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 ECTS catalogue includes subject contents in English Language. The 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, after the student’s arrival, 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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Mechanical Engineering Department Coordinator  
Coimbra Institute of Engineering  
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3030 – 199 Coimbra  
PORTUGAL  
Tel.: (+351) 239 790 330  
calcobia@isec.pt
## ECTS CATALOGUE

**Code 6063610- MASTER Mechanical Equipment and Systems Course**

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<th>Title – English</th>
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Course Unit: MANUFACTURING TECHNOLOGIES

Subject type: Specialty Sciences  
Research Area: Mechanical Engineering

Year: 1.º  
Semester: 2.º  
ECTS: 6

Working Hours

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Total of Working Hours: 156

Lecturer

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<tr>
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<td>Pedro Miguel Soares Ferreira</td>
<td>PhD</td>
<td>Adjunct Prof.</td>
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<td>Fernando António Gaspar Simões</td>
<td>PhD</td>
<td>Coordinator Prof.</td>
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<tr>
<td></td>
<td>Vitor Manuel Maranha Lopes</td>
<td>MSc</td>
<td>Invited Assist.</td>
</tr>
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<td>Tutorial Orientation</td>
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Responsibility(s) Lecturer(s): Pedro Miguel Soares Ferreira

Goals / Skills

Sensitize students and give them to know the advanced manufacturing processes and their main applications in the industry.

Program Contents

1. **3D Modeling**
   - Importance of 3D modeling in manufacturing processes. Bases of 3D modeling. Creation of three-dimensional parametric models. From 3D geometry to 2D drawing. From 3D geometry to rendered view.

2. **EDM technology**
   - Introduction; Types of EDM; Principles of operation; Work processes and factor regulation; Electrodes and their materials; Dielectric liquids; Washing or cleaning; Surface quality; Fixing of electrodes; Wire EDM; EDM group.

3. **Reverse Engineering**
   - Introduction; Three-dimensional scanning; Surface scanning; Surface scanning and modeling; Continuous scanning; Interfaces for CAD systems; Coordinate measuring machines (CMM).

4. **Rapid Prototyping**
   - Introduction; Traditional prototyping technologies; Rapid prototyping; Stereolithography (SL or SLA); Manufacture by layers (LOM); Selective sintering (SLS); Three-dimensional printing (TDP); Fused Melted Deposition (FDM); Thermojet; Conversion of prototypes to obtain functional prototypes; Conversion of prototypes into plastic pieces; Conversion of prototype without metallic parts; Execution of production tools (RT).
5. Water Jet Technology
   Historical Introduction; Fundamentals of the process; Operative parameters; Equipment characteristics; Applications: Water jet cleaning; Cutting and; Drilling; Comparison with other methods; Safety and environment.

6. Laser Technology
   Historical Introduction; Fundamentals of the process; Main types of lasers used industrially; Laser systems; Laser cutting and drilling; Operative parameters; Equipment characteristics; Applications; Safety and environment.

7. Strategies adopted in the movement of the tool in CAM Systems
   Definition of tolerance in tool trajectory calculation; Machining strategies used in CAM programs; Influence of the machining strategies on the cutting blade.

8. High Speed Machining
   Development and characterization of high speed machining; Machine tools for high-speed work; Programming and data transmission in high speed machining.

9. Application of Manufacturing Technologies in the Production of Components for Mechanical Equipments
   Degrees of freedom of the manufacturing equipment and nomenclature of the working axes. Computer Assisted Manufacturing: EDM; Drilling and Threading; Milling by planes and Multi-axes; Reverse Engineering and Rapid Prototyping. Dimensional and surface characterization of components manufactured by different manufacturing technologies.

Work Done
Not applicable.

Teaching Methododoly
The presentation of the contents is essentially carried out in the course of theoretical classes, using as main support the projection of slides or transparencies. In the practical classes are presented and explored parts of the program that, by their nature, provide a more applied approach, where experimental activities are implemented with students intervention that allow familiarization with equipment and software used in the manufacture and dimensional and superficial characterization of mechanical components.

Bibliography
- Mastercam – software manual

Evaluation Method
The assessment of knowledge comprises a final examination of all theoretical and practical contents. The final mark is classified by assigning a grade in the scale of 0 to 20 values.

Conditions for Exam Admission
Not applicable.

Access Conditions and Attendance Excuse
Not applicable.

Conditions for Results Improvement
In accordance with the legislation and regulations.

