SYLLABUS
YEAR 2017-2018

SYLLABUS

Course	
Name	PRODUCT DESIGN
Code	-
Degree	Máster en Ingeniería Industrial
Year	Segundo
Semester	1º
ECTS credits	6
Character	Optativa complementaria
Departament	Ingeniería Mecánica
Area	Diseño
Coordinator	Mariano Jiménez Calzado

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DATOS ESPECÍFICOS DE LA ASIGNATURA

Context of the course
Contribution to the professional profile
Getting students to acquire an overview of the development cycle of a product, with special emphasis on the conceptual design and validation process using computer simulation systems. The aim of this course is to provide you with: • Advanced Concepts for mechanical design and eco-design. • Basics of geometric modeling. • Ability to define the behavior of the model through simulation. • Knowledge of the scope of applications of reverse engineering.
Pre-requisites
Knowledge of engineering drawings fundamentals.

CONTENTS AND MODULES

Contents	
THEORY.	
1.	**INTRODUCTION TO DESIGN A PRODUCT. (4 HOURS). Javier Manini.**
	Advanced Concepts for mechanical design. Selection of mechanical elements. Ecodesign. Apprenticeship advanced application design (CAD), analysis and simulation (CAE) and manufacturing (CAM) and reverse engineering.
2.	**COMPUTER AIDED DESIGN, CAD. (6 HOURS). Javier Manini.**
	Solutions related to Computer Aided Design,CAD. CAE (analysis and simulation), CAM, PDM-PLM. Types of data handled in systems design. Geometric patterns. Neutral formats. Images (raster). Parts lists. Reports. Tables geometric coordinates. FEM calculations, etc.
3.	**ADVANCED DESIGN WITH COMPLEX SURFACES. (16 HOURS). Silvia Fdez.**
	Mathematical concepts for curve and surface definition. Surface modeling with CREO Parametric: datum features and wireframe geometry, basic and advanced surfacing tools, operations on surfaces (joining, trimming, extending, checking connections…), creation and edition of solids using surfaces.
4.	**REVERSE ENGINEERING. (16 HOURS). Silvia Fdez.**
	General methodology: point clouds, meshes (.stl), NURBS surface models and parametric CAD models. Digitizing methods and main technologies: applications and selection of reverse engineering systems. Hardware and software involved. Photogrammetry with Autodesk Remake. Data alignment, point cloud cleaning up, mesh reconstruction and improvement with Geomagic Studio. Surface models, history-based solid models and export to CAD software with Geomagic DesignX.
5.	**ANALYSIS AND SIMULATION OF A PRODUCT OR COMPONENT. (12 HOURS). David Fernández Caballero**
	Numerical methods in mechanical engineering. Finite element method.
6.	**IMPLEMENTATION OF A SYSTEM OF CAD / CAM / CAE / PLM. (6 HOURS). Javier Manini.**
	User industries of these systems. Basic characteristics and requirements of each industry. Products CAD / CAM / CAE market, share and evolution. Benchmarking choice. Data Organization. Network (TCP / IP, NFS, NIS). Managing concurrent access. License Management application usage. Peripherals (queues, utilities shipping). Access to CAD. Management Tasks (users, Back-up, profiles, access). Statistics. Control information providers. User training.

LABORATORY.
1. PRACTICES STANDARD ABOUT ADVANCED MECHANICAL DESIGN.
3 sessions of 2 hours. Using CATIA system CAD tools, students will design and model functional parts and assemblies (creation, dimensioning and manipulation).
2. PRACTICES WITH A SYSTEM OF CAD/CAM/CAE/PLM CATIA V5-WINDCHILL.
6 sessions of 2 hours Advanced modeling solids. Advanced modeling complex surfaces.
3. PRACTICES REVERSE ENGINEERING PRACTICES.
5 sessions of 2 hours Scanning with different techniques. Treatment of the scanned data.
4. PRACTICE WITH CAE (ANSYS) SYSTEM.
4 sessions of 2 hours. Linear static analysis that simply provides stresses or deformations. Advanced transient nonlinear phenomena involving dynamic effects

Competences - Goals	
Generic competences	
CG3.	Knowledge on basic and technological matters that helps the learning of new method and theories. Student will be trained to be flexible in front of new challenges.
CG4.	Ability to solve new problems, make decisions, be creative, critical reasoning and to communicate knowledge and skills inside the Industrial Engineering field.
CG8.	Ability to apply principles and methodologies of quality.
CG10.	Ability to work and be active part of a multilingual and multidisciplinary team.

