DEGREE CURRICULUM

MACHINE DESIGN AND TESTING I

Coordination: NOGUES AYMAMI, MIQUEL

Academic year 2016-17

Subject's general information

Subject name	MACHINE DESIGN AND TESTING I
Code	14522
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</th><th>Modality</th></tr><tr><td>Master's Degree in Industrial Engineering</td><td>1</td><td>COMPULSORY</td><td>Attendance-based</td></tr></table>
ECTS credits	6
Groups	1GG
Theoretical credits	3
Practical credits	3
Coordination	NOGUES AYMAMI, MIQUEL
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	40% lectures in class 60% independent student work
Important information on data processing	Consult this link for more information.
Language	Catalan. However some material could be also in Spanish or English
Office and hour of attention	Miquel Nogués, Tuesday from 19:00 to 21:30, Thursday from 10:00 to 11:30

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
NOGUES AYMAMI, MIQUEL	mnogues@diei.udl.cat	6	Monday from 18:00 to 20:00 Tuesday from 9:30 to 11:00

Subject's extra information

The main background needed to take advantatge of this subject are:

Skills in the use of a 3D CAD software

Knowledge of Elasticity and Strength of Materials

Knowledge of Theory of Mechanisms

Learning objectives

Provide students with the basic knowledge and techniques, tools, skills and abilities to effectively develop professionals activities involved in conducting machine designs. For this reason, the topics considered to be developed are both kinematics and dynamics in three dimensions, in order to carry out a proper assessment of stress of any machine part. In addition, the vibratory motion is introduced, and the bases of balancing rotors and multicylindrics machines are exposed.

The achivement of the above objectives can be specified in:

- Improve both vision and skills on the spatial movement
- Learning to use CAD for kinematic and dynamic analysis
- Introducing vibrational moviment analysis
- Achieve basic knowledge in balancing devices
- Improve skills in mechanical design

Competences

Basic competences

- **CB2** To be able to applytheknowledgegainedand to solveproblems in newenvironments in wider contexts (or multidisciplinary) relatedwiththearea of study.

General competences

- **CG4** Capacity to conceive, design and implement projects and/or provide new solutions, using the tools that the engineering offers.
- **CG6** To have suitable knowledge of the scientific and technologic alissues of: mathematical, analytical and numerical methods in engineering, electrical engineering, energetic engineering, chemical engineering, mechanical engineering, mechanics of continuous means, industrial electronics, automation, manufacture, material, quantitative methods of management, industrial computing, urbanism, infrastructures, etc.
- **CG7** To project, calculate and design products, processes, installations and plants.
- **CG9** To do research, development and innovation in products, processes and methods.

Specific competences

- **CE3** Capacity for thedesign and testing of Machines.

Cross-disciplinarycompetences

- **CT3** Mastering ICT's.

Subject contents

Unit 1. 3D Rigid Body Kinematics

1.1 Vector time derivative in a mobile coordinate system

1.2 Common coordinate systems in mechanical analysis.

1.3 Three-dimensional position analysis

1.4 Three-dimensional velocity analysis

1.5 Instant rotation centers and centrodes

1.5 Three-dimensional acceleration analysis

1.6 Kinetic energy

Unit 2. 3D Rigid Body Dynamics

2.1 Linear and angular momentum

2.2 Inertia tensor and its properties

2.3 Free-body diagrams

2.4 Newton-Euler equation of motion

2.5 Gyroscopic effects

2.6 Virtual work

Unit 3. Introduction to Vibration mechanics

3.1 Fundamentals of vibration

3.2 Free vibration of single degree of freedom systems

3.2 Harmonically excited vibration

3.4 Determination of natural frequencies and mode shapes

Unit 4. Balancing rotors and engine cylinder

4.1 Balancing rotors introduction

4.2 Static balancing

4.3 Dynamic balancing

4.4 Balancing multicilindrical systems.

Methodology

Lectures: theoretical contents and proposal and/or resolution of some practical examples.

Problems: Presentation and discussion of problems that will eventually solve by the students in a individual way or in groups.

