



Course guide

240IME33 - 240IME33 - Conformation Systems of Pieces

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: IRENE BUJ CORRAL

Others:

PRIOR SKILLS

It is recommended to previously take the subject Manufacturing Systems of the GETI or another equivalent subject.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CEEMAT3. Design, calculate and model aspects related to the materials for mechanical components, structures and equipment.
CEMEI22. Knowledge and abilities to verify and control the facilities, processes and products.

TEACHING METHODOLOGY

Two class hours for theory and exercises are planned in large groups. There will also be 5 laboratory classes of 2 hours in small groups.

LEARNING OBJECTIVES OF THE SUBJECT

General objective:

- To define the maximum number of processes by means of which the innumerable products that surround us have been manufactured, except those concerning machining processes. In addition, to apply such knowledge to the definition of the general manufacturing process for pieces.

Specific objectives:

- To describe the Manufacturing and Control processes for pieces obtained by: Casting, Forging, Extrusión, Tube Manufacturing, Sintering, Welding, Thin Metal Sheet Parts, Thick Metal Sheet Parts, obtention of plastic and composite materials parts and union and assembly processes. Identification of applications and limitations of each process.
- To identify the limitations of the production means available, as well as the way to achieve a better use of such media.
- To learn to recognise the workpieces' specifications which condition and impose the suitable and most appropriate process according to available production means.
- To define the most convenient combination of manufacturing processes for manufacturing a workpiece of given specifications, in order to achieve a product as competitive as possible.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	24.00
Hours small group	13,5	12.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

1-Casting processes

Description:

- Introduction. Metals and alloys employed. Design of cast parts. External and internal models. Moulding boxes. Moulding earths. Melting furnaces. Hand moulding. Machine moulding. Shell casting. CO2 casting. Investment casting. Metallic mould. Gravity casting. Injected die casting and centrifugal casting. Continuous casting. Complementary operations. Inspection and quality control of cast parts. Defects of cast parts and design recommendations for cast parts.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize casting processes, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Casting processes exercises. Laboratory classes 1 to 5 to see the manufacture of models by means of 3D printing and manufacture of parts with sand casting.

Full-or-part-time: 28h

Theory classes: 6h

Laboratory classes: 8h

Self study : 14h

2-Forging processes

Description:

-Introduction. Defects of the initial ingots. Forging processes. Furnaces for heating parts to be forged. Most important characteristics of forged parts. Free forging. Die forging. Forging machines: hammer and press. Heat treatments of forged parts. Finishing of forged parts. Verification and quality control of forged parts. Design recommendations for forged parts.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize forging processes, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises about forging processes.

Full-or-part-time: 8h

Theory classes: 4h

Self study : 4h

3-Extrusion

Description:

- Introduction. Direct and indirect hot extrusion. Direct and indirect cold extrusion.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize extrusion of metals, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises about extrusion of metallic parts.

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

5-Manufacture of tubes

Description:

- Introduction. Manufacture of tubes from bent metal sheets with and without welding process. Manufacture of seamless tubes: successive forging, estrusion, Mannesmann and Stiefel. Manufacture of "pilger" rolled tubes. Manufacture of tubes by drawing.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize manufacture of metallic tubes, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises about manufacture of tubes.

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

5-Metal sheet parts

Description:

- Introduction. Characteristics of metal sheets. Cutting processes (punching, shearing, oxicut, laser, plasma, waterjet). Bending. Deep drawing and hydroforming. Beading. Profiling. Clinching. Rotational forming. Machines for manufacturing metal sheet parts. Quality control of metal sheets. Typificatin of defects in metal sheet parts and Design recommendations for metal sheet parts.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize manufacture of metal sheet parts, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises about metal sheet forming

Full-or-part-time: 16h

Theory classes: 6h

Laboratory classes: 2h

Self study : 8h

6-Sintering processes

Description:

- Introduction to the sintering process. Materials used for sintering. Industrial process. Applications and limitations of sintered parts. Advantages and disadvantages of the sintering process versus other manufacturing processes. Processes in which sintering is the only process to be used and Design recommendations for parts to be obtained by means of sintering processes

