

Machine Design 2

1. **Course number and name:** 020CM2ES4 Machine Design 2
2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours per week
3. **Name(s) of instructor(s) or course coordinator(s):** Ali AL Shaer
4. **Instructional Materials:** PowerPoint slides

Textbooks/References:

- Machine Design: An Integrated Approach, Robert L. Norton, 4th edition, Pearson international, ISBN 978-0-13-138438-5.
- Shigley's Mechanical Engineering Design, Richard G. Budynas and J. Keith Nisbett, eleventh edition, Mc Graw Hill, ISBN-13 978-0073398211.
- Design of Machinery – An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L. Norton, fourth edition, Mc Graw Hill, ISBN 978-0-07-312158-1

5. Specific course information

a. Catalog description:

This course is a continuation of machine design 1. The students continue to learn and size mechanical components in machines such as helical, bevel, and worm gears, brakes, clutches, flywheels, and flexible mechanical elements. They will also study the design of tension, compression, and torsion springs, screws and fasteners, and weld design. Introduction to planetary gear trains and differential transmissions is included. Mechanical organs or elements are studied regarding static, dynamic loads and vibration phenomena.

b. Prerequisites: Machine Design 1 (020CM1ES3) and Mechanical Vibrations (020VMEEES2) or Vibrations (020VIBES2).

c. Selected Elective for ME students.

6. Educational objectives for the course

a. Specific outcomes of instruction:

A student who successfully fulfills the course requirements will have demonstrated an ability to:

- Design of basic machine elements such as helical, bevel, and worm gears, brakes, clutches, flywheels, screws and fasteners, and flexible mechanical elements to meet desired needs.

b. PI addressed by the course:

PI	1.1	1.2	1.3	2.3	3.2
Covered	x	x	x	x	
Assessed					

7. Brief list of topics to be covered

- **Chapter 1: Helical, Bevel, and Worm Gears:** Helical gears – Bevel gears – Worm-sets. (4 Lectures).
- **Chapter 2: Spring Design:** Spring rate – Spring configurations – Spring materials – Helical compression spring – Design of helical compression springs for static loading – Design of helical Compression springs for fatigue loading – Helical extension springs Helical torsion springs – Belleville spring washers. (5 Lectures).
- **Chapter 3: Screws and Fasteners:** Standard thread forms – Power screws – Power screws – Stresses in threads – Types of screw fasteners – Strengths of standard bolts and machine screws – Preloaded fasteners in tension – Determining the joint stiffness factor – Controlling preload – Fasteners in shear. (4 Lectures).
- **Chapter 4: Weldments:** Welding processes – Weld joints and weld types – Principles of weldment design – Static loading of welds – Static strength of welds – Dynamic loading of welds – Treating a weld as a line – Eccentrically loaded weld patterns – Design considerations for weldments in machines (4 Lectures).
- **Chapter 5: Clutches, Brakes, and Flywheels:** Types of brakes and clutches – Clutch/Brake selection and specification – Clutch and brake materials – Disk clutches– Disk brakes – Drum brakes – Flywheels. (4 Lectures).
- **Chapter 6: Flexible Mechanical Elements:** Belts – Flat- and Round-Belt Drives – V Belts – Timing belts – Roller chain – Wire rope – Flexible shafts. (4 Lectures).
- **Chapter 7: Power Transmission Case:** Design sequence for power transmission – Power and torque requirements – Gear specification – Shaft layout – Force analysis – Shaft material selection – Shaft design for stress – Shaft design for deflection – Bearing selection – Key and retaining ring selection – Final analysis. (3 Lectures).