Centre | University College of Engineering of Vitoria-Gasteiz
---|---
Name of subject | 26049 – Machine Design
Qualification | Degree in Mechanical Engineering
Type | Compulsory
Credits | 9 ECTS
Year | 3
Term(s) | 2nd
Department | Mechanical Engineering
Language | English, Spanish and Basque

Outcomes / Objectives

Calculation, construction and testing of machines. Design of components, mechanisms and machines

Syllabus

Chapter 0.- An overview of mechanical design and analysis.
  0.1.- Course approach and organisation.
  0.2.- Subject syllabus.
  0.3.- Current state of machine analysis and design.
  0.4.- Relationship with other subjects.
  0.5.- Codes and standards.
  0.6.- Units.
Chapter 1.- Introduction to machine design.
  1.1.- Design criteria.
  1.2.- Design and analysis of machines: approximate calculations, FEM, prototypes.
  1.3.- Selection of materials: qualitative and quantitative properties.
  1.4.- Factor of safety in machine design.
Chapter 2.- Calculations with static stresses.
  2.1.- Local effects: stress concentration.
  2.2.- Static failure theories in machine design.
  2.3.- Factors promoting brittle failure in ductile materials
  2.4.- Introduction to fracture mechanics
Chapter 3.- Fatigue of materials in mechanical design and analysis.
  3.1.- Fatigue testing; fatigue limit.
  3.2.- Factors affecting the fatigue limit.
  3.3.- Fatigue stress concentration.
  3.4.- Effect of average non-null stresses.
  3.5.- Cumulative damage; Palmgren-Miner method.
  3.6.- Multiaxial stress fatigue analysis
Chapter 4.- Introduction to the Finite Element Method (FEM)
  4.1.- A brief historical description
  4.2.- Intuitive basis
  4.3.- Field of application
  4.4.- Properties of elements
  4.5.- Organisation of a Finite Element programme: preprocessor, processor and postprocessor
Chapter 5.- Design of shafts and associated parts
5.1.- Introduction
5.2.- Shaft dimensioning: static and fatigue.
5.3.- Design of other shaft-associated parts: couplings, keys, bolts and pins
5.4.- Some aspects to consider when designing shafts
5.5.- Pre-design of crankshafts
Chapter 6.- Calculation of gears
6.1.- Gear design overview
6.2.- Module calculation: Lewis formula
6.3.- Resistance module verification
6.4.- Wear resistance module verification
Chapter 7.- Belt drives
7.1.- Introduction and classification
7.2.- Belt behaviour model
7.3.- Belt drive design
Chapter 8.- Clutches, brakes and screws
8.1.- Operation and types of clutches
8.2.- Friction clutches
8.3.- Approach to the braking phenomenon
8.4.- Brake calculation: band brake, shoe brake and disc brake
8.5.- Power drive screws; ball screws
Chapter 9.- Roller bearings and bearings
9.2.- Static and dynamic load bearing capacity. Equivalent load.
9.3.- Durability of roller bearings.
9.4.- Roller bearing selection. Use of catalogues.
9.5.- Bearings with hydrodynamic and hydrostatic lubrication
Chapter 10.- Experimental methods in machine design
10.1.- Test types
10.2.- Measuring instrumentation
10.3.- Static load and fatigue testing
10.4.- Vibration testing: natural frequencies, vibration absorption and vibration modes.
10.5.- Machine monitoring and diagnostics.

**Methodology**

**Teaching Method**

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<th>Face-to-Face Teaching Hours</th>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
<th>Clinical practice</th>
<th>Workshops</th>
<th>Industrial workshops</th>
<th>Field practice</th>
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<th>Student Hours of Non Face-To-Face Activities</th>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
<th>Clinical practice</th>
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Assessment System

**General criteria**

→ Written essay exam  
→ Practical tasks (exercises, case studies or problems)  
→ Individual assignments  
→ Group assignments  
→ Presentation of assignments, reading...

**Bibliography**

**Basic Bibliography**

- Lecturer’s notes.  
- SHIGLEY, S.E. : "Diseño en Ingeniería Mecánica"  
- SPOOTS, M.F. : "Elementos de máquinas."  
- CARLOS ANGULO, LUIS NORBERTO LÓPEZ DE LACALLE..."Elementos de máquinas"

**In-depth Bibliography**

- NORTON: "Diseño de máquinas"  
- LUIS GARCIA PASCUAL: "Teoría de máquinas".  
- MOTT.:"Diseño de elementos de máquinas"  
- G.NIEMANN.:"Elementos de máquinas".

**Magazines**

- Electronic Journals for Mechanical Engineering.  
- Mechanical Engineering Education.  
- Journal of Mechanical Design.  

**Websites**

- [http://moodle.ehu.es](http://moodle.ehu.es)  
- [http://www.aenor.es/](http://www.aenor.es/)  
- [http://www.indarbelts.es/](http://www.indarbelts.es/)  
- [http://www.cadersa.es/](http://www.cadersa.es/)