Date

24/01/2019

Signature from the lecturer responsible for the course
Course Unit
WEAR AND CORROSION

Subject type
Specialty Sciences     Research Area Mechanical Engineering

Year 1     Semester 1     ECTS 6

Working Hours

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Total of Working Hours 160

Lecturer

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<td>Laura Maria Teixeira Santos</td>
<td>Grad.</td>
<td>Adj. Prof.</td>
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<td>João Miguel Maia Carrapichano</td>
<td>PhD</td>
<td>Coord. Prof.</td>
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<td>Grad.</td>
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<td>João Miguel Maia Carrapichano</td>
<td>PhD</td>
<td>Coord. Prof.</td>
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</table>

Responsible(s) Lecturer(s) João Miguel Maia Carrapichano

Goals / Skills
Upon completion of this unit, the student should be able to: Understand, measure and control wear phenomena in materials of mechanical components and systems; Use laboratory techniques and equipments in tribological studies and interpret experimental results; Understand the corrosion principles and common corrosion forms; Be aware of methods used to mitigate and prevent corrosion.

Program Contents

Part I – Wear
Introduction to tribology: significance, origins and objectives; economic impact. Friction and wear: friction fundamentals; surface effects in tribology - adsorption, surface topography, measurement of surface roughness; friction models; friction values and friction influent parameters; energy dissipation by friction; wear mechanisms; wear laws; wear influential parameters; wear maps. Materials for tribological applications: tribological and metallurgical compatibility; conventional and novel materials; surface preparation techniques for tribological applications; coatings and surface treatments. Lubrication and lubricants: lubrication significance and objectives; lubrication regimes; dry or solid lubrication; self lubrication; lubricant types and application; lubricant oils proprieties; viscosity; mineral oils; synthetic oils; lubricant additives; solid lubricants and coatings; gaseous lubricants; greases; transportation and lubricants applications. Mechanical components for tribological applications: bearings - journal and thrust bearings, plain and rolling bearings; seals - static, dynamic, pseudo-static.
Lubrication systems and components lubrication: plain and rolling bearings lubrication; gears and roller chain lubrication; turbines and motors lubrication. 

Tribological tests - equipments and methods; standard tests; applications.

Part II - Corrosion

Introduction to corrosion: definition; classification; corrosive environments; corrosion damage; corrosion costs; corrosion engineering.

Electrochemical fundamentals of corrosion: electrochemical reactions; standard electrode potentials; Nernst equation; electrochemical cells.

Corrosion kinetics: corrosion rate units; Fraday's law; polarisation; passivation; effect of environmental variables on the corrosion rate.

Types of corrosion: uniform corrosion; galvanic corrosion; crevice corrosion; pitting corrosion; intergranular corrosion; selective corrosion; erosion corrosion; stress corrosion.

Corrosion prevention: materials selection; modification of environment; design; metallic coatings; non-metallic inorganic coatings; organic coatings; cathodic and anodic protection. High temperature corrosion: high temperature oxidation - protective oxide films, mechanisms of oxidation, oxidation kinetics, resistance of metals to oxidation; other mechanisms of high temperature corrosion.

Work Done

Based on measurement techniques, applications and laboratory work. Wear part, mainly at P classes, introduce the use of experimental methods in tribology - to study surfaces engineering and processes of interacting surfaces in relative motion, as friction, wear, lubrication and lubricants, and to study materials for tribological applications, lubrication systems and components lubrication. At corrosion TP and P classes are study and experimented the corrosion mechanisms and forms, as the different methods of corrosion control.

Teaching Methodology

The main contents are transmitted at theory classes used expositive techniques, as PowerPoint support, to developing skills through lectures accomplished with discussions. The iterative applications as the exercises resolution are conformed on theoretical-practical lectures. Practical classes, main to developing practical skills, through lectures with individual or group discussions, consist in experimental methods applications with students hand care, that aloud the sedimentation on wear and on corrosion theoretical fundamentals and concepts and theoretical-practical bases.

Bibliography


Supporting texts (by course unit teachers).

Evaluation Method

Final written exam (75.0%); laboratory work or a case-study presented by written report or by oral presentation with discussion at wear (12.5%), and, at corrosion, practical written exam (12.5%). At wear, depending on the number of students by year, that compromises the limit of the conditioned level of practical work at laboratory plant, it will be possible the same situation - practical written question at the final exam instead of laboratory or case-study reports - and not doing the students directly and individually this laboratory practice, but watching the overall execution of the same. To Erasmus student's progress assessment can be established by lectures as complementary meetings in English language, to develop parallel written project work in a predefined subject, with individual final presentation and discussion, complementing or replacing the final written test, whether in wear or corrosion, depending on the respective teacher.

Conditions for Exam Admission

According to general rules used in the school.

Access Conditions and Attendance Excuse

It's necessary presence at 75% of practical classes. The students with positive classification on the last year at those practical examination parts, are dispensed of this presences.

