

Manufacturing Processes 1

- 1. Course number and name:** 020PF1ES3 Manufacturing Processes 1
- 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 Harkous
- 4. Instructional Materials:** PowerPoint slides; Videos; Lab experiments.

Textbooks/References:

- Fundamentals of Modern Manufacturing, 7th edition, M.P. Groover, Wiley, 2020.
- Manufacturing Engineering and Technology, 8th edition in SI units, S. Kalpakjian, Pearson Education, 2020.
- A Textbook of Manufacturing Technology (Manufacturing Processes), R.K. Rajput, Laxmi publications, 2007.
- Manufacturing Technology (Vol 1 & 2), 3rd edition, P.N. Rao, McGraw-Hill Education, 2001.
- DeGarmo's Materials and Processes in Manufacturing, 11th edition, J.T. Black, Wiley, 2012.

5. Specific course information

a. Catalog description:

This course covers the main manufacturing processes used in the industry for different types of materials (metal, glass, plastics, rubber, composite materials, ceramics). It explains the concept of manufacturing in its large sense: the factory organization and design, the selection of processing operations and the production systems. The covered topics include the study of phase diagrams for different types of metal alloys, a global description of raw materials, and the operations used for their extraction and preparation (for metals, ceramics, polymers, and composites). Also, the course introduces the material removal processes. It details the different operations made by a lathe, the basics of CNC machines and the G-code programming language for milling and turning processes.

b. Prerequisite: Computer Assisted Drawing (020DAMCI4 or 020DAMNI4)

c. Selected Elective for ME students.

6. Educational objectives for the course

a. Specific outcomes of instruction:

- Analyze the fundamentals of manufacturing process and the main materials used in fabrication techniques.
- Associate the engineering principles with the different steps of manufacturing: processing, treatment, assembly and finishing operations.

- Recognize the development of the microstructure based on the type and the composition of a metal alloy.
- Describe the categories, the structure, the properties, and the extraction operations for the four families of materials (metals, ceramics, polymers, and composites).
- Interpret the main operations of lathe machine and recognize the different types of material removal process.
- Write a G-code for different examples of milling and turning operations.

b. PI addressed by the course:

PI	2.1	2.2	2.3	6.1	6.2	6.4
Covered	x	x	x	x	x	x
Assessed	x	x	x	x	x	x

7. Brief list of topics to be covered

- **Chapter 1: Introduction and Overview of raw materials:** What is Manufacturing? – Classification of materials – Processing operations – Production systems. (3 Lectures).
- **Chapter 2: Review of the Mechanical Properties of Metals:** Mechanical Behavior: Concepts of stress and strain – Properties related to elastic deformation – Properties related to plastic deformation – Property variability and design/safety factors. (2 Lectures).
- **Chapter 3: Phase Diagrams of Metals:** Definitions and Basic Concepts – Review: One-component Phase Diagrams of Water – Binary Isomorphous Systems – Interpretation of Phase Diagrams – Development of Microstructure in Isomorphous Alloys – Binary Eutectic Systems – Development of Microstructure in Eutectic Alloys – The Iron-Carbon System. (5 Lectures).
- **Chapter 4: Extraction and Preparation of Raw Materials:** Metals (Ferrous Alloys; Non-Ferrous Alloys; Production of Iron and Steel) – Ceramics and Glass (Overview; Structure; Traditional Ceramics; New Ceramics; Glass) – Polymers (Overview; Polymerization; Structures; Crystallinity; Thermal Behavior of Polymers; Additives; Thermoplastics; Thermosets; Elastomers; Polymer Recycling; Polymer Biodegradability) – Composite materials (Overview; Components in a composite material; The reinforcing phase; Other Composite Structures; The Interface; Rule of Mixtures; Fiber-Reinforced Composites). (5 Lectures).
- **Chapter 5: Material removal processes:** What's lathe? – Turning and related operations – Drilling – Milling – Cutting-tool technology (Tool materials; Cutting fluids) – Gear Manufacturing – Grinding and other abrasive processes – Nontraditional cutting processes – Introduction to CNC Machining – CNC Programming Basics – CNC Milling – CNC Turning. (5 Lectures).