

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

9.1.- Different types. Nomenclature. Characteristic elements.

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

Face-to-Face Teaching Hours

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
60		21	9					

Student Hours of Non Face-To-Face Activities

Lectures	Seminars	Classroom practice	Lab. practice	Computer sessions	Clinical practice	Workshops	Industrial workshops	Field practice
90		32	13					

Assessment System

General criteria

- Written essay exam
- Practical tasks (exercises, case studies o 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.
- Journal of Mechanical Engineering Science.

Websites

- <http://moodle.ehu.es>
- <http://www.aenor.es/>
- <http://www.skf.com/>
- <http://www.geartechnology.com/>
- <http://www.indarbelt.es/>
- <http://www.infomecanica.com/>
- <http://www.cadersa.es/>