Conditions for Results Improvement

Improving grades or retaking exams is allowed, according to general rules of the course and used in the school.

Date

12.10.2018

Signature from the lecturer responsible for the course
Program Contents

Course Unit

MECHANICAL STRUCTURES

Subject type
Speciality Sciences

Research Area
Engeneering Sciences

Year 1
Semester 1
ECTS 6

Working Hours

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Total of Working Hours

Lecturer

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<td>Pedro Miguel Martins Miguens Amaro</td>
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Responsible(s) Lecturer(s)

Luis Manuel Ferreira Roseiro

Goals / Skills

This curricular unit is composed of three components: theoretical, theoretical/practical and laboratory, which interconnect. In the theoretical and theoretical/practical components is intended that students acquire knowledge and skills that allow them to understand the approach to problems involving various mechanical structures, using analytical and numerical methods. In the laboratory component will be developed the necessary experimental procedures to carry out tests involving this type of structures. This approach includes the experimental application of the concepts of experimental stress analysis in the structures to be analyzed. It is intended that the students apply the theoretical and experimental concepts, implementing various works in the course of the curricular unit.

Program Contents

1. Review: International Systems of Units (SI). Concept of the internal actions and stresses. Types of internal actions and stresses. Typical structural elements. Hypotheses and basic steps in the analysis of a structure. Dimensioning principles. Standardization applicable to mechanical structures and their importance.


Work Done
The various items of this curricular unit include the execution by students of several demonstrative experimental works. The works, carried out in groups, involve analytical and/or numerical and/or experimental resolution, and comparison/discussion/interpretation of the results obtained. There may be the inclusion of research and study of the standard that involves the mechanical structure under study.

Teaching Methodology
In the theoretical component, several methodologies will be used. In parallel with the acquisition of the theoretical knowledge will be executed application examples, privileging the exchange of ideas, approach and problem solving by the students themselves during the class. The experimental connection of the theoretical concepts and analytical resolution will be developed, in parallel, during the laboratory classes, with direct intervention of the students through the execution of experimental works. In addition, it is foreseen the identification and study of structures in real environment. The work to be carried out intends to deepen competences regarding the application of the described concepts and the ability to work as a team.

Bibliography

Evaluation Method
The evaluation of the curricular unit is done through a final written examination, the elaboration of works to be developed in the course and the elaboration/discussion of the various works developed. The written test will take place on the dates established by law, with a value of 12. During the course unit students will be asked to form work groups. The various groups will develop, in the course of the classes, some work involving research and experimentation, from which reports will be written and presented and discussed. The valorization of experimental part will be 8. Students' commitment, participation, resourcefulness and motivation will also be evaluated. It is necessary to obtain a minimum of 40% of quotation in the written part. To students with worker-student status, or who demonstrate that they cannot participate in the classes and thus carry out the work described above, will be distributed research and development work framed in the
subjects of the curricular unit, which will be submitted to a discussion. There are no presences imposed in the classes of the discipline, however, considering the surroundings, particularly with an experimental component, students are encouraged to participate in all classes.

**Conditions for Exam Admission**

Students who have not done the experimental work or the research work, will be admitted to the exam, but for a global quotation of 15 values.

**Access Conditions and Attendance Excuse**

Nothing to add.

**Conditions for Results Improvement**

Nothing to add.

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# Course Unit Description

## Course Unit Title
INSTRUMENTATION AND CONTROL

## Curricular Nature
Engineering Sciences  
**Academic Area** Mechanical Engineering

## Year 1.º  
Semestre 1.º  
ECTS 6

### Contact Hours

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## Total Hours of Work

### Teachers

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<tr>
<td>Theoretical classes</td>
<td>Pedro Jorge Borges Fontes Negrão Beirão</td>
<td>PhD.</td>
<td>Associate Professor</td>
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<tr>
<td></td>
<td>Carlos Jose de Oliveira Pereira e Jorge Alcobia</td>
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<td>Associate Professor</td>
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<td>Pedro Jorge Borges Fontes Negrão Beirão</td>
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<td>Associate Professor</td>
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### Head Teacher
Pedro Jorge Borges Fontes Negrão Beirão

## Course aims / Skills acquired

Acquaint students to the importance that experimental methods can have in solving engineering problems as well as and to provide training that allows them to operate, configure and select measurement systems. To foster the development of new skills associated with experimental work, namely problem identification, assembly planning, analysis and synthesis of information.

Acquaint students with fundamental concepts about systems control theory. Apply acquired knowledge in the resolution of theoretical-practical exercises and several laboratorial works.

Analyse and design control systems.