Learning Results[1]	
To learn about the development of new products.	
RA1.	Stages of products lifecycle.
RA2.	Express product design ideas using 2D sketches and concepts design.
RA3.	Role of CADCAMCAE technologies.
RA4.	Optimal design criteria.
To model complex parts and assemblies with a leading CAD software.	
RA5.	Creation, dimensioning and manipulation.
RA6.	Parametric design and modeling criteria. Advanced Modeling solids.
RA7,	Advanced modeling complex surfaces.
RA8.	Render the appearance of a product.
To learn about reverse engineering process.	
RA9.	Main technologies and main applications identification.
RA10.	Stages and components of the process.
RA11.	Main brands and suppliers available.
RA12.	Use of a 3D digitalization scanner.
RA13.	Use of a point cloud editing software
To learn about the analysis and optimization of a designed part or assembly with a leading CAE software.	
RA14.	Role of a CAE software in the design stage to validate functional performance.
RA15.	Theory of finite element method.
RA16.	General phases of the process.
To learn about reverse PLM technology.	
RA17.	Life cycle management of a product by a PLM system.
RA18.	Interact with the PLM system and the CAD system through of a role within company.

[1] Learning results are observable indicators of the competences acquired, which allow assessing the degree of competence of the students. The competences are usually more general and abstract. Learning results are observable indicators of competences.

TEACHING METHODOLOGY

General methodological aspects	
Both classroom and non-classroom activities are developed to imply the students within the learning activities. The subjects are developed to keep the student attention and following the competencies acquisition by the students. Student activities are key factors to develop this course.	
Classroom methodology: Activities	**Competences**
1. **Lectures and general presentations**. The teacher will explain key concepts and procedures for every theme showing the more important aspects. Practical examples will be presented, discussed and solved to complete the understanding.	CG3, CG4, CG8 Y CG10
2. **Laboratory work.** Lectures and general presentations complement each other with the laboratory where the students solve problems using computers, machines and equipments. Cases will be open challenges that can be analyzed and solved by the use of the concepts already presented in class. The laboratory sessions will end up with a laboratory report to present the work performed.	CG4, CG8 Y CG10
3. **Team Work presentations**. The teacher will ask for team works of any proposed matter. Students will have to look for additional documentation to what was shown in class. Students must justify their conclusions and add value with their engineering mind. These works will be public presented in class.	CG4 Y CG10
Non-classroom methodology: Activities	**Competences**
1. **Self-learning** to understand the concepts and methodologies described in class and to apply them to different problems given by the instructor. Materials to be used are slides, multimedia files, personal and teacher notes, and recommended books.	CG3 Y CG10
2. **Laboratory preparation and reporting** revised and updated with the rest of information given in the subject.	CG4, CG8 Y CG10
3. **Team Works**. Preparation and presentation of team work project. Students must find the information sources to create outstanding works. In addition, instructors will address the questions of students individually or in groups during their office hours, and will also help them orient their learning process	CG4 Y CG10

SYLLABUS-PLANNING PRODUCT DESIGN - 2º MIIND -C1º

	CLASSROOM ACTIVITIES				NON CLASSROOM ACTIVITIES				LEARNING RESULTS	
Week	h/s	Classroom theory-problems	Laboratory	Evaluation	h/s	Autonomous study on theory	Problems solving	Autonomous work on problems and practices	Competences	Description
1	4	**Presentation (0,5 h)+ Theory chapter 1 (3,5 h)**			4	Reading and studying the theoretical contents seen of chapter 1	Do exercise in class chapter 1 ()		RA1, RA3	Stages of products lifecycle and Role of CADCAMCAE technologies.
2	4	**Practices chapter 2 (2 h)**	2 sessions of 2 hours - Practices Advanced Mechanical Design		8	Autonomous development of laboratory practice	Read the protocol and resolve the issues identified		RA2, RA4	Express product design ideas using 2D sketches and concepts design. Optimal design criteria.
3	4	**Practices chapter 2 (2 h) + Theory chapter 3 (2 h)**	1 session of 2 hours of practices Advanced Mechanical Design	Midterm exam chapters 1 and 2	8	Close study and practices of chapter 1 and 2	Read the protocol and resolve the issues identified	Do the report of the lab.	RA2, RA4	Express product design ideas using 2D sketches and concepts design. Optimal design criteria.
4	4	**Practices chapter 3 (4 h)**	2 sessions of 2 hours - Practices Advanced modeling solids and complez surfaces		8	Autonomous development of laboratory practice	Read the protocol and resolve the issues identified		RA5, RA6, RA7, RA8	Creation, dimensioning and manipulation, Parametric design and modeling criteria. Advanced Modeling solids. Advanced modeling complex surfaces and Render the appearance of a product.
5	4	**Practices chapter 3 (4 h)**	2 sessions of 2 hours - Practices Advanced modeling solids and complez surfaces		8	Autonomous development of laboratory practice	Read the protocol and resolve the issues identified		RA5, RA6, RA7, RA8	Creation, dimensioning and manipulation, Parametric design and modeling criteria. Advanced Modeling solids. Advanced modeling complex surfaces and Render the appearance of a product.
6	4	**Practices chapter 3 (4 h)**	2 sessions of 2 hours - Practices Advanced modeling solids and complez surfaces	Midterm exam chapter 3	8	Close study and practices of chapter 3	Read the protocol and resolve the issues identified	Do the report of the lab.	RA5, RA6, RA7, RA8	Creation, dimensioning and manipulation, Parametric design and modeling criteria. Advanced Modeling solids. Advanced modeling complex surfaces and Render the appearance of a product.
7	4	**Theory chapter 4 (2 h) + Practices chapter 4 (2 h)**	1 session of 2 hours of practices Reverse Engineering		8	Reading and studing the theoretical contens and Autonomous development of laboratory practice	Do exercise in class chapter 1 ()		RA9, RA10, RA11, RA12, RA13	Stages and components of the reverse engineering process. Main brands and suppliers available. Use of a 3D digitalization scanner. Use of a point cloud editing software
8	4	**Practices chapter 4 (4 h)**	2 sessions of 2 hours of practices Reverse Engineering		8	Autonomous development of laboratory practice	Read the protocol and resolve the issues identified		RA9, RA10, RA11, RA12, RA13	Stages and components of the reverse engineering process. Main brands and suppliers available. Use of a 3D digitalization scanner. Use of a point cloud editing software
9	4	**Practices chapter 4 (4 h)**	2 sessions of 2 hours of practices Reverse Engineering	Midterm exam chapter 4	8	Close study and practices of chapter 4	Read the protocol and resolve the issues identified	Do the report of the lab.	RA9, RA10, RA11, RA12, RA13	Stages and components of the reverse engineering process. Main brands and suppliers available. Use of a 3D digitalization scanner. Use of a point cloud editing software
10	4	**Theory chapter 5 (4 h)**			8	Reading and studing the theoretical contens	Do exercise in class chapter 5 ()		RA14, RA15	Role of a CAE software in the design stage to validate functional performance. Theory of finite element method.
11	4	**Theory chapter 5 (4 h)**			8	Reading and studing the theoretical contens	Do exercise in class chapter 5 ()		RA14, RA15	Role of a CAE software in the design stage to validate functional performance. Theory of finite element method.
12	4	**Practices chapter 5 (4 h)**	2 sessions of 2 hours of practices Finite Element Method		8	Autonomous development of laboratory practice	Read the protocol and resolve the issues identified		RA14, RA15, RA16	Role of a CAE software in the design stage to validate functional performance. Theory of finite element method. General phases of the process.
13	4	**Practices chapter 5 (4 h)**	2 sessions of 2 hours of practices Finite Element Method	Midterm exam chapter 5	8	Close study and practices of chapter 5	Read the protocol and resolve the issues identified	Do the report of the lab.	RA9, RA10, RA11	Role of a CAE software in the design stage to validate functional performance. Theory of finite element method. General phases of the process.
14	4	**Theory chapter 6 (2 h) + Practices chapter 6 (2 h)**	1 session of 2 hours of practices PLM			Reading and studing the theoretical contens and Autonomous development of laboratory practice	Do exercise in class chapter 6 ()		RA17, RA18	Life cycle management of a product by a PLM system. Interact with the PLM system and the CAD system through of a role within company.
15	4	**Practices chapter 6 (4 h)**	2 sessiona of 2 hours of practices PLM	Midterm exam chapter 6	8	Close study and practices of chapter 6	Read the protocol and resolve the issues identified	Do the report of the lab.	RA17, RA18	Life cycle management of a product by a PLM system. Interact with the PLM system and the CAD system through of a role within company.

