression. Checking model adequacy. Nonlinear models. Classification methods.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

The proposed programmatic contents include both a complement of the knowledge acquired before enrolling in this M.Sc., as well as the introduction of new fundamental topics related to this M.Sc.

Complemented by the use of computational tools, the programmatic contents will provide student the knowhow to perform data analysis.

4.4.7. Teaching methodologies (including students' assessment):

The theoretical lectures will consist of exposition of concepts. In the theoretical-practical classes the students will conducted small projects and solve exercises under teachers' supervision.

The evaluation will consist in 2 (two) projects, each quoted for 10 (ten) values, or in 1 (one) test and 1 (one) project, each quoted for 10 (ten) values, or in a final exam quoted for 20 (twenty) values.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: In the theoretical lectures concepts mentioned in the programmatic contents will be introduced. Afterwards, these concepts will be applied and its interpretation discussed in the theoretical-practical classes, using whenever possible real data. The use of computational tools will facilitate these applications.

4.4.9. References:

Ross, S. – Introduction to Probability and Statistics for Engineers and Scientists, Elsevier

Ryan, T. – Modern Engineering Statistics, Wiley

Reis, E. – Estatística Multivariada Aplicada, Edições Sílabo

Farinha, J. - Asset Maintenance Engineering Methodologies, CRC Press

**4.4.1.1. Title of curricular unit:**

**Logistics**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Silvino Dias Capitão

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students): The objective of the curricular unit is to develop skills related with management of logistics chain (planning, transportation, warehousing and handling of goods), including management of services in the supply chain. It also aims to raise the students' awareness of the importance of issues related with supply chain management in an integrative perspective of all actors and flows involved in the chain, taking into account the requirements placed to logistics, management and monitoring decision-making process.

The curricular unit also intends to give the students a conceptual support that gives them a comprehensive view of the supply chain, the logistics function, the transport and distribution mechanisms, as well as an adequate perception of the proposed methodologies to plan and manage of the supply chain's operation.

4.4.5. Syllabus:

1. Logistics and Supply Chain: transport;

2.Decision models: routing planning (single vehicle and multiple vehicles); the classic transportation problem; the transexpedition problem; flow models (minimum cost flow; maximum flow). Location problems of infrastructures (single equipment, multiple equipment, discrete location problems: simple location with and without capacity limits, p-median problem, coverage problem, p-centre problem).

3. Planning and analysis of logistic chains based on GIS (Geographic Information Systems), by using maps and georeferenced information: best route; closest equipment; attainable services from a specific point; Vehicle routing; location-allocation of equipment.

4. Warehousing: Typologies of Warehouses; Basic Warehousing Operations; Warehousing and Handling Systems; Design; Layout; Current tendencies of warehousing.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

The presented syllabus allows the students a conceptual perception of the supply chain in what concerns the players involved and their functions, the real and informational flows and the relations between the different players. By acquiring competencies on the conceptualization of the entire supply chain, students can strengthen the study of these systems through their modelling, by using decision support methods, modelling routes, flows, equipment location, and actions that affect the quality of customer response. Students will use conventional optimization tools, while they will have also the opportunity to use conceptual models in tools that use SIG to take advantage of location information to model the reality of logistics systems.

Storage systems will also be approached in order to develop critical analysis skills on the operation of existing infrastructures, in order to propose operation improvements, promoting greater efficiency and effectiveness.

4.4.7. Teaching methodologies (including students' assessment):

Case studies: students carry out analysis of solutions in a professional context to solve complex problems; Group learning: students work in groups to solve a particular problem and learn to work in a team in an efficient way;

Discussion: there is an exchange of ideas in groups of 5 to 20 students;

Practical work: students develop solutions to practical problems or develop practical projects;

Written and oral presentation of reports: students present certain topics, reports or projects, in written and / or oral form;

Seminars: experts present certain topics followed by question and answer sessions.

Assessment: final exam on theoretical and theoretical-practical topics with a weight of 70% in the final grade.

Group research project, with compulsory presentation and discussion, with a weight of 30% in the final grade. Approval is obtained with a final mark of not less than 9.5 in 20.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The teaching methodology used allows the student to learn from the teacher and through independent research. The inquisitive process used in the theoretical-practical lessons allows students to face relevant questions about certain subjects, urging them to participate in their analysis and discussion, towards the search for the best solution, or the understanding of the advantages and/or disadvantages of various solutions. In the analysis of case studies, a review of methodologies capable of applying to each case study is done and then students are encouraged to find or to design the solution, by themselves or in groups, always guided and enlightened by the teacher.

The individual or in group research task develops teamwork performance, requires the autonomous interpretation of scientific and technical texts, promotes self-learning, and develops the capacity of analysis, synthesis and writing reports. This type of tasks is

also useful to develop the capacity of students to justify the decisions made and options taken, through argumentation and discussion.

