

Course Unit	Machine Design	Field of study	Mechanical Constructions
Bachelor in	Mechanical Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	3
Type	Semestral	Semester	1
Level	1-3	ECTS credits	6.0
Code	9123-759-3103-00-23		
Workload (hours)	162	Contact hours	T - TP - PL - TC - S - E - OT - O 60

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Carlos Alberto Rodrigues Andrade

### Learning outcomes and competences

- At the end of the course unit the learner is expected to be able to:
1. Be able to generally characterize and compare the different types of power transmission machinery elements.
  2. Get ability to calculate and design components to fatigue.
  3. Understanding kinetically and dynamically and analyse the operation of spur and helical gears transmissions.
  4. Know the types, applications and key features of rolling bearings and bearings.
  5. Being able to select/design power transmission by belts and mechanical chains.
  6. Get ability to proper handling of tables, abacus and standards.
  7. Know and identify functions of shafts and associated parts.

### Prerequisites

Before the course unit the learner is expected to be able to:  
Without requirements

### Course contents

Introduction to fatigue project design. Power mechanical transmissions and power screws. Belts Transmission Design. Chains Transmission Design. Gears - Fundamentals. Spur Gears. Helical Gears. Rolling Bearings. Springs. Welding and other permanent connections. Threaded connections. Tribology and lubricants. Springs and dampers. Shafts and Associated Parts.

### Course contents (extended version)

1. Introduction to mechanical design
  - Concept of mechanical design
  - Most usefull materials in mechanical design
  - Fatigue
2. Gear Transmission Design
  - Types and components; Kinematic analysis; Selection of transmission, Teeth countour properties.
  - Theeth correction; Interference; Efficiency; Chain gears; Manufacturing processes;
  - Damage in the teeth; Lubrication; Gear;
3. Spur Gears - Fundamentals.
  - Dynamic analysis;
  - Kinematics of gears - Geometry of gearing; Involute Properties;
4. Helical cylindrical Gears:
  - Design Fundamentals - Dynamic Analysis; Tables and charts for Design.
5. Roller Bearings:
  - Types/applications; bearing life; Loads; selection, lubrication, mounting and dismounting; Outages.
6. Shafts and Associated Parts:
  - Functions; Design of shafts; Couplings; Universal Joints; Selection.
7. Draft chain drives:
  - Types and elements; Kinematic analysis,
  - Selection of transmission, assembly and maintenance; Dynamic analysis.
8. Belts Transmission Design:
  - Types of belts; Standardization; Geometry and speed (kinematic analysis);
  - Selection of the transmission; Details of construction and assembly; Dynamic analysis
9. Hydrostatic bearings:
  - Types and applications; Rolling Bearing Life; Loads; Selection; Lubrication; Assembly/disassembly.
10. Introduction to tribology and lubricants
11. Power screws.
12. Springs:
  - Type and function; Stress and strain; Helical springs design; Energy storage capacity.

### Recommended reading

1. Branco, C. M. et al. , "Projecto de Órgãos de Máquinas", Fundação Calouste Gulbenkian, 2005.
2. Shigley, J. E. et al. , "Mechanical Engineering Design", SI Version, McGraw-Hill, 2014
3. Ugural, A. C. , "Mechanical Design Of Machine Components", 2nd ed. SI Version, McGraw-Hill, 2018.
4. Hindhede, et al. , Machine Design Fundamentals – A Practical Approach, Edited by Prentice – All.

### Teaching and learning methods

In lecture classes shall be used expository and self-learning. In practical classes will be solved problems using the methods discussed in lecture classes. Use will be the technical manuals, eventually software and laboratories.

### Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%
2. Alternativa 2 - (Student Worker) (Final)
  - Practical Work - 50%
  - Final Written Exam - 50%

**Language of instruction**

Portuguese

**Electronic validation**

Carlos Alberto Rodrigues Andrade	João Eduardo Pinto Castro Ribeiro	João da Rocha e Silva	José Carlos Rufino Amaro
29-09-2023	29-09-2023	02-10-2023	07-10-2023