EVALUATION AND GRADING CRITERIA

Evaluation activities	Grading criteria	Weight
Exams: End of term exam (paper+computer).	- Application of concepts to problem solving. - Analysis and interpretation of problems results.	50 %
Exams: Midterms exams.	- Concepts understanding.	10 %
Laboratory Lab reports.	- Concepts understanding. - Application of concepts to problem solving. - Analysis and interpretation of problems results. - Analysis and interpretation of laboratory results.	30 %
Continous evaluation: Homework.	- Concepts use to solve real cases. - Team working skills.	10 %

GRADING

Grading method
Standard evaluation at the end of the term • 10% Midterms exams. • 10% Homework. • 30% Lab reports. • 50% End of term exam (paper+computer) Attendance: minimum 85% to be allowed to take the exam. According to article 93 of the General Guidelines of the Universidad Pontificia Comillas, class attendance is compulsory for all students. Absence of more than 15% of the total amount of classes can result in the denial of the right to examination in the first exam session of the same academic year. The academic ruling of the University can be extended to the extraordinary exam session as well. **Additional evaluation during July (for those who do not pass at the end of the term)** • 30% Lab reports. • 70% July exam (paper+computer)

SUMMARY OF THE WORK PLAN AND TIMETABLE

Classroom and Non-classroom methodology: Activities	Date	Date Delivery
• Reading and studying the theoretical contents	After each theory class	View planning
• Resolution of the problems proposed	View planning	View planning
• Delivery of the problems proposed	View planning	View planning
• Midterms Exams	Weeks 3, 6, 9, 13 y 15	View planning
• Practices of laboratory	View planning	View planning
• Delivery laboratory report	Weeks 3, 6, 9, 13 y 15	View planning
• Preparation of Final Exam	December	View planning

SUMMARY OF THE STUDENT WORKING HOURS			
CLASSROOM ACTIVITIES			
Lectures general presentations	**Team work presentations**	**Lab sessions and problems solving**	**Exam**
8	6	36	4
NON-CLASSROOM ACTIVITIES			
Autonomous study on theory	**Autonomous work on team project**	**Autonomous work on practices**	**Prepare for examination**
14	14	7	15
		ECTS CREDITS:	**6 (145 hours)**

REFERENCES AND RESOURCES

References

Basic:

- Ulrich K.T., Eppinger S.D. (2012), Product Design and Development, McGraw-Hill.
- Raja V., Fernandes K.J., (2008), Reverse Engineering. An Industrial Perspective. Springer.
- Advanced tutorials for Creo. Users Guide (Parametric Technology Corporation)
- CATIA Solids/Surface Design Users Guide (Dassault Systémes).

Recommended:

- DISEÑO ASISTIDO. CAMPOS DE APLICACIÓN I Y II. Manuel Domínguez Sotomonte, UNED, 2008.
- GEOMETRÍA MODERNA PARA INGENIERÍA. Leandro Tortosa Grau, Editorial ECU, 2012