4.4.9. References:


- Ballou, R. (2004). Business Logistics / Supply Chain Management, Pearson Education, 5ª Edição.
- Carvalho, J. (Coordenador) & outros (2012). Logística e Gestão da Cadeia de Abastecimento, Edições Sílabo, 1ª Edição (ISBN: 978-972-618-598-7.
- Costa, J. Dias, J. Godinho, P. (2010). Logística, Imprensa da Universidade de Coimbra (ISBN: 978-989-260040-6).
- Hensher, D., Button, K. Haynes, K., Stopher, P- 2008). Handbook of Transport Geography and Spatial Systems, Emerald Group Publishing Limited (ISBN: 978-0-0804-4108-5).
- Grant, D. & outros (2006). Fundamentals of Logistics Management, McGraw-Hill.
- Rushton, A. Croucher, P. Baker, P. (2006) The Handbook of Logistics and Distribution Management. The Chartered Institute of Logistics and Transport (UK), 3rd Edition.


**4.4.1.1. Title of curricular unit:**

**Financial Management**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: José Luís Ferreira Martinho

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students): The main goal of this course is to provide students with the essential knowledge of financial management, such as the time value of money, the value creation with the investment methods appraisal, the financial report and financial analysis.

At the end of this course, students should be able to:

i) Understand the main principles of financial management ii)
Understand and apply the methods of investment appraisal iii) Compare
and Select different financing sources

iv) Understand the information contained in the different financial statements

v) Analyse the different kind of information required to report and judge the overall economic and financial status of the company vi) Evaluate different alternatives and justify the proposed solutions vii) Communicate written and oral, in the context of group work.

4.4.5. Syllabus:

Principles of Financial Management

- Time Value of money. Long-term Financial decisions: Capital Investments and Financing the business. Financing the business.

Making capital investment decisions

- Types of investment and the nature of investment decisions. Methods of investment appraisal.

Financial Report

- The major financial statements: Balance sheet, income statement and cash flow statement. The effect of trading

operations on the financial statements Basics of
Taxation

- Portuguese tax systems: main direct and indirect taxes. Main Impacts of taxation on Financial Management and Report

Analysing and interpreting financial statements

- Profitability, financial and risk ratios. The nature and impact of working capital. Cost–volume–profit analysis Budgeting

- Budgets, long-term plans and corporate objectives. Using budgets for control and the variance analysis.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

The main objective of this curricular unit is to provide basic knowledge of financial management and the fundamental principles of financial theory. The Syllabus is developed from the concepts of the time value of money and the long-term financial decisions: the analysis of investments and the financing of organizations. The understanding of financial reporting, due to the correct interpretation and analysis of financial statements, is also important to provide students with the essential knowledge about the financial management of organizations.

4.4.7. Teaching methodologies (including students' assessment):

The learning process begins with the presentation of the fundamental concepts by the lecturer, followed by the resolution of practical exercises, illustrating the concepts and techniques discussed. During the semester, students should do autonomously two assignments, including written reports and presentations. The final grade also includes a final exam.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: In order to achieve the above learning objectives, it is fundamental to acquire the underlying theoretical concepts, as well as their application in practical cases. In this way, this course focuses on the performance of work autonomously, outside of classes, and its presentation and defense, fundamental for exercising and evaluating communication skills and self-learning.

4.4.9. References:


- Atrill, P. e McLaney, E. - Accounting and finance for non-specialists, Prentice Hall, 5th ed ,2006

- Brealey, R. e Myers, S. - Principles of corporate finance, McGraw-Hill/Irwin, cop., 7th ed., International ed., 2003

- Fernandes, R. F. - Contabilidade para não contabilistas, Almedina, 2ª ed, 2008.

- Mota, António Gomes & et al. (1997). Gestão financeira: casos práticos. 2ª ed., Centro de Investigação de Mercados e Activos Financeiros

- Nabais, C. e Nabais, F. - Prática Financeira I – Análise Económica e Financeira, Lidel, 5ª ed., 2009.

- Nabais, C. e Nabais, F. - Prática Financeira II – Análise Económica e Financeira, Lidel, 5ª ed., 2009.

- das Neves, J. C. - Análise Financeira: métodos e técnicas, Texto Editora, 5ª ed., 1991

- Quelhas, Ana Paula & Correia, Fernando (2009). Manual de matemática financeira. Almedina

**4.4.1.1. Title of curricular unit:**

**Energy Management**

4.4.1.2.EE

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Dulce Helena de Carvalho Coelho

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

The main aims of this course unit are:

To familiarize students with the basic concepts of energy management

To know the tariff legislation

To learn the methodology, phases and expected outputs of energy audits in industry

To learn about technologies and systems for improving energy efficiency

To help students to develop the knowledge and analytical skills needed for a successful career in the energy sector, in terms of energy policy analysis and energy management At the end of this course unit the learner is expected to be able:

To become familiar with the concepts related to energy use and efficient use of energy

To analyse electricity bills

To know how to prepare and perform energy audits

To know to apply energy consumption rationalization plans

To investigate and choose efficient technological solutions and be able to argue with the employer or client.

4.4.5. Syllabus:

Introduction to Energy Management. Global, European and National energy trends: by fuel and by sector.

National Energy Characterization. Portuguese Energetic Balance. The policy background to energy efficiency.

Electric rate structures - Understanding Electric Rate Structure and Billing.

Energy Audit in Industrial Facilities. Objectives; Types of energy audits; Methodology and energy audit equipment; Energy Audit results. Energy analysis - Sankey diagrams. Preparing an energy audit report. The Energy-Intensive Consumption Management System (SGCIE). Energy Consumption Rationalization Plan (PREn). PREn Report structure.

