

Course guide

320057 - AT - Drives and Transmissions

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.
709 - DEE - Department of Electrical Engineering.
729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Condal Margarit, Jordi
Alvarez Del Castillo, Javier

Others: Romero Perez, Daniel
Torrent Gelma, Miguel

PRIOR SKILLS

It is considered very convenient to have taken the subjects of Theory and design of machines and mechanisms, Fluid Engineering, as well as the common subjects of mechanical systems and electrical systems.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:

1. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

- Sessions of practical work.
- Independent work and study exercises or tests.
- Preparation and evaluated in group activities.

The professor will introduce the theoretical foundations of the subject, concepts, methods and results illustrating them with examples.

The sessions of practical work in classroom are:

- a) session that the teacher will guide students in analyzing and solving problems by applying techniques concepts and theoretical results. (80%)
- b) Sessions of submissions made by students in groups. (20%)

Students must study independently to absorb and retain concepts, solve exercises proposed either manually or with the aid of the computer.

Students work in small groups to prepare publicly presented.

LEARNING OBJECTIVES OF THE SUBJECT

Introduce the different engines available to us, which is currently used. Understand and apply correctly the best transmission on each machine valuing economic criteria, technical and savings energy.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	90,0	60.00
Hours medium group	30,0	20.00

Total learning time: 150 h

CONTENTS

TOPIC 1: Electric drivers. Accessories

Description:

- Three-phase asynchronous motors.
- Single phase motors from fractional power.
- DC motor.
- Servomotors.
- Brushless.
- Stepper Motors.
- Linear Motors.
- Natural and forced ventilation.
- Brake motor.
- Absolute and relative encoder, linear, circular.
- End of stroke: electromechanical, inductive, capacitive, etc..
- Positioning.

Related activities:

- P1.-Reading: Plate and terminals. Study of the connections and power supplies.
- Software to choose a high efficiency motor in case of replacement or substitution, economic study.
- P2. - Comparison engine as accessories, how to connect them to the motor control.

Full-or-part-time: 21h

Theory classes: 4h

Practical classes: 6h

Self study : 11h

TOPIC 2: Changes in the speed of electric drives

Description:

- Frequency, parameterization.
- Variable engine-CC
- Servo controllers
- Booting: process
- Stability. Operating point

Related activities:

- P3. - Parameterization of frequency
- P4. ¿ Static starter. Make a bypas.
- P5. - Parameterization

Full-or-part-time: 16h

Theory classes: 2h

Practical classes: 3h

Self study : 11h

TOPIC 3: Power Output. Oil Hydraulic and hydrostatic basic elements

Description:

Specialization in oil-hydraulic pump-motor couplings, regulation systems in open and closed circuit. Applied to oleohydraulics of both the industrial and mobile field, both conventional and proportional.

Session 1) PUMPS AND MOTORS IN TRANSMISSIONS

- 1.1) General Oil Hydraulics Review
- 1.2) Pumps and Motors
 - 1.2.1) Pumps and motors in transmissions
 - 1.2.2) Types of pumps
 - 1.2.3) Flow fluctuations
 - 1.2.4) Operating parameters
 - 1.2.5) Introduction to variable flow
 - 1.2.6) Pressure compensation
 - 1.2.7) Load Sensing
 - 1.2.8) Types of motors
 - 1.2.9) Operating parameters
- 1.3) Difference between open and closed circuit
- 1.4) Example of applications
- 1.5) Example of circuits

(SELF-ASSESSMENT: Questionnaire)

Session 2) OPEN CIRCUIT CONTROL SYSTEMS

- 2.1) Industrial / mobile oleohydraulic conceptual difference
 - 2.1.1) CETOP modular valves.
 - 2.1.2) Mobile valves (control blocks / in-line valves)
- 2.2) Flow regulation in oleohydraulics
 - 2.2.1) Fixed flow pumps (throttles, VRC.2 way, VRC-3 way)
 - 2.2.2) Variable flow pumps. (Load sensing system)
 - 2.2.3) Comparison between fixed / variable flow pump regulation. Energy criteria.
 - 2.2.4) Multi-actuator compensated systems
 - 2.2.5) Pilot types.
 - 2.2.6) Application example

