COURSE PROGRAM[1]

Academic Year: 2022/2023

Identification and characteristics of the course			
Code[2]	501339	ECTS Credits	6
Course name (English)	HYDRAULIC AND PNEUMATIC MECHANISMS		
Course name (Spanish)	MECANISMOS HIDRÁULICOS Y NEUMÁTICOS		
Degree programs[3]	Degree in Mechanical Engineering (industrial branch)		
Faculty/School[4]	Industrial Engineering School		
Semester	8	Type of course	Optional
Module	Optional courses		
Matter	Thermodynamics and Fluids Mechanics		
Lecturer/s			
Name	Office	E-mail	Web page
M. Guadalupe Cabezas Martín	D0.5	mguadama@unex.es	
Subject Area	Fluid Mechanics (Mecánica de Fluidos)		
Department	Mechanical, Energetic and Materials Engineering		
Coordinating Lecturer[5] (Ifmore than one)			

Competencies[6] (see tablehttp://bit.ly/competenciasGrados)

Basic Competences	Check With an "X"	General Competences	Check With an "X"	Transversal Competences	Check With an "X"	Specific Competences Basic Formation	Check With an "X"	Specific Competences Common to the Industrial Branch	Check With an "X"	Specific Competences Specific Technology	Check With an "X"	Specific Competences Specific Technology	Marcar con una "X"
CB1		CG1	X	CT1	X	CEFB1		CECRI1		CETE1		CETE11	
CB2		CG2	X	CT2	X	CEFB2		CECRI2		CETE2		CETE12	
CB3		CG3	X	CT3	X	CEFB3		CECRI3		CETE3		CETE13	
CB4		CG4	X	CT4	X	CEFB4		CECRI4		CETE4		CETE14	
CB5		CG5	X	CT5	X	CEFB5		CECRI5		CETE5		CETE15	
		CG6	X	CT6	X	CEFB6		CECRI6		CETE6	X	CETE16	
		CG7	X	CT7	X			CECRI7		CETE7		CETE17	
		CG8	X	CT8	X			CECRI8		CETE8		CETE18	
		CG9	X	CT9	X			CECRI9		CETE9		CETE19	
		CG10	X	CT10	X			CECRI10		CETE10		CETE20	
		CG11	X					CECRI11				CETFG	
		CG12						CECRI12					

[1] In case of joint programmes, inter-faculty programmes, double degrees, etc., please collect information from all degrees and all faculties involved in the same document.
[2] In case there is more than one code for a given subject, please include all.
[3] In case the subject is delivered in more than one degree, please include all (also double degrees).
[4] In case the subject is delivered in more than one faculty, please include all.
[5] In case the subject is delivered in more than one faculty, please include name of responsible lecturer at each one.
[6] Competencies must conform to those specified in the "Degree's Verified Memory".

Contents
Course outline[6]
Fluid power actuators. Flow rate fluctuations. Hydraulic technology. Hydraulic fluids characteristics. Regulation and control valves. Hydraulic circuits and applications. Hydraulic (hydrostatic) transmission. Compressed air generation, distribution and treatment. Pneumatics and vacuum circuits. Pneumatic applications.
Course syllabus
Name of unit 1: Introduction Contents of unit 1: • Fundamentals of fluid power. • Components of a basic hydraulic circuit. • Hydraulic fluids. • Components of a basic pneumatic circuit. • Compressed air generation, distribution and treatment. • Hydraulic and pneumatic differences. • Fluid power applications. Practical activities: (see below)
Name of unit 2: Hydraulic pumps Contents of unit 2: • Hydraulic pump types. • Hydraulic pump performance. Characteristic curves and performance. • Pump selection for an application. Practical activities: (see below)
Name of unit 3: Cylinders Contents of unit 3: • Hydraulic and pneumatic cylinders types and components. • Cylinder performance. • Cylinder selection for an application. • Direct and indirect control basic circuits and applications. Practical activities: (see below)
Name of unit 4: Motors. Contents of unit 4: • Motor types and components. • Performance and characteristics curves. • Motor selection for an application. • Direct and indirect control basic circuits and applications. • Hydrostatic transmissions. Practical activities: (see below)
Name of unit 5: Pressure valves. Contents of unit 5: • Pressure valves types and components. • Performance and characteristics curves. • Pressure valve selection for an application. • Circuits and applications. Practical activities: (see below)
Name of unit 6: Flow valves. Contents of unit 6: • Flow valves types and components. • Performance and characteristics curves. • Flow valve selection for an application. • Circuits and applications. Practical activities: (see below)

Name of unit 7: Directional control valves.
Contents of unit 7:

- Directional control valves (DCV) types and components.
- Performance and characteristics curves.
- DCV selection for an application.
- Circuits and applications.

