Course guide
240EI024 - 240EI024 - Integrated Manufacturing Systems

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 AUTOMOTIVE ENGINEERING (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Compulsory subject).
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Irene Buj Corral

Others: Joan Ramon Gomà Ayats
Lluís Costa Herrero
Dominguez Fernandez, Alejandro
Minguella Canela, Joaquim
Uceda Molera, Roger

PRIOR SKILLS

Basic knowledge in manufacturing.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMEI02. Knowledge and ability to project, calculate and design integrated manufacturing systems.
CEEMEC3. Use the design tools CAD/CAM/CAE, the numerical simulation CFD and the dynamic simulation for the design and advanced calculation of facilities and fluid dynamic systems.

TEACHING METHODOLOGY

Learning methodology is based on three kinds of activities: theory classes, exercise classes and laboratory classes. In the classes, the teacher introduces the subject, provides concepts and knowledge, and by means of practical exercises or application examples, helps to understand the content. In some classes exercises or problems are proposed to be solved at home, which help to consolidate knowledge. The laboratory classes combine the Manufacturing Technology Laboratory and the computer rooms. At the laboratory, different numerical control machines, which are used for machining parts, are shown. At the end of the laboratory and workshop sessions the students in groups will have to answer a set of questions/ exercises about taught knowledge in the corresponding session.

LEARNING OBJECTIVES OF THE SUBJECT

General objective: The general objective of the subject is to provide students with knowledge and capabilities that are necessary to identify, evaluate, compare and select most appropriate elements that allow integrating manufacturing systems. Basically computer assisted elements used for manufacturing, which allow their integration, are treated.

Specific objectives: See specific objectives and programmed activities of each lesson.

STUDY LOAD

Type	Hours	Percentage
Hours large group	17,0	22.67
Hours small group	10,0	13.33
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

1-Manufacturing Systems

Description:
Introduction, types of productive systems, types of manufacturing systems, basic components of the manufacturing systems.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select the basic components of the manufacturing systems.

Related activities:
Theory class.

Full-or-part-time: 3h
Theory classes: 1h 30m
Self study : 1h 30m

2-Numerical Control (NC) Machines

Description:
Introduction. Previous concepts. Historical references. Features of NC machines. Basic elements. Control of axes. Main features of NC. Basic Programming and Advanced Programming concepts. Types of NC machines.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize numerical control machines, functions and features of CNC programming, applications and possibilities of numerical controls, and type of machinery where it can be applied.

Related activities:
Advanced programming with NC exercises. Laboratory class 1 to see the manufacture of parts programmed with NC and different NC Machines in the Manufacturing Technology Workshop of ETSEIB.

Full-or-part-time: 13h
Theory classes: 4h 30m
Laboratory classes: 2h
Self study : 6h 30m

3-Assembly systems

Description:
Lay-out of assembly systems, rigid or random transport systems, rigid and flexible assembly systems

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of transport systems.

Related activities:
Theory class and exercises.

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

4-Automated manufacturing

Description:
Introduction. Automatization of functions. Sensors and actuators. Robots. Control systems and PLCs. Communication.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select the different function automatization systems.

Related activities:
Theorty class and laboratory classes 2, 3, 4 and 5 with the CAM (computer assisted manufacturing) software Cimatron.

Full-or-part-time: 3h
Theory classes: 1h 30m
Self study : 1h 30m

5-Flexible Manufacturing Systems

Description:
Introduction. Concepts. Materials and workpieces. Tools. Tool kits. Machines. Systems for monitoring tools. Measuring elements. Transport and manipulation of workpieces and tools. Stores. Flexible assembly.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of different elements that allow automated flexible manufacturing.

Related activities:
Theory class. Exercises.

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

6-Preparation of machines

Description:
Manufacturing in small batches. SMED methodology.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select different systems for preparing machines.

Related activities:
Theory class. Exercises.

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

7-Computer Integrated Manufacturing

Description:
Introduction. Unattended manufacturing. Data capture and analysis. Management of computer integrated systems. 4.0 Factory.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of different elements that allow computer integrated manufacturing.

Related activities:
Theory class.

Full-or-part-time: 3h
Theory classes: 1h 30m
Self study : 1h 30m

8-Design for manufacturing

Description:
Introduction. Design for manufacturing and assembly. Concurrent engineering.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select different systems of design for manufacturing.

Related activities:
Theory class.

Full-or-part-time: 3h
Theory classes: 1h 30m
Self study : 1h 30m

9-Digital manufacturing

Description:
Introduction. CAD, CAM and CAE systems. Virtual factory. Software integration. Customized applications.

Specific objectives:
To provide students with knowledge and skills required to identify, evaluate, compare and select different systems of digital manufacturing.

Related activities:
Classe de teoría. Laboratory classes 2, 3, 4 and 5 with the CAM (computer assisted manufacturing) Cimatron software.

Full-or-part-time: 19h
Theory classes: 1h 30m
Laboratory classes: 8h
Self study : 9h 30m

GRADING SYSTEM

Qualification is based on four types of evaluations: a partial test, a final exam, evaluation of laboratory sessions and an exam of the laboratory classes. In the partial test and the final exam theoretical and practical knowledge from the classes as well as exercises. Laboratory sessions are evaluated from the questionnaire that the students will fill in at the end of every class, as well as from the exam of the laboratory classes.
Algorithm for calculation of final mark is:
Nfinal = 0,1NSL + 0,1NIP+ 0,8Max[NEF; 0,6NEF+0,4NPP]
with: NSL: Qualification of Laboratory and Workshop Sessions. NIPL: Individual qualification of the laboratory classes. NEF: Qualification of Final Exam. NPP: Qualification of Partial Test.

Reassessment:
Reassessnent exam assesses all theory and exercises content of the course. Mark obtained in the reevaluation exam NER will substitute marks NPP of the Partial Test and NEF of the Final Exam.
Nfinal = 0,1·NLT + 0,1·NTC+ 0,8·NE

EXAMINATION RULES.

Rules for tests and exams:
Nothing can be taken either to the theory part of the exam. In the exercise part of the exam, the numerical control form can be taken.

BIBLIOGRAPHY

Basic:
- Vivancos Calvet, Joan. Fabricación Asistida por Ordenador. Barcelona: CPDA-ETSEIB, 2010. ISBN 8496616231.

Complementary:
- Chang, Tien-Chien ; Richard A. Wysk ; Hsu-Pin Wang. Computer-Aided Manufacturing. 3rd ed. New York: Pearson Prentice Hall, 2006. ISBN 9780131429192.
- Vivancos Calvet, Joan et al. Fabricació Flexible. Barcelona: CPDA-ETSEIB, 1996. ISBN 8489349541.
- Vivancos Calvet, Joan ; Gomà; Joan Ramon. Sistemas CAM para la generación de programas de control numérico. Prestaciones y características. Barcelona: CPDA-ETSEIB, 1999. ISBN 8469904442.
- Vivancos Calvet, Joan. Control Numèric 2 : Programació. 3a ed. Barcelona: Edicions UPC, 1997. ISBN 8483012189.
- Vivancos Calvet, Joan. Control Numèric 1 : Conceptes, característiques i elements bàsics [on line]. 3a ed. Barcelona: Edicions UPC, 1997 [Consultation: 28/09/2018]. Available on: http://hdl.handle.net/2099.3/36326. ISBN 8483012170.

RESOURCES

Audiovisual material:
- Sistemas Integrados de Fabricación. Apuntes. Sistemas Integrados de Fabricación: Material docente preparado por el equipo de profesores de la asignatura.