SESSION 3) CLOSED CIRCUIT CONTROL SYSTEMS



- 3.1) Introduction to the closed circuit.
- 3.2) Type circuit
- 3.3) Dimensioned motor-pump system
- 3.3) Pilot type.
- 3.4) Application example

SESSION 4) TRANSMISSION IN VEHICLES

- 4.1) Dimensioning of the wheel motor
- 4.2) Influence of the terrain
- 4.3) Free-Wheling concept
- 4.4) Overcenter valves

(SELF-ASSESSMENT: Shaving machine design)

SESSION 5) EXAMPLES AND PROBLEMS

- 5.1) FAN-DRIVE
- 5.2) CONCRETE MACHINE
- 5.3) STREET SWEEPER

SESSION 6) EXAMPLES AND PROBLEMS

- 6.1) Open circuit problem 1
- 6.2) Open circuit problem 2
- 6.3) Closed circuit problem 1
- 6.4) Closed circuit problem 2

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 2h

Self study : 13h

TOPIC 4: Connections to the motor

Description:

- Elastic couplings
- Accuracy couplings
- Torque limiters
- Clutches
- Hydraulic Couplings
- Mechanical speed variables

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 4h

Self study : 11h

TOPIC 5: Gear transmissions

Description:

- Types of gears and its calculation
- Reducers. Technology and selection
- Units of intermittently rotation
- Units of force, mechanical hammers

Full-or-part-time: 23h

Theory classes: 6h

Practical classes: 6h

Self study : 11h

TOPIC 6: Flexible Transmission

Description:

- For belt
- For string
- Cardan joints

Full-or-part-time: 16h

Theory classes: 3h

Practical classes: 2h

Self study : 11h

TOPIC 7: Elements supports

Description:

- Calculation of bearings
- Sealing elements
- Lubrication of transmissions

Full-or-part-time: 16h

Theory classes: 3h

Practical classes: 2h

Self study : 11h

TOPIC 8: Transmissions with hydrostatic and mechanical components. Case studies

Description:

- Combination with gearboxes
- Overlapping powers
- Drive vehicles (wheels, caterpillars, etc.)
- Drive with argue
- Driven propeller, pumps and fans
- Drive mechanisms (excavators, cranes, etc.)

Full-or-part-time: 20h

Theory classes: 4h

Practical classes: 5h

Self study : 11h



GRADING SYSTEM

- 1st test : 25%
- 2nd test: 25%
- 3rd test: 25%
- Activities: 25%

BIBLIOGRAPHY

Basic:

- Henriot, Georges. Traité théorique et pratique des engranages. 6e. éd. Paris: Dunod, 1979. ISBN 2040156070.
- Decker, Karl-Heinz. Elementos de máquinas. Bilbao: Urmo, 1980. ISBN 8431403403.
- Decker, Karl-Heinz. Elementos de unión. Bilbao: Urmo, 1980. ISBN 8431403438.
- Fraile Mora, Jesús. Máquinas eléctricas. 8a ed. Madrid: Ibergareta, 2016. ISBN 9788416228669.
- Fraile Mora, J.; Fraile Ardanuy, J. Problemas de máquinas eléctricas. Madrid: McGraw-Hill, 2005. ISBN 8448142403.
- Cundiff, John S. Fluid power circuits and controls: fundamentals and applications [on line]. Boca Raton: CRC Press, 2002 [Consultation: 09/05/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=263326>. ISBN 0849309247.
- València, Eugeni [et al.]. Oleohidráulica: problemas resueltos [on line]. Barcelona: Edicions UPC, 2006 [Consultation: 06/05/2020]. Available on: <http://hdl.handle.net/2099.3/36807>. ISBN 848301856X.