Practical activities: (see below)

Practical activities for all units:
Practical activities cannot be associated to just one unit. Circuits include different components and complexity is increased.
Hydraulics (2 hours sessions)
H1: Relief pressure valve set point. Pump and motor characteristics and performance.
H2: Characteristics and performance of a double acting cylinder. Pressure losses in the circuit.
H3: Vertical loads in circuits. Load velocity regulation.
H4: Counterbalance valves. Load velocity regulation circuits comparative.
H5: Performance of several actuators circuits.
Pneumatics (all sessions are 2 hours, but N3 that is 1,5hour long)
N1: Direct control of single and double acting cylinders.
N2: Indirect control of single and double acting cylinders. Velocity regulation.
N3: Logic valves in pneumatic.
N4: Circuits with several cylinders. Signal temporization.
N5: No rod cylinder and vacuum ejector.

Educational activities[7]

Student workload in hours by lesson		**Lectures**	**Practical activities**				**Monitoring activity**	**Homework**
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
Presentation	1.5	1						0.5
1	8	4						4
2	8	4						4
3	19.5	9					1.5	9
4	6	3						3
5	6	3						3
6	4	2						2
7	4	2						2
Assessment[8]	93	2		19.5			1.5	70
Lab practice H1, H2, N1, N2	24			8				16
Lab practice H3-H5 y N3-N5	34.5			11.5				23
Midterm exam	7	1						6
Project	13.5						1.5	12
Final Assessm.	14	1						13
TOTAL	150	30		19.5			3	97.5

L: Lectures (100 students)
HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (30 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

[7] The contents of this table must literally conform to the information of document 12c.
[8] Specify total number of hours devoted to assessment in the present subject.

Teaching Methodologies[6]

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Used methodologies labelled as "X"
1. Explanation and discussion of theoretical contents.	X
2. Resolution, analysis and discussion of support examples or previously proposed exercises.	X
3. Exposition of related topics by students.	X
4. Development of case studies or demonstrations at laboratory, computer room, etc.	X
5. Resolution of specific doubts in small groups in order to identify potential problems in the teaching-learning process, and academic guidance for essays, case studies, practical works, demonstrations, etc.	X
6. Search for information prior to the development of the topics, or for complementary information once they are in progress.	X
7. Preparation of essays, either individually or in groups.	X
8. Study of each topic, which may consist of: content study, analysis of practical exercises or case studies, preparation for examinations, etc.	X

Learning outcomes[6]

When passing this course, students will know:

- how power transmission in a fluid works.
- How to evaluate hydraulic and pneumatic systems and stablish differences between them.
- the applicable standards.
- the volumetric pumps and how to select an adequate one.
- the linear actuators and how to attach them to a mechanism
- the motors and their application
- how to regulate flow and pressure in a circuit.
- How to select the adequate component size
- How hydraulic transmissions work in closed loop, both in stationary and non stationary.

Assessment systems[6]

Assessment criteria:

Evaluation will be done considering the criteria listed below.

CE1. Understands real and theoretical performance of hydraulic and pneumatic circuits and their components.

CE2. Know the standard symbols used in technical documentation. Understands how a medium complexity circuit operates. Can design a circuit for a simple operation.

CE3. Uses catalogues and technical documentation. Interprets technical information correctly and selects components valid for a particular application.

CE4. Express clearly and with the proper language the operation of a hydraulic or pneumatic circuit, and can justify decision related to the design or selection of its components.

CE5. Can build a simple circuit with real components.

CE6. Can work in a team, collaborating in the work organization and decision making.

Criteria CE1-CE4 are applied in all evaluations activities and criteria CE5-CE6 are only applied in the evaluation of the practical work in the laboratory. Evaluation criteria allow to control the achievement of the competences corresponding to the course. Relation between competences and criteria is shown in the table below.