Rational Use of Energy (RUE). Strategies for Energy Savings in Industry. Power reduction; Power factor correction; Lighting systems; Electric Motors; Compressed Air; Steam and Process Heating Systems; Heat Recovery. Renewables in Industry. ISO 50001 – Energy Management System. Overview of ISO 50001 Standard.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

In a first approach, the contents of this curricular unit focus on the study of introductory concepts in the field of Energy Management, in particular the Global, European and Portuguese energy panorama, energy sustainability and the rational use of energy. In a second phase, other topics are analyzed, namely energy audits, with special emphasis on the industrial sector, actions to promote the rational use of energy in industrial facilities and the development of Energy Consumption Rationalization Plans for energy-intensive facilities. The implementation of Energy Management Systems under NP EN ISO 50001 will also be addressed. Finally, the concepts learned are applied in case studies that allow the assessment of energy efficient measures in economic, environmental and energetic terms.

4.4.7. Teaching methodologies (including students' assessment):

Theoretical classes: a theoretical explanation of the whole subject is presented, complemented with the presentation of different case studies. Theoretical-practical classes: resolution of theoretical-practical exercises and case study analysis to apply the knowledge acquired; preparation of small practical works; use of various monitoring equipment. The student also has 6 hours of weekly support (office hours). The evaluation will be done by final exam, without consultation.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The teaching methodologies are in line with the objectives of the curricular unit. Along theoretical classes, the subjects are explained and the discussion of the different themes are allowed, taking into account the students' knowledge level and their doubts. Some small case studies adapted to different subjects will be presented.

The practical classes are fundamental for the resolution of case studies according each subject, allowing the student to learn and apply the acquired concepts throughout the semester, with their autonomous work and with the help of the teacher.

4.4.9. References:

National and European regulations / legislation.

Dulce Coelho. Auditorias Energéticas e Força Motriz.

Vitor Magueijo et al. Medidas de Eficiência Energética Aplicáveis à Indústria Portuguesa: Um Enquadramento Tecnológico Sucinto. ADENE, (2010).

OECD/IEA. Energy Management Programmes for Industry (2012).

Industrial Energy Audit Guidebook: Guidelines for Conducting an Energy Audit in Industrial Facilities (2010).

Patrik Thollander and Jenny Palm. Improving Energy Efficiency in Industrial Energy Systems (2013). US DoE. Department of Energy. A Guide to Energy Audits (2011).

IIASA. Energy End-Use: Industry (2014).

World Energy Council. Energy Efficiency Potentials and Barriers for Realization in the Industry Sector (2013).

UNIDO. Energy efficiency in developing countries for the manufacturing sector (2011).

AEP - Casos de utilização de energias renováveis (2010).

HKEIA. Guidebook for ISO 50001 Energy Management System (2013). AIDA. Sistema de Gestão Energética Guia Prático (2014).

**4.4.1.1. Title of curricular unit:**

**Metrology**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2Teacher: Elói Pereira

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

1. Familiarization and capacity for the use of physical quantities and units of measure
2. Familiarization with the fundamental concepts necessary to the act of measuring
3. Ability to differentiate, interpret and statistically management of the measures, errors and uncertainties
4. Familiarization with the different types of metrology
5. Familiarization and ability to design the process of metrological control of measurement equipment
6. Ability to design a metrology laboratory

4.4.5. Syllabus:

1.Metrology

-History

-Concepts

-Precision vs. Accuracy vs. Veracity

-Calibration vs. Verification vs. Adjustment vs. Testing

-Pattern

-Traceability

2.Analysis of errors

-Fundamental concepts of statistics

-Measurement error

-Type of errors

-Measurement uncertainty

-Types of uncertainty

-Identification and modelling of sources of uncertainty

-Propagation of uncertainty

-Results presentation

3. Calibration and test procedure

- Characterization of the equipment to be calibrated

-Pattern

-Protocols

-Manual, semi-autonomous and autonomous calibration

-Programming languages for calibration processes

- Physical Interfaces

-Criterion of Acceptance

- Calibration and test certificates

4.Laboratory calibration

-Organization of a calibration laboratory and tests

-Control of environmental conditions

-Materials control data bases

-Logistics chain

-Quality management system

-Standards (IEEE, DIN, AFMETCAL, etc.), (ISO 9001, ISO 10012, ISO / IEC 17025) -Accreditation of a calibration laboratory

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

- The content of point 1 provides theoretical and practical skills to answer the learning objectives of points 1, 2 and 4;
- The programmatic contents of point 2. focus on providing students with mathematical tools in order to address the learning objective 3;
- The contents of point 3. focus on enabling the student with practical skills in the field of calibration and testing. These skills contribute directly to the learning objective 5;
- The contents of section 4. allow the student to have a transversal view of the technical and formal requirements inherent to the implementation of a calibration and test laboratory. These skills directly contribute to the learning objective 6.

4.4.7. Teaching methodologies (including students' assessment):

1. Theoretical classes with incidence in the programmatic contents;
2. Practical classes aimed at clarifying doubts about homework and final project
3. Homework
4. Evaluation tests
5. Final project

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: ● The theoretical classes as well as the assessment tests allow to provide and to assess the fundamental bases necessary to address all the learning objectives;

- Practical classes as well as homework focus primarily on providing the practical skills needed to meet the learning objectives 3, 4 and 5;
- The final project aims to expose students to the problems inherent to technical and quality management in a calibration and testing laboratory. It aims at learning objective 6.

