UNICUSANO
ROME

Code: IIND-04/A **Credits: 9**
Matter: Manufacturing Processes
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
Prof. Stefano Guarino – stefano.guarino@unicusano.it

Objectives
The Manufacturing Processes course aims to provide a comprehensive overview of the main topics related to technological transformation processes. It introduces students to foundry processes, explaining how metals are worked through casting, as well as to plastic deformation processes to understand material shaping techniques. The course will also cover chip removal methods, fundamental for mechanical processing, and material joining techniques. Finally, it will address essential concepts regarding processing phases and process control, offering a complete view of production activities in the mechanical field.

Course Structure*:*
The Manufacturing Processes course has the following structure:
- INTRODUCTORY ELEMENTS;
- CASTING PROCESSES;
- FORMING PROCESSES;
- MACHINING PROCESSES;
- JOINING PROCESSES;
- PROCESS CONTROL.

Competencies:
The expected learning outcomes are:
A. Knowledge and understanding: At the end of the course, students will have acquired knowledge of the physical foundations and phenomenological aspects of the main mechanical processing techniques. Additionally, through E-tivity exercises, they will develop the ability to formulate and solve problems related to industrial process design.

B. Applying knowledge and understanding: Upon completion of the course, students will have developed the skills to apply acquired competencies to solve issues related to material transformation processes, such as foundry, plastic deformation, chip removal, and unconventional processes. They will also be able to interpret results obtained in the sizing of a production process, assessing both the physical coherence of the results and the engineering feasibility and sustainability of the proposed solution.
C. Making judgments: Students will be able to analyze the functioning of a technological process, highlighting its advantages and critical aspects, and identifying the most appropriate choice for the specific case under analysis.
D. Communication skills: Students will be able to use correct and comprehensible technical-scientific language, enabling them to clearly and unambiguously express the technical knowledge acquired in the proposed and analyzed topics.
E. Learning skills: At the end of the course, students will be capable of learning new solutions and applying their acquired knowledge to solve various issues related to the design and analysis of industrial processing.

Syllabus

Subject 1. INTRODUCTORY ELEMENTS.
Technological transformation processes. Geometric attributes of products: dimensional accuracy, dimensional tolerances, geometric tolerances. An overview of the main properties of materials of technological interest. Mechanical and technological testing related to the workability of metallic materials.
Subject 2. CASTING PROCESSES.
Metal melting and solidification. Foundry processes in temporary and permanent molds. Mold creation. Molding processes and techniques in sand. Shell casting. Gravity, centrifugal, and pressure-assisted casting. Defects, inspection, and finishing of castings. Shrinkage stresses in castings. Technical and economic aspects of foundry processes.
Subject 3. FORMNIG PROCESSES.
Mechanics of plastic deformation. Bulk forming processes. Forging and stamping. Extrusion. Rolling: general concepts; process sizing elements; defects; an introduction to rolling mills. Drawing: general concepts; drawing forces; work; drawing equipment. Sheet forming processes: bending, deep drawing, and punching.
Subject 4. MACHINING PROCESSES.
Cutting mechanics. Cutting tools: geometry and sizing. Tool materials. Tool wear. Selection of optimal cutting conditions. Turning. Milling. Drilling. Grinding.

Subject 5. JOINING PROCESSES.
Autogenous and heterogeneous welding. Oxyacetylene welding, arc welding, controlled atmosphere, and resistance welding. Non-conventional welding techniques. Defects and fractures in welded joints. Mechanical characteristics of welded joints.
Subject 6. PROCESS CONTROL.
Statistical process control. Experimental design techniques and Analysis of Variance.

Evaluation system and criteria

The exam consists a written test useful for verifying the ability to analyze and rework the concepts acquired. The evaluation of the e-tivity from 0 to 4 points is carried out, in itinere, during the course. The written test includes a series of questions assessed from a minimum of 0 to a maximum of 26 points and requires a reworking of the theoretical and practical concepts studied during the course. The expected learning outcomes regarding subject knowledge and communication skills are assessed by the written test, while the ability to apply them, the ability to draw conclusions and the ability to self-learn are assessed in itinere through the e-tivities.

Bibliography and resources

1. *Materials to consult:*

Notes written by the instructor are available in English. The notes cover the course contents and examination programme.

2. *Recommended bibliography:*

- Manufacturing Engineering and Technology - Serope Kalpakjian., Steven R. Schmid – Ed Prentice Hall