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize manufacture of sintered parts, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Sintering exercises

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

7-Manufacture of plastic parts

Description:

- Introduction. Plastic materials, their properties, and comparison with metals' and other materials' properties. Applications of plastics. Processes for obtaining different plastic materials. Viscoelastic model about behaviour of plastic regarding deformation, and parameters influencing deformation. Definition of the mould dimensions. Processes for obtaining granular materials. Cold and hot compression moulding. Injection moulding. Machines for injection moulding. Extrusion of profiles and other plastic parts. Machines used for plastic extrusion. Blowing processes. Thermoforming processes. manufacture of reinforced plastic parts. Manufacture of plastic foams. Environmental impact of plastics.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize manufacture of plastic parts, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises about manufacture of plastic parts. Laboratory class about manufacturing process for obtaining plastic models with 3D printers.

Full-or-part-time: 14h

Theory classes: 7h

Self study : 7h

8-Assembly and joining processes

Description:

Introduction to assembly processes. Reversible assemblies. Semi-reversible assemblies. Irreversible assemblies. Welding processes. Adhesive joining.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize assembly processes, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises related to assembly and joining systems.

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

9-Surface treatments

Description:

Electrolitic treatments, electroless treatments, galvanization, anodization and painting processes.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize surface treatments, as well as different types of machines that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises related with surface treatments.

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

10-Heat treatments

Description:

Heat treatments for steel parts, heat treatments for copper and aluminium parts, heat treatments for other materials.

Specific objectives:

To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize heat treatments, as well as different types of facilities that can be employed and main applications, advantages and limitations of the different process variants.

Related activities:

Exercises related to heat treatments.

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

GRADING SYSTEM

Formula for calculation of final mark is:

$$N_{\text{final}} = 0,15 \cdot \text{NLT} + 0,1 \cdot \text{NTC} + 0,75 \cdot \text{Max}[\text{NEF}; 0,6 \cdot \text{NEF} + 0,4 \cdot \text{NPP}]$$

with: NLT: Qualification of Laboratory Sessions. NTC: Qualification of Semestral Work. NEF: Qualification of Final Exam. NPP: Qualification of Partial Test.

Reassessment:

The Reassessment Exam corresponds to the content of theory and exercises of the subject. The obtained mark of the Reevaluation Exam NER replaces the marks NPP of the Partial Exam and NEF of the Final Exam.

$$N_{\text{final}} = 0,1 \cdot \text{NLT} + 0,1 \cdot \text{NTC} + 0,8 \cdot \text{NER}$$

EXAMINATION RULES.

Exams will contain theory and exercises. In the theory part nothing can be read. In the exercises part, it is possible to read a sheet with formulae.

BIBLIOGRAPHY

Basic:

- Buj Corral, I. ; Costa Herrero, Ll. ; González Rojas, H. ; Vivancos Calvet, J. Tecnologías de Fabricación II : Montajes, uniones, acabados de superficies y tratamientos térmicos. Barcelona: ETSEIB.CPDA, 2007. ISBN 8469916258.
- Buj Corral, I. ; Costa Herrero, Ll. ; González Rojas, H.A. ; Vivancos Calvet, J. Tecnologías de Fabricación II : Fabricación de piezas de plástico. Barcelona: ETSEIB. CPDA, 2006. ISBN 849661610X.
- Sierra Alcolea, C. ; Costa Herrero, Ll. ; Buj Corral, I. ; Vivancos Calvet, J. Tecnologías de Fabricación II : Fabricación de piezas por fundición. Barcelona: ETSEIB.CPDA, 2005. ISBN 8495355914.
- Sierra Alcolea, C. ; Costa Herrero, Ll. ; Buj Corral, I. ; Vivancos Calvet, J. Tecnologías de Fabricación II : Fabricación de piezas por deformación plástica y por sinterizado. Barcelona: CPDA de la ETSEIB-UPC, 2005. ISBN 8495355957.