4.4.9. References:


- Taylor, J. (1997). Introduction to error analysis, the study of uncertainties in physical measurements. ● Joint Committee for Guides in Metrology. (2008). International vocabulary of metrology—Basic and general concepts and associated terms (VIM).
- ISO (2005, May). ISO/IEC 17025: 2005 General requirements for the competence of testing and calibration laboratories. In ICS (Vol. 3, p. 20).
- Bucher, J. L. (Ed.). (2012). The metrology handbook. ASQ Quality Press.


**4.4.1.1. Title of curricular unit:**

**Physical Asset Management**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Hugo David Nogueira Raposo

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

The objective of this unit course is to provide students with knowledge about Physical Asset Management. It is intended that students to develop skills that allow them, in conceptual and practical, to understand the concepts related to the analysis, evaluation and management of physical assets taking into account the binomial replacement/profitability; to identify and be able to use the major asset management and replacement models. To determine whether a major repair or technological upgrade is economically feasible and when equipment should be replaced in an economic perspective or in a perspective of technological obsolescence. To know the performance evaluation techniques, cost models and indicative values for different types of assets. Accounting for economic, financial, social and environmental costs. To know how to define the benefits of an asset. To know the models of cost-benefit in time, deterministic and random. To know the recommendations of ISO 5500X (0, 1,2).

4.4.5. Syllabus:

1. Contextualization of physical asset management; organization's policy and vision;
2. Scope of management of Physical Assets: Financial; Physical spaces; Operational; Human Resources;
3. Elements of the Asset Management System: General Requirements; Asset Management Policy and Strategy;
4. Asset management information; Risk assessment and planning; Implementation and Operation;
5. Control of maintenance management performance and performance indicators for Physical Assets;
6. Organization of the Asset Park;
7. Asset acquisition and replacement - Analysis and decision models;
8. Life Cycle Analysis (Life Cycle Cost - LCC versus Life Cycle Investment - LCI): Econometric models for life cycle analysis;
9. Investment Analysis versus Life Cycle Analysis;
10. Decision Support Model in Physical Asset Management;
11. Technological trends and obsolescence;
12. Support standards for Physical Asset Management: ISO 55000; ISO 55001; ISO 55002.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The programmatic content described enables us to enable future professionals with the necessary knowledge to use the best engineering practices for property:

Propose alternatives to obsolete design of organizational structures, leading to improved reliability and availability of Physical Assets and consequent reduction of maintenance costs;

Adopt the most appropriate maintenance policies for each case based on the importance of each Physical

Asset to the Organization and the consequences of the failures that occurred;

Construct key indicator structures that allow continuous monitoring of the performance of the management of maintenance of Physical Assets;

Judge of the opportunity to carry out major repairs or modifications to existing Physical Assets or simply replace them with the objective of continuously improving the quality and / or reducing the cost of the services provided.

Know and apply the Standards of support to Physical Asset Management.

4.4.7. Teaching methodologies (including students' assessment):

The content's presentation is carried out during the T classes, using as main support the projection of slides. The student’s participation is often raised through the formulation of questions that reflect on the different subjects discussed and create opportunities to clarify doubts.

In the TP classes, application problems are solved, allowing students to get in touch with practical questions and critical analysis of the results obtained. Some of the TP classes will be used to carry out research work in order to prepare the individual work report.

Final evaluation by examination in the form of written test, with a maximum duration of 3 hours, defined in accordance with REACTA.

An evaluation component with a maximum weighting of 25%, resulting from the intervention of the student and/or submitted work; the classification matrix of this component is defined at the beginning of the semester.

(Final grade = 0,75 NE + 0,25 NT (NE- Exam note; NT- Note of student work or intervention)).

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: In the theoretical classes the theoretical contents are exposed using methods of exposition supported in PowerPoint projections of concepts and figures.

Practical theoretical teaching is intended to complement the training of students in subjects that are largely new to them and are intended to motivate them to study concrete engineering problems in which they have to apply fundamental knowledge of management, maintenance, economics, mathematics and mechanics for its resolution.

The theoretical-practical problems that are proposed in the classes and in the evaluation tests are intended to consolidate and test the knowledge and to foster the mathematical formulation of the problems and the proposal of innovative solutions, rigorous or simplified, for problems of increasing complexity.

The clarification of doubts and the discussion of different approaches to the problems generate interactivity during the classes. Examples of application in the companies of the concepts described in the lesson are narrated by the Teacher for greater motivation of the students.

The visit to the laboratories and some industrial facilities will put the students in contact with a varied number of application cases.

Occasionally students may participate in some ongoing study or research in connection with any research project or service contract related to the discipline program.

4.4.9 References:

FARINHA, J. (2018): Asset Maintenance Engineering Methodologies. CRC Press; 1st ed. English. ISBN-10:

1138035890. ISBN-13: 978-1138035898

FARINHA, J. (2011): Manutenção – A Terologia e as Novas Ferramentas de Gestão. MONITOR, Lisboa, Portugal.

ISBN 978-972-9413-82-7.