## Course contents

### Instrumentation module:

Characterisation of measuring systems: functional description of a measuring system.

Characteristics of instrumentation: passive and active sensors, calibration, modifying and interfering inputs, accuracy and errors.

Operational modes of instrumentation: null instrument, deflection instrument, analogic and digital sensors.

Static and dynamic characteristics of instrumentation: output/input relation, drift, hysteresis and backlash, saturation, bias, nonlinearity error, dynamic states, response of different linear systems types, zero-order, first-order and second-order blocks, calibration.

Measurement of linear and angular displacement: resistive sensors: potentiometers, inductive sensors, linear and rotary variable reluctance.
transducer, linear variable differential transformer (LVDT), rotary variable differential transformer, eddy current, capacitive sensors: pressure, accelerometers and force transducers, capacitive liquid level measurement, piezoelectric transducers, optical encoder displacement sensors: encoder signals, encoding principles, magnetic displacement sensors: magneto-resistive sensors: Hall effect sensor.


**Control module:**
Introduction to control systems, mathematical principles, block diagram algebra, time domain response analysis, basic control actions, mathematical modelling of real systems, stability of linear systems, error analysis, design and implementation of simple control systems using Matlab and Simulink.

**Written assignments**
Transducers calibration report. Construction of control systems in Matlab/Simulink.

**Teaching methodology**
Theoretical-practical classes with computer support; Theoretical-practical classes with discussion; Laboratory classes with computer support; Group learning; Brainstorming.

**Bibliography and Resources**
- PowerPoints supplied by teachers

**Grading procedures**
Formal assessment exams, calibration report and Matlab/Simulink's theoretical-practical test (0 to 20 points in all assessments).

Weighting:
- Formal assessment exams (60%);
- Calibration report (20%) sent to the teacher in paper and in digital format (e-mail) until the last week of classes;
- Matlab/Simulink's theoretical-practical test (20%) to be held in the last week of Control module classes;

Course unit approval dependent of a weighted average of the three evaluation components equal to or higher than 9.5 points and to a grade equal to or higher than 9.0 points in the formal assessment exam.

Assignment conditioned to minimum frequency of 80% of lectured theoretical-practical and practical classes. Criterion of minimum attendance not applicable to students with worker-student status or similar.

Reference elements allowed in formal evaluation exams if provided by teachers. Computer use allowed in Matlab/Simulink theoretical-practical test.

**Requirements for taking final exams**
Students gain access to exams when they have a minimum frequency of 70% of theoretical-practical and laboratory classes.

For students with worker-student status or similar, the prior criterion of minimum attendance is not applicable.

**Requirements for taking tests and other means of continuous evaluation**
Not applicable.

**Procedures for improving grades or retaking exams**
It is only allowed to improve grades to the component evaluated in the exam.

---

**Date**

11-10-2018

**Signature of Teacher responsible for the course unit**

[Signature]

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Im-13-79_A2
Course Unit: COMPUTATIONAL METHODS IN ENGINEERING

Subject type: Complementary Sciences
Research Area: Mechanical Engineering and Mathematics

Year: 1st Semester: 1st

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Total of Working Hours: 156

Lecturer

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<td>António Manuel de Morais Grade</td>
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Responsible(s) Lecturer(s): António Manuel de Morais Grade

Goals / Skills
The objectives of this curricular unit are to strengthen, increase and apply fundamental knowledge in mathematics and programming, crucial to the understanding and scientific treatment of the subjects taught and used in other curricular units of Mechanical Engineering, grounded in an analytical and computational treatment, thus contributing to the following specific competences:
- To know how to use numerical modeling methods in the structural calculation of any mechanical component, making use of own programs or commercial software;
- To know how to apply computational methods in the analysis and resolution of engineering problems, especially in the areas of fluid mechanics and thermal systems.

Program Contents
THEORETICAL-PRACTICAL CLASSES
1. Laplace transform

2. Polynomial interpolation
   Polynomial: definition, operations and properties. Taylor’s Formula and Polynomial. Interpolator polynomial: definition,
graphical interpretation and Newton's formula of divided differences.

3. Differentiation and Numerical Integration
Formulas of progressive, regressive and centered differences. Trapeze rule and Simpson rule. Quad function of Matlab.

Euler and Runge-Kutta methods (RK2 and RK4). Functions of Matlab: ODE23, ODE45 and others. Introduction to Graphical User Interface (GUI) in Matlab and its application for interface and output of a PVI solution.

