Course guide
220105 - TMM - Machine and Mechanism Theory

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Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: FRANCISCO JAVIER FREIRE VENEGAS

Others: BEATRIZ PURAS GÓMEZ
ANA MARAÑON MARTINEZ
ESTEVE COMAS CESPEDES
CARLOS GUSTAVO DIAZ GONZALEZ
CARLOS RIO CANO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE19-GRETI. Knowledge and skills for the calculation, design, and testing of machines. (Specific Technology Module)
CE13-INDUS. Knowledge of the principles of machine theory and mechanisms. (Common module in the industrial branch)

TEACHING METHODOLOGY

The course is divided into three parts:
* Lecture sessions.
* Practical sessions (exercises and problems).
* Lab sessions.
* Self-study and doing exercises and activities.
In the lecture sessions, teachers will introduce the theoretical principles of the subject, concepts, methods and illustrate with examples appropriate to facilitate understanding.
In practical sessions in the classroom, teachers guide students in applying theoretical concepts to problem solving, based on critical thinking at all times. Some exercises will be proposed to be solved in the classroom and outside the classroom, to promote contact and use the basic tools needed to solve problems.

In the laboratory sessions, teachers will guide students in conducting experiments that illustrate theoretical concepts, based on critical thinking at all times. It will propose that students calculate theoretically the results of experiments and compare it with the experimental results.
Students, autonomously, should work the material provided by the teacher and the result of the work sessions, to assimilate concepts. Teachers will provide a study and monitoring activities plan (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

The machine and mechanism theory course introduces the theory course and principles of kinematics and dynamics of mechanical multi body systems. The motion force and mass basic concepts are introduced, to explain some methods to get the equations of motion of multi body systems.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	32,0	21.33
Hours medium group	14,0	9.33
Hours small group	14,0	9.33

Total learning time: 150 h

CONTENTS

kinematic

Description:

Structural analysis of mechanisms
Speed â□□â□□analysis
Acceleration analysis

Related activities:
1, 2, 5 y 6

Full-or-part-time: 50h
Theory classes: 10h
Practical classes: 5h
Laboratory classes: 5h
Self study : 30h

Transmissions

Description:

Gears
Gear box.

Related activities:
1, 2, 3, 5, 6

Full-or-part-time: 19h
Theory classes: 5h
Practical classes: 2h
Laboratory classes: 2h
Self study : 10h

Static mechanisms

Description:

Strength, work and performance in mechanisms
Force reduction: graphic method
Virtual jobs and powers

Related activities:
1, 2, 3, 5, 6

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 2h
Laboratory classes: 2h
Self study : 14h

Dynamic mechanisms

Description:
Energy theorem
Exerjian Equation
Lagrange Equations
D'Alembert method

Related activities:
1, 2, 3, 4, 6

Full-or-part-time: 57h
Theory classes: 11h
Practical classes: 5h
Laboratory classes: 5h
Self study : 36h

ACTIVITIES

1. LARGE GROUP SESSIONS / THEORY

Description:
Previous and subsequent preparation of theory sessions and assistance to them.

Specific objectives:
Transfer the necessary knowledge for a correct interpretation of the contents developed in the large group sessions, solving doubts in relation to the syllabus of the subject and development of the specific competence. To Know the principles of the theory of machines and mechanisms.

Material:
General bibliography of the subject.

Delivery:
During some of the sessions may be proposed no classroom exercises, individually or in small groups.

Full-or-part-time: 52h
Theory classes: 26h
Self study: 26h

2. SMALL GROUP SESSIONS / PROBLEMS

Description:
Pre-session and post-session preparation of problem and practice sessions and attendance.

Specific objectives:
Acquire the necessary skills for a correct interpretation of the problems of the subject, as well as a satisfactory resolution of these. Preparation for the practical part of the exams of the subject.
Development of specific competence Know the principles of the theory of machines and mechanisms.

Material:
General bibliography of the subject.
Exercises on the Athena platform
Collection of problems of the subject.

Delivery:
During these sessions, on-site and virtual exercises, either individually or in small groups, would be developed by the faculty and the student body. During some of the sessions, non-contact exercises can be proposed, individually or in small groups.

Full-or-part-time: 43h
Practical classes: 13h
Laboratory classes: 10h
Self study: 20h

3. SMALL GROUP SESSIONS / PRACTICES

Description:
Pre-and post-preparation of laboratory practice sessions, problems workshop and assistance to them.