FARINHA, J. (1997): Manutenção das Instalações e Equipamentos Hospitalares - Uma Abordagem Terológica, Livraria Minerva, Coimbra, 1997. ISBN: 972-8318-16-2.

ASSIS, R. (2010): Apoio à decisão em manutenção na gestão de activos fisicos. Lisboa: 1ª Ed., Lidel. ISBN:

9789897521126.

CABRAL, J. S (2006): Organização e Gestão da Manutenção. Lisboa: 6ª Ed., Lidel. ISBN: 978-972-757-440-7.

Pinto, C. V. (2002): Organização e Gestão da Manutenção. Lisboa: 2ª Ed., Monitor. ISBN: 972-9413-39-8. Amaral, F. D. (2016): Gestão da Manutenção na Indústria. Lisboa: 1ª Ed., Lidel. ISBN 978-989-752-151-5. Haarman, M., Delahay G. (2012): Value Driven Maintenance - New Faith in Maintenance. 3rd edition, Mainnovation. ISBN 90-808270-2-9.

**4.4.1.1. Title of curricular unit:**

**Special Physical Assets**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Jorge Rafael Nogueira Raposo

4.4.3. Other teachers:

<sem resposta>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students): The goal of this subject is to provide students the knowledge about the special physical assets applied on the various areas of engineering sciences. It is aimed that the students know the special assets, applications and functions as well as working principles, knowing how to select equipment among the many studied areas of the subject.

4.4.5. Syllabus:

Electromechanical equipment: Electric motors. Cutting, protection and control equipment. Frequency inverters. PID. Sensors. Power amplifiers. Photovoltaic panels. Condensers. Command, supervision and safety automation.

HVAC: UTAS, AC systems, fans, conduits.

Machines and tools: Mechanical and hydraulic presses, Lathes, Milling, Drilling machine and CNC. Cutting and welding equipment.

Fluid networks: Piping, valves, reservoirs, leak detection systems and auxiliary equipment.

Systems for the prevention and combat of urban and forest fires: Hydrant systems, detection and alarm. Active and passive combat systems, Management and combat, fuel management, simulators and SAD. Vertical transport: Chains; slings; Differentials; Claws and stingrays; Pusher and bivouac cars Kitchens and laundry equipment.

Biomedical equipment: diagnosis, treatment, monitoring and life support.

Equipment for sterilization / disinfection: Autoclaves, Sealing machines, Distillers. Emergency generators and UPS.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The study of special physical active global characteristics allows students to know the parameters that regulate their operation and performance and to realize the diversity of configurations and applications that they can assume. Giving them selection, sizing and usage criteria.

In the study of each family of assets will be analysed its applications and principles of operation from the bases of the disciplines of applied mechanics, physics, fluid mechanics, thermodynamics, electric machines and combustion engines. The characteristics of the main types of existing equipment will be studied, allowing students to understand the way they operate and their design and operation process.

The development of the work gives the students an opportunity to synthesize the knowledge acquired in this and other disciplines related to the selection and design of an equipment that must fulfil pre-defined characteristics.

4.4.7. Teaching methodologies (including students' assessment):

The teaching of the contents is essentially carried out during the theoretical classes, using as main support the projection of slides. In these classes, student participation is often raised through the formulation of questions that lead them to reflect on the different subjects discussed and create opportunities for clarification of doubts. In the theoretical-practical classes, application problems will be solved, allowing students to get in touch with practical questions and a critical analysis of the results obtained. Some of the theoretical-practical classes will be used to carry out research work in order to prepare the individual work report.

The Evaluation method will be based on the development of a work related to one of the areas covered in the classes and in final written exam.

(Final grade = 0.5 EN + 0.5 WN (NE- Exam note; WN- Work note)

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: Practical/theoretical teaching is intended to complement the training of students in subjects that are already comprehended, and are intended to motivate them to study concrete engineering problems in which they have to apply fundamental knowledge of mathematics, mechanics and thermodynamics for its resolution.

The theoretical-practical problems that are proposed in the classes and in the evaluation tests are intended to consolidate and test the knowledge and to foster the mathematical formulation of the problems and the proposal of innovative solutions, rigorous or simplified, for problems of increasing complexity.

The presentation of a specific physical asset to the remaining students, usually using didactic equipment in the ISEC plants, has the purpose of providing to the students the contact with the processes of operation of the assets, in order to verify the validity of the theoretical and applied concepts, as well as to confronted themes with questions of selection of the assets.

The visit to the laboratories and some industrial facilities will put the students in contact with a varied number of application cases.

Oral discussion of group work allows students to assess and improve their oral communication skills in order to present and defend their ideas.

Occasionally students may participate in some ongoing study or research in connection with any research project or service contract related to the discipline program.

