

# Course guide 340083 - DIME-D6012 - Mechanism Design

Last modified: 17/05/2023

Academic year: 2023	ECTS Credits: 6.0	Languages: Spanish	
Degree:	BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).		
Teaching unit:	712 - EM - Department of Mechanical Engineering.		
Unit in charge:	Vilanova i la Geltrú Scho	pol of Engineering	

LECTURER				
Coordinating lecturer:	AMELIA NÁPOLES ALBERRO			
Others:	Gonzalez Diaz, Nestor			

# **PRIOR SKILLS**

Previous concepts on which the subject has been planned: - The academic contents of the subject "Mechanics" (MECA).

# REQUIREMENTS

Have satisfactiation achieved the subjects: "Mechanics" (MECA)

# **DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES**

#### Specific:

- 1. D6. Ability to analyze and model kinematics and dynamic behavior of mechanical systems.
- 2. D7. Ability to simulate and design mechanisms as a solution for specific mechanical problems.
- 4. D9. Ability to analyze and solve machine and mechanism design problems.

#### Transversal:

07 AAT N2. 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. 5. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

# **TEACHING METHODOLOGY**

The face-to-face sessions are divided into theory classes, problems and laboratory practices. The theory and problem classes integrate the expositions of the basic theoretical concepts of the thematic contents of the subject and describe examples applied in the form of exercises. In the practical classes the mobility of the models available in the laboratory is studied, and the mechanisms available in video are studied, and the behavior is analyzed through tasks set by the teacher.

# LEARNING OBJECTIVES OF THE SUBJECT

When finishing the subject, the student has to be able to:

- Analyze and calculate the kinematics of the mechanisms as a result of a specific movement problem.
- Analyze and relate the forces and Torques transmitted during movement in the mechanism.
- Analyze and solve the design of a mechanism applying the synthesis criteria.



# **STUDY LOAD**

Туре	Hours	Percentage
Self study	90,0	60.00
Hours small group	15,0	10.00
Hours large group	45,0	30.00

Total learning time: 150 h

# CONTENTS

#### 1-Geometry of mechanisms

#### **Description:**

Recapitulation of Conceptes adquisides in l'asignatura MECA, on Geometry dels mechanismes: Definicions. Cinematic parells. Equivalent Mecanism Schematics. He invested cinematic. Graus de llibertat. Criteria of Grübler i de Kutzbach.

# