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240EI024 - Integrated Manufacturing Systems

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering

Teaching unit: 712 - EM - Department of Mechanical Engineering

Academic year: 2019

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Compulsory)
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2012). (Teaching unit Optional)
MASTER ' S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: 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.

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Study load

Total learning time: 75h	Hours large group:	17h	22.67%
	Hours small group:	10h	13.33%
	Guided activities:	0h	0.00%
	Self study:	48h	64.00%

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Content

1-Manufacturing Systems

Learning time: 3h

Theory classes: 1h 30m
Self study : 1h 30m

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

Related activities:
Theory class.

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

2-Numerical Control (NC) Machines

Learning time: 13h

Theory classes: 4h 30m
Laboratory classes: 2h
Self study : 6h 30m

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.

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.

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.

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3-Assembly systems

Learning time: 6h

Theory classes: 3h
Laboratory classes: 0h
Self study : 3h

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

Related activities:
Theory class and exercises.

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

4-Automated manufacturing

Learning time: 3h

Theory classes: 1h 30m
Laboratory classes: 0h
Self study : 1h 30m

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

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

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

5-Flexible Manufacturing Systems

Learning time: 6h

Theory classes: 3h
Self study : 3h

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.

Related activities:
Theory class. Exercises.

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.

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6-Preparation of machines

Learning time: 6h

Theory classes: 3h
Self study : 3h

Description:
Manufacturing in small batches. SMED methodology.

Related activities:
Theory class. Exercises.

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

7-Computer Integrated Manufacturing

Learning time: 3h

Theory classes: 1h 30m
Self study : 1h 30m

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

Related activities:
Theory class.

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.

8-Design for manufacturing

Learning time: 3h

Theory classes: 1h 30m
Self study : 1h 30m

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

Related activities:
Theory class.

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

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9-Digital manufacturing	Learning time: 19h Theory classes: 1h 30m Laboratory classes: 8h Self study : 9h 30m

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

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

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

Qualification 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.
Reevaluation:
Reevaluation 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
In order to go to reevaluation exam it is necessary, at least, to hava attended one final exam of the subject during the same academic year.

Regulations for carrying out activities

Rules for tests and exams:
Nothing can be taken either to the theory part nor to the exercises part of exams.

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Bibliography

Basic:

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

Complementary:

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.

Vivancos Calvet, Joan. Control Numèric 2 : Programació. 3a ed. Barcelona: Edicions UPC, 1997. ISBN 8483012189.

Vivancos Calvet, Joan et al. Fabricació Flexible. Barcelona: CPDA-ETSEIB, 1996. ISBN 8489349541.

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 ; Gomà; Joan Ramon. Sistemas CAM para la generación de programas de control numérico. Prestaciones y características. Barcelona: CPDA-ETSEIB, 1999. ISBN 8469904442.

Others resources:

Audiovisual material

Sistemas Integrados de Fabricación. Apuntes

Sistemas Integrados de Fabricación: Material docente preparado por el equipo de profesores de la asignatura.