4.4.9. References:


- J. M. Torres Farinha (1997), Manutenção das Instalações e Equipamentos Hospitalares: Minerva
- Barbara L. Christe (2009): Introdution to Biomedical Instrumentation: Cambridge University Press
- John G. Webster, Editor (2009): Medical Instrumentation: Fourth Edition
- Luis Adriano Oliveira, António Gameiro Lopes; Mecânica dos fluidos. ISBN: 972-8480-13-X
- Raposo JRNR (2016) Extreme Fire Behaviour Associated to Merging of Two Linear Fire Fronts. Coimbra.
- Handbook – Fundamentals.: ASHRAE 2005 ASHRAE
- Handbook - HVAC Systems and Equipment.: ASHRAE 2004 ASHRAE
- Handbook - HVAC Applications.: ASHRAE 2003 ASHRAE
- Handbook – Refrigeration: ASHRAE 2002 ASHRAE
- Principles of Heating, Ventilating and Air-Conditioning Solutions Manual.: ASHRAE 0000 ASHRAE
- Electrical Machinery: A. E. Fitzgerald, Charles Kingsley, Stephan D. Umans, McGraw - Hill 6ª Edição


**4.4.1.1. Title of curricular unit:**

**Physical Assets and Cross Infection**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: José Pedro Figueiredo

4.4.3. Other teachers:

<no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students): To know the most relevant concepts about cross infection, applicable to the physical assets of the organizations.

4.4.5. Syllabus:

1- IACS FRAMEWORK

- IACS historical framework;

- National Program for Prevention and Control of IACS (PNCI) - action strategies;

2- IACS EPIDEMIOLOGICAL SURVEILLANCE

- General principles;

- Intervention areas;

- Organization of the active surveillance system;

3- CONTROL OF COLONIZATION AND IACS SURVEYS

- General aspects;

- Preferential surveillance: more frequent infections; areas and patients at risk; procedures;

- Rules relating to specific situations;

4- GENERAL IACS PREVENTION AND CONTROL STANDARDS

- Personal hygiene;

- Environmental control;

5- HYGIENIZATION / STERILIZATION

- Cleaning, decontamination and disinfection of the physical and material environment;

- Recommendations on disinfectants;

- Sterilization methods;

6 - GENERAL MEASURES OF HYGIENE

- Circuit of hospital waste;

- Hospital clothing circuit;

- Power supply circuit;

7- OCCUPATIONAL BIOSECURITY PRECAUTIONS

- Accident at work with biological risk; -
Prevention of occupational risks.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The syllabus establishes a systematic bridge with the Organizations, so, face the theoretical exposition made by the teacher, practical cases will be presented.

4.4.7. Teaching methodologies (including students' assessment):

Theoretical classes, practical classes, visits to institutions, application of questionnaires.

The Assessment will consist in the development of a work related to one of the subjects addressed in the curricular unit and in a final Exam in the times predicted by the ISEC' rules.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The programmatic contents establish bridges with the Organizations, according to their nature, to better emphasize the different aspects that the cross infection may assume.

In addition, study visits may be made to several organizations in different areas of activity, as mentioned above, to consolidate the above methodological approach.

4.4.9. References:


• Richard P. Wenzel (2002): Prevention and Control of Nosocomia Infections. LWW; Fourth edition. ISBN-10:

0781735122. ISBN-13: 978-0781735124

• AdvanceCare. (2017). O que é a legionella? https://advancecare.pt/artigos/saude-e-bem-estar/o-que-e-a-legionella. Acedido em 30 de Outubro 2017.

• Agência Nacional de Vigilância Sanitária. (2017) Intervenções e medidas de prevenção e controle da resistência microbiana - Brasil http://www.anvisa.gov.br/servicosaude

https://www.rch.org.au/quality/clinical_risk_management/. Acedido em 30 de Outubro de 2017

• Direção Geral de Saúde (2014). Prevenção e Controlo de Infeções e de Resistência aos Antimicrobianos em números (2014) - Programa de Prevenção e Controlo de Infeções e de Resistência aos Antimicrobianos, Lisboa.


**4.4.1.1. Title of curricular unit:**

**Organization and Maintenance Management**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: José Manuel Torres Farinha

4.4.3. Other teacher: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

• To learn:

o the organizational models that support the management; o the Maintenance Management tools that optimize the cost of the life cycle; o the management tools that allow to optimize the acquisitions and substitutions; o the Maintenance state diagnostic tools that allow you to organize a maintenance department; o to apply the maintenance standards that allow the certification of maintenance services; o to use dynamic modelling techniques to solve complex maintenance problems.

• To know: o to act in a Maintenance department at the level of Management and related functions;

o to dialogue with the various departments that interact with the maintenance department, namely at the level of the preparation of documents and processes;

o to develop a framework of KPI, integrated with the organization's KPI;

o to address the implementation of maintenance standards; to find, autonomously, the real solutions to the real maintenance' problems at the state of the art.

4.4.5. Syllabus:

The maintenance function at nowadays. NP 4492/2010: NP 4483: 2009; NP EN 13269: 2007; NP EN 13306: 2007; NP EN 13460: 2009; NP EN 15341: 2009; CEN / TR 15628: 2007.

The organization and the maintenance management. The maintenance control. The Maintenance planning: The various types of planning. The implementation of a planning strategy. The maintenance and management of the life cycle of physical assets. The Life Cycle Investment (LCI) and the importance of implementing a maintenance policy. The Organizational models and maintenance management: 5S; TPM (Total Productive Maintenance); Lean maintenance.

The Life Cycle Management of Physical Assets: Acquisition of Equipment; Elaboration of the specifications - Selection - Reception and Installation - User Training.

Diagnosis of the Maintenance Status: Holistic Method of Diagnosis; Establishment of an action plan for improvements.