5. Partial Differential Equations (PDEs)

PRACTICAL CLASSES
1. Programming in Matlab

2. Applications to Mechanical Engineering
Final work with specific applications to mechanical engineering.

Work Done
Theoretical-practical activities of learning and evaluation distributed throughout the semester, programming of mathematical methods and application in Matlab and computer algebra system (CAS) programs, with different weights in the final assessment of the TP component. Final work related to a mechanical engineering theme.

Teaching Methodology
Classroom presentation teaching, analysis, resolution of exercises, problems of application and discussion of results obtained computationally.
Use of an e-learning platform (distance learning) as a complement and extension of the TP classes, emphasizing the use of thematic forums, as one more activity for exposure, discussion and resolution of doubts and application problems.

Bibliography
- MORAIS, V.; VIEIRA, C. - MATLAB : Curso Completo, Ed. FCA, 2013
- GLYN, James - Modern Engineering Mathematics, Addison – Wesley
- ROSS, S. - Differential Equations, McGraw Hill
- MOLER, Cleve B. - Numerical computing with MATLAB, Ed. Siam, 2004
- FAUSETT, Laurene V. - Applied numerical analysis using MATLAB, Ed. Prentice Hall, 1999
- JALURI, Yogesh - Computer Methods for Engineering, Ed. Allyn and Bacon, Inc.
- HAHN - Essential MATLAB for Scientists and Engineers, 3e, Ed. Pearson Education, 2002
- CHAPMAN - MATLAB Programming for Engineers, 3e. Thomson Engineering, 2005
- GRADE, Antônio - Apresentações das Aulas Práticas de MCE, ISEC, 2014
- CORREIA, Arménio - Aportamentos de AM2 e Matemática Aplicada, ISEC, 2008

Evaluation Method
There are two types of assessment:

1st Option:
- Application work to Mechanical Engineering, with final evaluation - Weight of 60%;
- Theoretical-practical learning activities, with evaluation distributed throughout the semester - Weight of 40%;

2nd Option:
- Only the application work to Mechanical Engineering, with final evaluation - Weight of 100%;
Students can choose any of the options.
The final application work to Mechanical Engineering is mandatory. For their accomplishment the students must group in groups of two elements. Exceptionally is possible to have works elaborated individually. Each group will be assigned a different theme; groups may propose themes. The groups should use the last practical classes to begin their work and to analyze and discuss specific problems of the same with the teachers. The evaluation of knowledge related to the application work is fundamentally based on the following factors:
- Report of the work, including the listing of the MATLAB program;
- Work presentation;
- Final discussion.
Each group will deliver 2 printed copies of the report and 2 CD's with Matlab files and the report file, until the limit dates
established at the beginning of the semester. The presentation and discussion of the work will be carried out before a jury of 2 teachers of the curricular unit, in oral public, until the end of the exam period. The presentation should not exceed 30 minutes (15 minutes per student) and the discussion of the entire work 1 hour and 30 minutes. Although all the students in the group have to know the totality of the work, each of the students is responsible for different parts of the work, presenting and defending their part in the final discussion. The final classification of the work is therefore individual.

Conditions for Exam Admission
N.A.

Access Conditions and Attendance Excuse
N.A.

Conditions for Results Improvement
N.A.

Date
12.10.2018

Signature from the lecturer responsible for the course

[Signature]
## Program Contents

**Course Unit**  
PROJECT, INTERNSHIP OR DISSERTATION (PIMST)

**Subject type**  
Specialty Curricular Unit

**Research Area**  
Mechanical Engineering

**Year**  
2nd

**Semester**  
1st and 2nd

**ECTS**  
60

### Working Hours

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**Total of Working Hours**  
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**Lecturer**

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<td>Anabela Duarte de Carvalho</td>
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<td>Gilberto Cordeiro Vaz</td>
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<td>João Manuel N. Malça de Matos Ferreira</td>
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### Responsible(s) Lecturer(s)

António Manuel de Morais Grade

### Goals / Skills

The main aims of the Project / Dissertation are:
- To provide the student the opportunity to demonstrate autonomy and originality;
- To develop the capacity to plan and organize a large project / dissertation over a long period;
- To apply the knowledge and techniques acquired throughout the course.

The main aims of the Internship are:
- To gain relevant work experience that will aid the access and integration of the student into professional life;
- To provide the required knowledge and transferable skills which enables the students to pursue their careers;
- To put into practice the knowledge and techniques acquired throughout the course.
Program Contents

Development of an individual oriented project, internship or dissertation privileging subjects that embrace several areas of mechanical engineering and related to real world cases. The project, internship or dissertation culminates in the elaboration of a final report or thesis written on the work developed, that meets the academic requirements of the level of a Masters.

