**Course number and name:** Machine Design
**Credits:** 6 ECTS (3 US credits)
**Credit categorization:** Engineering Topic
**Instructor:**
**Office:**
**Email:**
**Office hours:**
**Textbook:**
**Required:**
Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson., Fundamentals of Machine Elements, Third Edition, 2013, CRC Press, ISBN 9781439891322
**Recommended supporting material:**

**Specific Course information:**
**Brief description:**
This course applies the fundamentals of mechanical engineering design to analyze, design, and/or select components typically used in the design of complete mechanical systems. The course covers the design process and analysis of stress and deflection; material properties and loading (steady state and variable) as they relate to failure prevention; and the procedures for design and analysis of common machine elements such as columns, cylinders, fasteners and springs. In team reverse-engineering projects, students apply the course topics to real hardware. The course emphasizes computer techniques and responsible design (safety factors and ethics).
**Prerequisites or co-requisites:**
Mathematics, Physics, Strength of Materials
**Required** (Required, Elective or Selected Elective)

**Course objectives and outcomes:**
**Course objectives:**
1. To enable students to design and predict failure of fundamental machine elements such as gears, springs, shafts etc. by providing them with a clear understanding of theory and applications.
2. To assist students to transfer theoretical knowledge into practical design by fabricating real mechanical devices.

**Course outcomes:**
Upon successfully completing this course, students will be able to:

- Identify, formulate and solve complex engineering problems to dimension mechanical components (ABET Student Outcome 1)
- Design to meet given performance specifications system considering public health, safety and welfare, as well as global, cultural, social, environmental and economic factors (ABET Student Outcome 2)
- Demonstrate ability to communicate effectively with a range of audiences (ABET Student Outcome 3)
- Be able to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of

engineering solutions in global, economic, environmental, and societal contexts (ABET Student Outcome 4)

- Be able to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (ABET Student Outcome 5)

**List of topics to be covered:**

1. Introduction, Basic Principles of Mechanics, Strength of Materials and Manufacturing
2. Beam loading and deformation, stress failure prediction and fatigue theory
3. Gear and gear trains, gear stresses
4. Helical compression springs, extension springs
5. Thread theory, power screws and fasteners
6. Shaft design, bearings and column design

**Time distribution:**

| Week | Contact hours | | Text |
|---|---|---|---|
| 1 | 3 | Introduction. Shear & moment diagram, Mohr's circle | Ch.1&2 |
| 2 | 3 | Materials and Manufacturing. Beams properties and loading | Ch.3&4 |
| 3 | 3 | Beam loading and deformation | Ch.5 |
| 4 | 3 | Uniaxial and multiaxial stress failure prediction | Ch.6 |
| 5 | 3 | Fatigue theory, fatigue regimes and endurance limit | Ch.7&8 |
| 6 | 3 | Gear theory. Gear trains | Ch.14&15 |
| | | Midterm exam 1 | |
| 7 | 3 | Gear tooth loading. Gear stresses | Ch.14&15 |
| 8 | 3 | Helical compression springs. Extension springs | Ch.17 |
| 9 | 3 | Thread terminology and power screws | Ch.16 |
| 10 | 3 | Threaded fasteners | Ch.16 |
| | | Midterm exam 2 | |
| 11 | 3 | Shaft design | Ch.11 |
| 12 | 3 | Bearings | Ch.12&133 |
| 13 | 3 | Column design | Ch.9&10 |
| 14 | 3 | Midterm exam 3. Final Exam | 3 |

**Assessment structure:**

| Methods of Evaluation | Weight | Date/freq. | Description |
|---|---|---|---|
| Final exam | Up to 60% | End of semester | Cumulative exam allowing to recover contents of up to 3 midterm exams |
| Following up activities | 40% | Every Week | Homework, Project, Exercises, Quizzes… |
| Midterm exams | 20% | Three per course | 3 midterm exams lasting 1,5 hours |

**HOMEWORK POLICY**

Homework is due the week after it is assigned (except when specified). The homework cycle gives an intervening class where students can ask questions. Late assignments will receive a score of 0 points.

**CLASS STRUCTURE**

Lectures will be the primary source of information. Students are expected to attend every class and to participate in class discussions. Homework assignments will be discussed in class. Students will be expected to work problems in class. You should review the chapters before the lecture.

**ACADEMIC INTEGRITY**

It is expected that all work done for this class will be in strict compliance with the principles of academic honesty and integrity. Cheating, plagiarism, copying, or dishonesty of any kind is not acceptable according to disciplinary regulation of IQS.

## DOCUMENT HISTORY

**PREVIOUS REVISIONS**

May, 2025. Prof. Andrés-Amador García-Granada.

**LAST REVISION**

May, 2025. Prof. Andrés-Amador García-Granada