Dynamic Modelling: Fault Trees; Fuzzy Logic; Diffuse trees of failure; Markov chains; Petri nets.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

The contents correspond to the State of the Art aiming at the Pedagogical Objectives and the competences that are intended to be assigned to the students, with the objective to establish a bridge between these and the Organizations.

This approach aims enhancing the value that graduates will add to the Organizations where they will practice (or today's practice) their professional activity.

4.4.7. Teaching methodologies (including students' assessment):

Teaching methodology:

• Theoretical exposition by the teacher;

• Exercise resolution and critical analysis of case study by the teacher;

• Resolution of exercises and case study by the students.

Evaluation:

• The evaluation of the Unit Course will be done by final examination and continuous evaluation through group work, with a maximum of two students per group.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The programmatic contents establish systematic bridges with the Organizations; so, face the theoretical exposition made by the teacher, it is important to present practical cases and, in some cases, the resolution of exercises.

It is important to point out that computerized resources will be used in various situations, such as simulations and application of tools, namely open source software.

Additionally, they would be made study visits to reference companies within the scope of the Unit Course of Organization and Maintenance Management.

4.4.9. References:


1. José Manuel Torres Farinha (2018): “Asset Maintenance Engineering Methodologies”. CRC Press; 1st edition

(May 29, 2018). English. Printed in USA. ISBN-10: 1138035890. ISBN-13: 978-1138035898

2. José Manuel Torres Farinha (2011): “Manutenção – A Terologia e as Novas Ferramentas de Gestão”. MONITOR, Lisboa, Portugal. ISBN 978-972-9413-82-7.
3. Norma NP 4492:2010 e Normas constituintes: NP 4483:2009 - NP EN 13269:2007 - NP EN 13306:2001 – NP EN ISO 9000 - NP EN 13460:2009 - NP EN 15341:2009 - CEN/TR 15628:2007.
4. Technical and Scientific papers.


**4.4.1.1. Title of curricular unit:**

**Maintenance Technologies**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Inácio Adelino da Fonseca

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

Choose and determine the best technology to use as EAM;

Choose and determine the best technology to use as CMMS;

Choose and determine the best technology to use as an IOT platform;

Choose and determine the best technology to use as Big Data analysis platform;

Choose and determine the best technology to use as expert system, augmented reality;

To study, choose and determine how to interconnect the existing ones, so as to a correct functioning;

Design an integrated total system through the use of commercial, academic or research products;

Perceive the technologies to support maintenance activities and design and design a systems supported in coherent and functional choices.

4.4.5. Syllabus:

EAM / CMMS and online reading of the sensors.

Automatic registration in the CMMS: Automatic creation of the equipment dossier; Automatic Creation of Maintenance Plans; Automatic Creation of Calibrations and Verifications.

Real-time interaction. Remote Maintenance. IOT. Big data.

Equipment: Self-diagnosis system and real-time communication.

Automatic integration of the Virtual model, for use with Augmented Reality and Artificial Vision.

Automatic location system.

Autonomous, interactive robots and maintenance support logistics.

Expert Systems; Artificial vision; mixed vision; augmented reality.

Protocols and interoperation of data between information systems.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The typical features of the EAM and CMMS tools and real cases of tools on the market are presented. As a case study for several devices, the data is inserted manually into one of the software tools. The volume of nonproductive work in this operation is discussed, and what should be typified for the automatic creation of equipment, maintenance, calibration and verification plans.

The second phase presents the problem of equipment sensing and the transmission of data to a centralized system and existing technologies. In the third phase they are presented the technologies that allow the treatment of the data generated by the measurement systems in real time. In the fourth phase, the technologies that allow the organization of preventive maintenance work, namely the interconnection with the operating organization (purchasing and logistics), ways of facilitating the work of technicians are presented. The interoperability of the various systems and associated technologies.

4.4.7. Teaching methodologies (including students' assessment):

In the theoretical classes an exposition of the material complemented with practical examples is made and in the laboratory classes are used technologies and studied cases and existing frameworks, related to the knowledge acquired in the theoretical classes Evaluation:

Evaluation of Practical work represents 50% of the final grade (10 points) with a final mark of not less than 5 points required. The other 50% follow from a written examination (10 points) with a final mark of not less than 4 points required.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: To guarantee the learning outcomes and competence acquisition, all topics are coherently integrated in the two different class types and autonomous study time. Special focus is put on the interconnection between the concepts and examples presented in the Lectures and the exercises and the experimental work to be implemented in the Practical-Laboratory classes. The sequence is carefully prepared, including practical examples in the Lectures in the format that is used in the Practical-Laboratory classes and including a synthesis of the theoretical concepts needed in a given exercise or laboratory experiment. This is done using the same formal representations and notation, supported by common bibliography that allows a uniform view of the concept to be studied.

The topics in the Syllabus, presented in the Lectures, are deepened and consolidated in the Practical Laboratory classes through the partially assisted solving of exercises and the implementation and test of experiments.

4.4.9. References:

Several materials in electronic format, through the Moodle platform, from acetates, Excel sheets, and software according to the programmatic contents.

