Course guide
340667 - OPCM - Operation and Programming of Machining Centers

Last modified: 17/05/2023

Unit in charge:	Vilanova i la Geltrú School of Engineering
Teaching unit:	712 - EM - Department of Mechanical Engineering.

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2023   **ECTS Credits:** 6.0   **Languages:** Spanish

LECTURER

Coordinating lecturer:	Gonzalez Rojas, Hernan Alberto
Others:	Gonzalez Rojas, Hernan Alberto

REQUIREMENTS

Materials Science and Engineering. Theory and Design of Machinery and Mechanisms I. Engineering of Manufacturing Processes

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

- Face-to-face sessions of exposition of contents and inductive deduction of laws.
- Face-to-face sessions of practical work carried out in groups (laboratory practices).
- Face-to-face sessions for solving exercises.
- Non-face-to-face activities

In the content presentation sessions, ISO code programming of numerical control machines such as milling machines, lathes, cutters and 3D printers is described in detail. Examples of G-code applications for NC milling machines and lathes are described and analysed. In the theoretical sessions on law deduction, the Specific Cutting Energy model is presented as a generic cutting model. An inductive analysis is carried out to deduce the different forms that the Specific Cutting Energy model takes depending on the machine used and the possible technical-economic scenarios.

In the laboratory practicals, group work is carried out with the aim of putting into practice the manufacture of parts and surface engraving.

In the classroom sessions for solving exercises, a generic methodology is developed for determining the cutting conditions in chip removal machines. This methodology is based on a limited set of objects or physical laws, which allow a wide range of situations to be analysed.

The non-face-to-face activities are associated with short tasks such as the determination of cutting conditions for a given technical-economic scenario. Or projects such as the manufacture of a part, an intense work that integrates the elaboration of roadmaps, the definition of cutting conditions, the generation of G-code and the manufacture of the part.

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LEARNING OBJECTIVES OF THE SUBJECT

1. Drawing up manufacturing roadmaps for the manufacture of parts by metal removal.
2. Definition of the cutting conditions of a machining process, considering the type of process, machine and technical-economic scenario.
3. Generation of G-code using CAD-CAM software.
4. Manufacture of parts using NC milling machine.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	15,0	10.00
Hours large group	45,0	30.00

Total learning time: 150 h

CONTENTS

1. Classification of manufacturing processes

Description:
1.1 Developments in manufacturing technology and the market.
1.2 Relative importance of materials
1.3 Classification of manufacturing processes according to DIN 8580 standard

Specific objectives:
Recognise and classify the different forming processes.

Full-or-part-time: 8h
Theory classes: 8h

2. Machining machines and machining operations

Description:
2.1 Description of conventional and numerical control milling and drilling lathe.
2.2 Turning Operations
2.3 Milling operations
2.4 Drilling operations
2.5 Abrasive operations

Specific objectives:
To learn about the different chip removal machines and the operations that can be carried out with each of them.

Full-or-part-time: 15h
Guided activities: 11h
Self study : 4h

3. Manufacturing roadmaps

Description:
3.1 Definition and elaboration of manufacturing roadmaps
3.2 Knowing the different lathe, milling and drilling tools, their standard notation and the operations that each of them can perform.

Specific objectives:
Plan and build manufacturing roadmaps of different parts.

Full-or-part-time: 18h
Theory classes: 4h
Guided activities: 14h

4. Numerical control

Description:
4.1 Comparison between systems with and without numerical control.
4.2 To know the five basic concepts necessary for programming.
4.3 Know and apply the ISO block structure for programming
4.4 Know and use the different ISO programming instructions
4.5 Produce line-by-line numerical control programs, manual programming.
4.6 Produce numerical control programs using CAD-CAM software..

Specific objectives:
Develop numerical control programs in ISO code to manufacture parts and products.

Full-or-part-time: 35h
Theory classes: 18h
Laboratory classes: 17h

5. Theory of metal cutting

Description:
5.1 Know the variables that control a metal removal process, cutting conditions.
5.2 Define and use the concept of tool life and the conditions for the working regime, infinite life or finite life.
5.3 Evaluate surface roughness in a machining operation, applying a geometric tool-workpiece intersection model.
5.4 Estimate machining time.
5.5 Estimate cutting power using a Specific Cutting Energy model.
5.2 Define cutting conditions according to the machine, lathe, milling machine or drilling machine and according to the technical-economic scenario, maximum production, minimum cost, maximum profit.

Specific objectives:
Define the cutting conditions associated with the machine and machining process.
To build a generic Specific Cutting Energy model and a roughness model of the cutting process.

Full-or-part-time: 60h
Theory classes: 22h
Laboratory classes: 10h
Guided activities: 10h
Self study : 18h

6. Flexible manufacturing

Description:
6.1 Aspects generating the emergence of flexible manufacturing.
6.2 Types of manufacturing
6.3 Flexible manufacturing cell
6.4 Identifying a flexible manufacturing system
6.5 How flexibility is achieved, the technology of groups or families
6.6 Formation of families using a similarity metric

Specific objectives:
Apply the concept of flexible manufacturing to a parts production line.
Identify families for the formation of groups.

Full-or-part-time: 12h
Theory classes: 5h
Guided activities: 7h

GRADING SYSTEM

The assessment of the course will be carried out according to the following indicators:
T: Theory partial exam
E: Exercise to be handed in.
P: Laboratory practicals, weighted average of the different programmed practicals.
F: Final Exam, theoretical integrative exam, covering all the topics covered in the course.

Final mark = 0,25T+0,10E+0,35P+0,3F

Only the written tests, corresponding to 75% of the final mark, will be revalidated.

BIBLIOGRAPHY

Basic:
- Kalpakjian, Serope; Schmid, Steven R. Manufactura, ingeniería y tecnología. Vol. 2, Procesos de manufactura [on line]. 7a ed. Ciutat de Mèxic: Pearson Educación, 2014 [Consultation: 19/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5324. ISBN 9786073227421.
- Kalpakjian, Serope; Schmid, Steven R. Manufactura, ingeniería y tecnología. Vol.1, Ingeniería y tecnología de materiales [on line]. 7a ed. Ciutat de Mèxic: Pearson, 2014 [Consultation: 19/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5323. ISBN 9786073227353.
- Boothroyd, Geoffrey; Knight, Winston A. Fundamentals of machining and machine tools [on line]. 3rd ed. Boca Raton, FL: Taylor and Francis, 2005 [Consultation: 20/02/2024]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9780429114243/fundamentals-metal-machining-machine-tools-winston-knight-geoffrey-boothroyd. ISBN 1574446592.
- Cruz Teruel, Francisco. Control numérico y programación : curso práctico : mecanizado : preparación y programación de máquinas de fabricación mecánica. 3a ed. Barcelona: Marcombo, 2020. ISBN 9788426728364.
- Carrasco Moreno, José; Mallorquín Egea, Salvador. Prácticas y procesos de taller de mecanizado : fabricación por arranque de viruta. 2a ed. Barcelona: Marcombo, 2018. ISBN 9788426726254.

Complementary:
- Groover, Mikell P. Fundamentos de manufactura moderna : materiales, procesos y sistemas [on line]. 3a ed. México [etc.]: Prentice-Hall Hispanoamericana, 2007 [Consultation: 13/02/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4585363. ISBN 9789701062401.