Group work: Development of a study in groups on a set of mechanical system.

Practices: 4 laboratory sessions. The first one, three-dimensional kinematics analysis, second session inertia tensor evaluation and dynamic analysis, third session is balancing rotors session and finally vibration analysis of a multi-cylindrical device.

Development plan

Week	Methodology	Unit	Attendance hours	Autonomous work hours
1	Lectures	Unit1: Theory Unit 1: Problems	2 0	0 0
2	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
3	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
4	Lectures Problems	Unit1: Theory Unit 1: Problems	2 2	3 3
5	Lectures Practice	Unit1: Theory Practice 1	2 2	3 3
6	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
7	Lectures Problems	Unit 2: Theory Unit 2: Problems	2 2	3 3
8	Lectures Practice	Unit 2: Theory Practice 2	2 2	3 3
9	Evaluation	Exam 1	2	4
10	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	3 3
11	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	3 3
12	Lectures Problems	Unit 3: Theory Unit 3: Problems	2 2	3 3
13	Lectures Problems	Unit 4: Theory Unit 4: Problems	2 2	3 3
14	Lectures Practice	Unit 4: Theory Practice 3	2 1	3 3
15	Lectures Practice	Unit 4: Theory Practice 4	2 2	3 3
16-17	Evaluation	Exam 2	2	4
18	Tutoring	Tutoring	1	2
19	Evaluation	Recovery exam	2	2

Evaluation

Targets	Avaluation activity	Criteria	%	week	O/V	I/G	Observations
Unit 1 i 2	Lab	(*)	5	5 & 8	O	G	
	Exam	(**)	35	9	O	I	
Unit 3 i 4	Lab	(*)	5	14 & 15	O	G	
	Exam	(**)	35	17	O	I	
Developing work	Report	(*)	20	14	O	G	
Recovery 1-4	Exam	(*)	70	20	V	I	

(*) Lab report uploaded by the scheduled date for evaluation

(**) Problems without documentation.

As it can be seen, there will be several evaluation activities:

- 1st individual written exam (week 9). The content to be evaluated is the one exposed and worked in class up to the date of the exam.
- Laboratory classes are mandatory to attend, and they will be evaluated by reports filled up by the student in group.
- Several developing work will be proposed, which must be done in groups, they should be uploaded by the scheduled date for evaluation.
- 2nd individual written exam (week 17 or 18). The content to be evaluated is the one exposed and worked in class from the 1rst written exam up to the date of the exam.
- In order to pass the subject, it is necessary that the weighted note of the notes of the two written tests, according to the relative weight of each, must be equal to or greater than 3,5. If such minimum mark is not achieving, students must do the recovery exam.
- Recovery exam (week 20). The content to be evaluated in this exam is exposed in class and worked throughout the course. If the student attend to this exam, the new grade obtained replaces the notes of the two previous written exams, whether it is greater as a minor. A minimum score of 3,5 in this exam is also established to pass the course.

Note: *If the minimum grade of 3,5 in the written exams are not achieved, the mark of the subject will be the minimum between the result of the average, according to the above table and 3,5*

Note: *The grades both, laboratory reports grades and exercises developed in group, are not recoverable.*

Bibliography

"Diseño de maquinaria", Robert L. Norton, Edicions Mc Graw Hill

"MECÀNICA de la partícula i del sòlid rígid", Joaquim Agulló i Batlle, Publicacions OK punt

"Disseny de màquines I. Mecanismes", Carles Riba Romeva, Edicions UPC.

"Mecanismes i màquines I. El frec en les màquines", Carles Riba Romeva, Edicions UPC.

"Mecanismes i màquines II. Transmissions d'engranatges", Carles Riba Romeva, Edicions UPC.

"Mecanismes i màquines III. Dinàmica de màquines", Carles Riba Romeva, Edicions UPC.

"Teoria de màquines" Salvador Cardona Foix i Daniel Clos Costa, Edicions UPC

"Mechanical design", Peter R.N. Childs, Arnold Publishers