- Farinha, José Manuel Torres, "Asset maintenance engineering methodologies", 2018, CRC Press, Taylor &

Francis Group, ISBN: 978-1-138-03589-8

- João Paulo Pinto, "Lean Maintenance", 2013, Lidel, ISBN: 978-972-757-877-1
- Rui Assis, "Supporting the Decision in Maintenance in the Management of Physical Assets", 2010, Lidel, ISBN: 978-989-752-112-6
- José Paulo Saraiva Cabral, "Organization and Management of Maintenance", Lidel
- Support texts prepared by the Teacher

**4.4.1.1. Title of curricular unit:**

**Research Methodologies**

4.4.1.2. EGI

4.4.1.3. Duration:

Semiannual

4.4.1.4. Working hours: 156

4.4.1.5. Contact hours:

30

4.4.1.6. ECTS:

6

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: José Manuel Torres Farinha

4.4.3. Other teachers:

<no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

• To learn: o to assess the relevance of the research topic; o to do the survey of the State of the Art; o to support the theme under discussion; o to structure a dissertation, a report, a project; o to structure the presentation of a research topic based on the preceding documents.

SKILLS

• To know:

o To prepare a dissertation, report, project; o to draw up a research project, and related documents; o to submit a scientific paper, project, and related documents; o to prepare a presentation of a thesis, a project, and related documents; o to present a research topic based on one of the preceding documents.

4.4.5. Syllabus:

Methods and Techniques of Scientific Research:

- Research objectives;
- Preparatory phase;
- Literature review (State of the Art):

o Sources of information (scientific, technical, other).

- Research strategy;
- Research development;
- Dissertation / Report / Project;
    - o Dissemination of results; o Definition of ways of dissemination; o Conception and execution of works for publication.
- Public evaluation / Public presentation;
    - o Contractualized research;
- Ethics and deontology.

4.4.6. Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

The contents correspond to the State of the Art aiming the Pedagogical Objectives and the Competences that are intended to be assigned to the students, with the objective to enable them to identify scientific and professional contents, as well as to prepare a dissertation and related documents and its submission and presentation in the specialized forums.

4.4.7. Teaching methodologies (including students' assessment):

Teaching methodology:

- Theoretical exposition by the teacher;
- Analysis of case study by the teacher; • Analysis of case study by students; o The previous approach will be made through systematic support of informatics systems to maximize the students' research skills and critical analysis of the contents under analysis.
- Evaluation: o The evaluation of the course unit will be done by several work groups, with a maximum of two students per group.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The contents correspond to the State of the Art aiming the Pedagogical Objectives and the Competences that are intended to be assigned to the students, with the objective to enable them to identify scientific and professional contents, as well as to prepare a dissertation and related documents and its submission and presentation in the specialized forums.

4.4.9. References:


- Sonja K. Foss (2015); "Destination Dissertation: A Traveler's Guide to a Done Dissertation". Paperback. Rowman & Littlefield Publishers; Second edition (October 23, 2015). ISBN-10: 1442246146. ISBN-13: 9781442246140
- Carol M. Roberts (2010): "The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation". Paperback. Corwin; Second edition (August 23, 2010). ISBN-10:

9781412977982. ISBN-13: 978-1412977982

- L. A. Oliveira (2012): "Dissertação e Tese em Ciência e Tecnologia" (2ª. ed.). LIDEL, ISBN-978-972-757-742-2
- Technical and Scientific papers

**4.4.1.1. Title of curricular unit:**

**Project or Internship or Dissertation**

4.4.1.2. EGI

4.4.1.3. Duration:

Annual

4.4.1.4. Working hours: 1092

4.4.1.5. Contact hours:

120

4.4.1.6. ECTS:

48

4.4.1.7. Observations:

<no answer>

4.4.2. Teacher: Master's Coordinating Committee and the other professors involved in the Master Course.

4.4.3. Other teachers: <no answer>

4.4.4. Intended learning outcomes (knowledge, skills and competences to be developed by the students):

- To develop the student's ability to plan and organize a thesis or project over a school year, through well-defined objectives, with a pragmatic timetable, leading to the successful completion of a report, a thesis or a project;
- Give the student the opportunity to demonstrate their autonomy and creativity;
- Apply the knowledge and techniques acquired throughout the course;
- Complete the training of the student, with the necessary skills to pursue a professional career in Industrial Engineering and Management.

4.4.5. Syllabus:

Three options:

1. Project of a Product, Process, or System, preferably in an organization external to ISEC, which may include two supervisors (one from the company and other from ISEC);
2. Internship (in a company), which is embodied in an internship report;3. Dissertation (R&D), which is embodied in a Master's thesis.

4.4.6. Evidence of the syllabus coherence with the curricular unit’s intended learning outcomes:

The supervision of each student is done in a personalized way according to the theme of the internship, project or dissertation.

The subject is within the scope of the scientific areas of the Master's degree.

4.4.7. Teaching methodologies (including students' assessment):

The internship, project or dissertation is accompanied by a personalized tutorial supervision.

The assessment is done through a public oral presentation and discussion of the project report, internship report or dissertation, with a maximum duration of two hours, evaluated by a jury of three to five members, including the teaching staff.

4.4.8. Evidence of the coherence between the teaching methodologies and the intended learning outcomes: The subject of the report, project or dissertation is within the scope of the scientific areas of the Master's degree.

4.4.9. References:

The bibliography and other specific study elements for each project, internship or dissertation will be indicated by the respective supervising professors and also the as the result of the research carried out by the student.