	CG1	CG2	CG3	CG4	CG5	CG6	CG7	CG8	CG9	CG10	CG11	CT1	CT2	CT3	CT4	CT5	CT6	CT7	CT8	CT9	CT10	CETE6
CE1	X		X		X		X					X							X			X
CE2	X		X	X				X	X			X	X	X								X
CE3	X		X	X	X	X	X	X	X	X	X		X		X	X		X	X		X	X
CE4	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X		X		X	X
CE5	X		X	X	X								X		X				X			X
CE6		X			X				X	X			X	X	X	X			X	X		

Assessment activities:

Among the assessment activities included in the formative program, in this course the following are used:

	Range fixed	Ordinary call	Extraordinary call	Global assessment
1. Final exam and/or partial examinations.	0%–80%	50%	50%	60%
2. Practical activities in: classroom, lab, computers room, visits, etc	0%–50%	30%	30%	40%
3. Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups	0%–50%	20%	20%	0%
4. Active participation in the learning activities.	0%–10%	0%	0%	---
5. Attendance to the learning activities.	0%–10%	0%	0%	---

Description of the assessment activities:

Midterm exam (EP) with three sections:

(1) one test of 5 questions with 4 possible answers related to the theoretical contents and their application;

(2) one practical problem with typical calculation done in the selection or analysis of real components; and

(3) one design exercise for a practical application.

Each section will be graded from 0 to 10. In the test each wrong answer rest one third of the right answer corresponding value. Midterm exam grade will be the average of the three section grades. Non recoverable* activity.

Cumulative final exam (EF) with three sections:

(1) one test of 10 questions with 4 possible answers related to the theoretical contents and their application;

(2) two practical problems with typical calculation done in the selection or analysis of real components; and

(3) one design exercise for a practical application.

Each section will be graded from 0 to 10. In the test each wrong answer rest one third of the right answer corresponding value. Midterm exam grade will be the average of the three section grades. Recoverable* activity.

Laboratory practice (PL) done in group and summarized in the practice report that includes the circuits' sketches, the previous calculation and the analysis of measurement results. The activity will be graded from 0 to 10. Students that obtain grades over 6 can keep the grade for the next course if necessary. Non recoverable* activity.

Project (PR) of design of a hydraulic mechanism. Recoverable* activity.

* Non recoverable: activity can only be done when scheduled and cannot be repeated in the extraordinary call. Grade in this activity is kept for the whole academic year.

Recoverable: activity can be repeated in the extraordinary call. Newer grades when repeated replace previous ones.

Final grade:

Final grade (CF) for the course will be calculated with the formula below:

If $EF \geq 4$, $CF = C$; else $EF < 4$, $CF = min(4, C)$

ordinary call $C = 0.2 \cdot EP + 0.3 \cdot EF + 0.3 \cdot PL + 0.2 \cdot PR$

extraordinary call $C = 0.5 \cdot EF + 0.3 \cdot PL + 0.2 \cdot PR$

where EP is the midterm exam grade, EF the final exam grade, PL the laboratory work grade and, PR the project grade.

The global assessment will be held the same day scheduled for the final exam of each call. It will consist of the following parts:

Cumulative final exam (EF) with three sections:

(1) one test of 10 questions with 4 possible answers related to the theoretical contents and their application;

(2) two practical problems with typical calculation done in the selection or analysis of real components; and

(3) one design exercise for a practical application.

Each section will be graded from 0 to 10. In the test each wrong answer rest one third of the right answer corresponding value. Midterm exam grade will be the average of the three section grades. Recoverable* activity.

Laboratory practice exam (EPL) consisting of building a hydraulic or/and pneumatic circuit with real components in the laboratory workstations for a particular application. This activity will be graded from 0 to 10. Grades over 6 can be maintained for next academic year if necessary. Recoverable* activity.

Final grade:

Final grade (CF) for the course will be calculated with the formula below:

If $EF \geq 4$ and $EPL \geq 4$, $CF = C$; else, $CF = min(4, C)$

where $C = 0.6\, EF + 0.4 \cdot EPL$
being EF the final exam grade and EPL the laboratory practice exam one.

Bibliography (basic and complementary)

Basic bibliography

B1. Notes from the course.

B2. Fluid Power Technology. *F. Don Norvelle.* West Publishing Company 1995.

Complementary bibliography

C1. Fluid powder basics. Fluid powder basics. *B. Trinkel*. Hydraulics and pneumatics 2007. http://hydraulicspneumatics.com/ebooks/fluid-power-ebook-fluid-power-basics

C2. Fluid power circuits explained. *B. Trinkel*. M. Gannon and R. Schneider. Hydraulics and pneumatics 2007. http://hydraulicspneumatics.com/ebooks/fluid-power-ebook-fluid-power-circuits-explained

Other resources and complementary educational materials

Hydraulic and pneumatic catalogues

W1. Boxch Rexroth http://www.boschrexroth.es

W2. Festo http://www.festo.com

W3. SMC http://www.smc.eu