GENERAL INFORMATION

Data of the subject	
Subject name	Design, integration and verification of machines
Subject code	DIM-MII-514
Mainprogram	Official Master´s Degree in Industrial Engineering
Involved programs	Máster Universitario en Ingeniería Industrial [First year]
Credits	4,5 ECTS
Type	Obligatoria
Department	Department of Mechanical Engineering

Teacher Information	
Teacher	
Name	Ana María Megia Macías
Department	Department of Mechanical Engineering
EMail	ana.megia@icai.comillas.edu

DESCRIPTION OF THE SUBJECT

Contextualization of the subject
Prerequisites
Basic knowledge about the process of machine industrial design and processes; industrial robotic systems and verification of machines.

Course contents

Contents
1. Complex mechanisms (industrial robots, excavators, cranes, etc.)
Typologies
Types of manipulators and their characteristics.
Positioning
Denavit-Hartenberg notation. Direct problem. Reverse problem.
Kinematics and Motion Study
Motion Kinematics. Trajectory control (joint interpolation and Cartesian interpolation).
Usage

Integrated manufacturing systems, flexible systems. Robotic online verification solutions.

2. Machine verification

Machine verification

Instrumentation and validation and verification procedures. Verification of machine elements. Verification of movements of machines. Contactless verification. Measurement variability. Causes of errors in measurement. Direct and indirect measures. Calculation of uncertainties.

3. Engineering and design

Engineering and design

Methodologies and procedures for the design of processes, products or systems. Definition of requirements, design specifications and functional structures of systems. Preliminary and dimensional designs.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Final exam (50%) (requiered minimum grade 4.0) **Mid-semester exam** (20%)	Understanding of concepts. Application of concepts to the resolution of practical problems. Analysis and interpretation of the results obtained in solving problems. Presentation and written communication.	70
Case studies in groups (10%) Resolution of small practical cases in groups of students, with deadlines. **Laboratory practice** (20%) The laboratory group will deliver a report about each practice (groups of 3 or 4 students).	Presentation (word, graphics,...) Search for detailed information in bibliography (if applicable). Correct application of the contents of the different thematic blocks. Problem statement and calculations correct. Reasoned and coherent conclusions. Attitude, initiative and good development of the practice in the laboratory. In the evaluation of the report, the same criteria as in practical cases.	30

Grading

- Class assistance is mandatory and will be checked every day. The absence of more than 15% of the teaching hours or the lack of delivery of the practices may have as a consequence the impossibility of taking the exam both in the ordinary call as in the extraordinary.
- Assistance the laboratory is mandatory and will be checked every day. Failure to attend one of the practices without just cause supposes a zero in the note of the same. Students who arrive late to a practice will be allowed to do it, but will have a grade penalty.

- The non-delivery of a practice report supposes a zero in the note of that practice. One day late delivery of any practice report supposes 2 points less in the note of the same. Delays of more than one day in the delivery of reports.
- Those students who manage to obtain a final grade equal to or greater than 5.0 in the subject may obtain 0.5 extra points for the attendance to all the technical talks / conferences that are organized within the framework of the subject.

During exams:

- The use of any books, notes or forms, nor their storage in programmable calculators that may falsify the results of the exam, except those provided with the statement of the exam, if any.
- Mobile phones must remain off, inside the backpack, purse or folder and away from the student at all times moment, under the chair or at the end of class.
- It is not allowed to attend the exam with a smartwatch or any other device that allows the connection or storage of data.

Ordinary evaluation

Final exam with theoretical-practical contents of the subject **(50%). Minimum grade 4.0**.

Mid-semester exam **(20%)**.

Practical Cases in group **(10%)**.

Laboratory practices **(20%)**.

For those students not reaching the minimum grade (4.0) in the final exam, the final grade will be the one obtained in the exam.

Extraordinary evaluation

Extraordinary exam with theoretical-practical contents of the subject **(70%). Minimum grade 4.0.**

Practical Cases in group carried out in the ordinary evaluation **(10%)**.

Laboratory practices session reports carried out in the ordinary evaluation **(20%)**.

For those students not reaching the minimum grade (4.0) in the final exam, the final grade will be the one obtained in the exam.

BIBLIOGRAPHY AND RESOURCES

Basic References

Resources for the theoretical-practical classes: Slides and notes of the subject. Proposed reference books.

Videos. Links to web pages. Exercises and practical cases.

Complementary references

Introduction to design. Asimow, Morris. Prentice-Hall, 1962.
Robotics: Control Sensing. Vis. K S Fu, Ralph Gonzalez, C S G Lee. McGraw-Hill, 1987.
VIM Vocabulario Internacional de Metrología. Conceptos fundamentales y generales, y términos asociados. Centro Español de Metrología.

GUM Evaluación de datos de medición. Guía para la Expresión de la Incertidumbre de Medida. Centro Español de Metrología.

UNE-ISO 230. Código de verificación de máquinas-herramienta. AENOR.