Specific objectives:
Recognize and apply the concepts studied in theory and problem activities.
Compare the theoretical forecasts with the observed results and draw conclusions.

Material:
General bibliography of the subject
Exercises on the Athena platform
Notes of the subject

Delivery:
For each session of laboratory practices, a document accrediting the work developed will be delivered, according to the conditions specified in each particular case.

Full-or-part-time: 16h
Laboratory classes: 4h
Self study: 12h

4. INFORMATIC SIMULATIONS

Description:
Freelance application of computer tools to solve problems of the subject.

Specific objectives:
Acquire the necessary skills for a correct interpretation of the problems of the subject, as well as a satisfactory resolution of these. Preparation for the practical part of the exams of the subject.
Development of specific competence Know the principles of the theory of machines and mechanisms.

Material:
General bibliography of the subject.
Exercises of the Athena platform
Collection of problems of the subject

Delivery:
For each simulation session to deliver a document accrediting the work developed, according to the conditions specified in each particular case.

Full-or-part-time: 18h
Self study: 18h

5. MIDTERM EXAM

Description:
Individual and written test on the contents of modules 1 and 2.

Specific objectives:
The test must show that the student has acquired and assimilated the concepts, principles and basic fundamentals related to modules 1, 2 and 3: Kinematics, Transmissions and Statics.

Material:
Test text.

Delivery:
The deliverable will be the resolution of the test.

Full-or-part-time: 9h
Theory classes: 2h
Practical classes: 1h
Self study: 6h

6. FINAL EXAM

Description:
Individual and written test on the contents of modules 3 and 4.

Specific objectives:
The test must show that the student has acquired and assimilated the concepts, principles and basic fundamentals of the whole subject, especially those related to modules 3 and 4: Static and Dynamic.

Material:
Test text.

Delivery:
The deliverable will be the resolution of the test.

Full-or-part-time: 12h
Theory classes: 4h
Self study: 8h

GRADING SYSTEM

The final grade depends on five evaluative acts:
* 1st and 2nd activities (problems): 10%
* 3rd activity (lab): 10%
* 4th activity (simulation): 10%
* 5th activity (partial exam): 25%
* 6th activity (final exam): 45%

In case of being unable to attend to the partial exam or not passing it, the student will have an automatic second opportunity for the day of the final exam. I this case, the grade will be :
* 1st and 2nd activities (problems): 10%
* 3rd activity (lab): 10%
* 4th activity (simulation): 10%
* 6th activity (final exam): 70%

NOTE: the final grade will be always the upper one.

EXAMINATION RULES.

Problems from activities 1 and 2 will be conducted in groups and writing. May be asked to defend publicly and are subject of discussion. Alternatively you can submit a collection of problems, but the score will be lower.
The activities 3 & 4 will be conducted in group. The laboratory work is necessary to grade this activity 3.
Activities 5 and 6 will be held individually and written.

BIBLIOGRAPHY

Basic:
- Paul, B. Kinematics and dynamics of planar machinery. Englewood Cliffs: Prentice Hall, 1979. ISBN 9780135160626.
- Norton, Robert L.; Rios Sánchez, Miguel Àngel. Diseño de maquinaria: síntesis y análisis de máquinas y mecanismos [on line]. 5ª ed. México: McGraw-Hill, 2013 [Consultation: 15/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5701. ISBN 9786071509352.
- Shigley, J. E.; Uicker, J. J. Teoría de máquinas y mecanismos. México: McGraw-Hill, 1982. ISBN 9789684512979.
- Khamashta, M.; Álvarez, L.; Capdevila, R. Problemas de cinemática y dinámica de máquinas, Vol. 1, Problemas resueltos de cinemática de mecanismos planos. 2ª ed. Terrassa: UPC. ETSEIT. Departament d'Enginyeria Mecànica, 1993. ISBN 847653003X.
- Khamashta, M.; Álvarez, L.; Capdevila, R. Problemas de cinemática y dinámica de máquinas, Vol. 2, Problemas resueltos de dinámica de mecanismos planos. 2ª ed. Terrassa: UPC. ETSEIT. Departament d'Enginyeria Mecànica, 1994. ISBN 8476530358.

RESOURCES

Audiovisual material:
- Col.lecció de problemes sense solució, per treballar l'assignatura

Hyperlink:
- Documentació a ATENEA