Project / Dissertation:
The subject of the project may be proposed by a member of the teaching staff or by the student. Each project / dissertation is assigned to one or more guiding teachers, according to the areas involved in the project / dissertation, which will provide tutorial guidance to the student throughout the year. The student and the guiding teachers will agree a project work plan that should be approved by the school Technical-Scientific Council. The work plan includes the project / dissertation objectives, scope and time schedule. The project / dissertation may eventually be conducted in collaboration with companies or other entities outside the school.

Internship:
Instead of a project, students have the possibility to undertake an internship program. The internship may be proposed by a member of the teaching staff, by a company/institution or by the student. Each internship work program is assigned to one or more guiding teachers, according to the areas involved in the internship, and one company/institution supervisor. The student, the guiding teachers and the supervisor will agree a work plan that should be approved by the school Technical-Scientific Council. The work plan includes the internship objectives, the internship activities and the time schedule. The ISEC establishes an internship protocol with the company / institution and with the student, to carry out the internship.

Work Done
N.A.

Teaching Methodology

The teaching methodologies to be used throughout the different stages of the project, internship or dissertation should be defined by the teaching guiding staff, in accordance with the intended objectives.

Bibliography

The bibliography and other specific study elements for each project, internship or dissertation will be indicated by the respective teaching guiding staff.

Evaluation Method

Public oral presentation and discussion of the project / internship report or the dissertation thesis before a 3 to 5 member jury, including one guiding teacher.

Conditions for Exam Admission
N.A.

Access Conditions and Attendance Excuse
N.A.

Conditions for Results Improvement
N.A.

Date
12/10/2018

Signature from the lecturer responsible for the course

[Signature]

Im-13-78_A1
Program Contents

Course Unit
PROJECT, INTERNSHIP OR DISSERTATION (CMEM)

Subject type
Specialty Curricular Unit
Research Area
Mechanical Engineering

Year
2nd
Semester
1st and 2nd
ECTS
60

Working Hours
Unaccompanied Working Hours

Activity Type
Working Hours Per Week
Total Hours
Activity Type
Total Hours

Theoretical Lectures

Theoretical-Practical Lectures

Practical-Laboratory Lectures

Tutorial Orientation
105
Study

Works / Group Works

Project

Evaluation

Additional

Total of Working Hours
1560

Lecturer
Activity Type
Name
Qualifications
Category

Theoretical Lectures
António Santos Simões
Doutoramento
Prof. Adjunto

Carlos José de Oliveira Pereira e Jorge Alcobia
Doutoramento
Prof. Adjunto

Fernando António Gaspar Simões
Doutoramento
Prof. Coordenador

João Miguel Maia Carrapichano
Doutoramento
Prof. Coordenador

Luís Filipe Pires Borrego
Doutoramento
Prof. Coordenador

Luís Manuel Ferreira Roseiro
Doutoramento
Prof. Coordenador

Pedro Jorge Borges Fontes Negrão Beirão
Doutoramento
Prof. Adjunto

Pedro Miguel Soares Ferreira
Doutoramento
Prof. Adjunto

Urbano Manuel Oliveira Ramos
Doutoramento
Prof. Adjunto

Theoretical-Practical Lectures

Practical-Laboratory Lectures

Tutorial Orientation

Goals / Skills
The main aims of the Project / Dissertation are:
• To provide the student the opportunity to demonstrate autonomy and originality;
• To develop the capacity to plan and organize a large project / dissertation over a long period;
• To apply the knowledge and techniques acquired throughout the course.

The main aims of the Internship are:
• To gain relevant work experience that will aid the access and integration of the student into professional life;
• To provide the required knowledge and transferable skills which enables the students to pursue their careers;
• To put into practice the knowledge and techniques acquired throughout the course.

Responsible(s) Lecturer(s)
Luís Filipe Pires Borrego
Program Contents
Development of an individual oriented project, internship or dissertation privileging subjects that embrace several areas of mechanical engineering and related to real world cases. The project, internship or dissertation culminates in the elaboration of a final report or thesis written on the work developed, that meets the academic requirements of the level of a Masters.

Project / Dissertation:
The subject of the project may be proposed by a member of the teaching staff or by the student. Each project / dissertation is assigned to one or more guiding teachers, according to the areas involved in the project / dissertation, which will provide tutorial guidance to the student throughout the year. The student and the guiding teachers will agree a project work plan that should be approved by the school Technical-Scientific Council. The work plan includes the project / dissertation objectives, scope and time schedule. The project / dissertation may eventually be conducted in collaboration with companies or other entities outside the school.

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Work Done
N.A.

Teaching Methodology
The teaching methodologies to be used throughout the different stages of the project, internship or dissertation should be defined by the teaching guiding staff, in accordance with the intended objectives.

Bibliography
The bibliography and other specific study elements for each project, internship or dissertation will be indicated by the respective teaching guiding staff.

Evaluation Method
Public oral presentation and discussion of the project / internship report or the dissertation thesis before a 3 to 5 member jury, including one guiding teacher.

Conditions for Exam Admission
N.A.

Access Conditions and Attendance Excuse
N.A.

Conditions for Results Improvement
N.A.

Date  Signature from the lecturer responsible for the course
12/10/2018  Luis Borrego
**Program Contents**

**Course Unit**

INDUSTRIAL EQUIPMENTS

**Subject type**

Sciences

**Research Area**

Mechanical Engineering

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**Total of Working Hours** 156

**Lecturer**

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**Goals / Skills**

The objective of this course is to provide students with knowledge of the equipment installed in various sectors of industry. The student gets the knowledge to know how to select equipment in the various areas covered in the course.

**Program Contents**

1. Mechanical Power Transmission
   - Shaft unions; Types of joints; Operation principle; Selection of shaft joints; Transmission of motion; Transmission by belts; Roller chain transmission; Free and non-return wheels; Main constructive forms; Characteristics and constructive forms; Selection; Speed selector; Types of drives; Operation principle; Selection and main applications; Tensors; Tensioners of chains and belts; Applications; Selection method; Anti-vibration supports; Types of oscillation systems; Terminology used and Selection criteria; Clutches; Types of clutches; Operation principle; Fields of application; Brakes; Types of brakes; Torque Limiters; General features; Types of assemblies; Selection; Speed reducers; Types of reducers; Formation of a reducer; Most used assemblies; Loads applied; Sizing; Motion inverters; Operating mode; Main applications.

2. Industrial Pipes
   - Standards, codes and specifications; Main standards and codes on pipes; Specifications of materials used in piping; Examples of specifications; Application of industrial pipes; Types of pipe protection; Sizing of tubes; Pipe holders; Accessories used for the installation of pipes.

3. Pneumatic Systems
Air compressors; Types of compressors; Installation of compressors; Maintenance; Cylinders and actuators; Constitution of a cylinder; Materials used in cylinder construction (standardization); Dimensioning of cylinders and actuators; Equipment for the treatment of air; Principle of operation of an FRL system; Their physical characteristics; Selection; Pneumatic valves, Electropneumatic valves and distributors; electropneumatic; Pneumatic accessories.

4. Oil-hydraulic systems

Hydraulic pumps; Types of pumps; Its constitution and principle of operation; Sizing of a pump; Main applications; Hydraulic motors; Oil-hydraulic distributors; Valves; Accumulators; Cylinders; Filtering techniques; Oil-hydraulic pipes; Electropump groups.

5. Industrial Valves

Classification of valves; Constitution and characteristics; Means of operation; Materials used in the construction of valves; Rotary joints; Servo-motors; Pneumatic actuators; Traps; Expansion Compensators; Equipment used in the installation of valves.

6. Lifting of Materials

Lifting chains and accessories; Types of slings; Application rules; Selection; Lift Differentials; Claws and stingrays; Push cars; Double beam cars.

Work Done

Individual work on a topic related to the contents given in the course

Teaching Methodology

The presentation of the contents is essentially carried out during the theoretical classes, using as main support the projection of slides. In the 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 performed, 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.

Bibliography

Rodrigues, António Máro V. S. - Sebenta da Disciplina; Catálogos de Fabricantes

Evaluation Method

Development of a work related to a topic given in the course. Final exam in the specified data. (Final grade = 0.5 EN + 0.5 WN (EN- Examination note; WN- Work note)

Conditions for Exam Admission

NA

Access Conditions and Attendance Excuse

Conditions for Results Improvement

Date
24/01/2019

Signature from the lecturer responsible for the course
Course Unit: MECHANICAL BEHAVIOUR OF MATERIALS

Subject type: Specialty Sciences
Research Area: Mechanical Engineering

Year: 1
Semester: 2
ECTS: 6

Working Hours

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Total of Working Hours: 160

Lecturer

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<td>Prof. Coordenador</td>
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<td>Maria de Fátima da Costa Paulino</td>
<td>MsC</td>
<td>Assistente Convidada</td>
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Goals / Skills

The main objective of this unit is to understand the concepts and acquire the procedures about the fundamental tools in design and control of mechanical components failure, taking into account their service conditions. The application of these concepts and tools covers a wide area of application, namely, in aerospace, aeronautic and naval industries, in the design of transport vehicles and pressure vessels, and also in several other components and structures subjected to static or dynamic loadings.

Program Contents

1. Main rupture and failure modes in mechanical components.
   Excessive elastic deformation, plastic deformation, ductile tear, wear, stress corrosion, fragile fracture, creep, fatigue.

2. Materials fatigue
determination of the basic parameters of fatigue. Life prediction of notched components. Conditions of initiation and propagation of fatigue cracks.

3. Linear elastic fracture mechanics

4. Elastic-plastic fracture mechanics

5. Stress corrosion

6. Application of fracture mechanics to fatigue

7. Creep and stress relaxation
Fundamental notions. Long duration creep tests. Equipment used in creep tests. Stress relaxation and recovery. Basic problems in creep design.

Work Done
Not applicable.

Teaching Methodology
The theoretical content is developed and displayed using audio-visual means and didactic models. In theoretical-practical classes typical exercises are solved. Teachers provide discipline information in platform "Moodle".

Bibliography
• BORREGO, L. P. Complementos da Fadiga de Materiais, Textos Pedagógicos, ISEC, 2002.
• BORREGO, L. P. Aplicação da Mecânica da Fractura à Fadiga, Textos Pedagógicos, ISEC, 2002.
• BORREGO, L. P. BRANCO, R. S. Colectânea de Problemas Teórico-Práticos, ISEC, 2002.

Evaluation Method
The evaluation of this curriculum unit is performed through a written test at the end of the semester. This test includes two components, a theoretical component and a theoretical-practical one, corresponding each to 50% of the final grade. It is required to obtain a minimum of 25% in each component.

Conditions for Exam Admission
There are no limitations.

Access Conditions and Attendance Excuse
Not applicable.

Conditions for Results Improvement
Repeating the theoretical and theoretical-practical written test under the conditions described in item evaluation method.

Date
24.01.2019

Signature from the lecturer responsible for the course
[Signature]
Program Contents

Course Unit

MATERIALS SELECTION

Subject type

Engineering Sciences

Research Area

Mechanical Engineering

Year 1

Semester 2

ECTS 6

Working Hours

Activity Type

Working Hours Per Week

Total Hours

Activity Type

Total Hours

Theoretical Lectures

2

28

Study

97

Theoretical-Practical Lectures

2

28

Works / Group Works

3

Practical-Laboratory Lectures

Tutorial Orientation

Study

Evaluation

Additional

Total of Working Hours 156

Lecturer

Activity Type

Name

Qualifications

Category

Theoretical Lectures

Fernando António Gaspar Simões

PhD

Coordinator Prof.

João Miguel Maia Carrapichano

PhD

Coordinator Prof.

Theoretical-Practical Lectures

Fernando António Gaspar Simões

PhD

Coordinator Prof.

João Miguel Maia Carrapichano

PhD

Coordinator Prof.

Responsible(s) Lecturer (s)

Fernando António Gaspar Simões

Goals / Skills

Characterization of the major classes of engineering materials, making a comparison of metallic materials with polymers, ceramics and composites

Presentation of the properties of different types of materials. Examples of the application of these materials in the industry.

Description and application of methods for selecting materials.

Selection of materials, depending on the requirements of the design, processing methods and economic requirements.

Program Contents

Metallic materials: Classification, properties and applications of non-alloy steels, alloy steels, cast irons, aluminum alloys, copper, magnesium, titanium, zinc and nickel.

Polymeric materials: Classification, properties and applications of thermoplastics, thermosets and elastomers used in engineering.

Ceramic materials: Classification, properties and applications of traditional and technic ceramics, and glasses. Processing of technical ceramics.

Composite materials: Classification of composites according with the type of matrix and reinforcement.
reinforcements and matrices. Advanced Composites.
Presentation and correlation of the main properties and parameters that characterize the materials. Quantification of properties. Correlation between function, material, form and process.

Work Done

Teaching Methododoly
In theoretical and theoretical-practical classes are presented the contents that allow the knowledge of the properties and applications of the studied materials, the manufacturing processes and methods of selection of materials. For this purpose, in theoretical-practical classes, commercial catalogs are often consulted, made the presentation of examples of materials in a wide range of materials gathered for the purpose, and also carried out some tests to determine mechanical properties. In the end, are presented different case studies of material selection for specific applications, taking into account the pre-requisites defined.

Bibliography
- MARCELO MOURA – Materiais Compósitos, Materiais, Fabrico e Comportamento Mecânico, 2ª edição, Publindústria.
- An Introduction to Advanced Composites and Prepeg Technologies, Centre of Composites Technology.

Evaluation Method
The evaluation of this course unit consists of an individual written exam (100% weight in the evaluation).

Conditions for Exam Admission

Access Conditions and Attendance Excuse

Conditions for Results Improvement

Date
25/01/2019

Signature from the lecturer responsible for the course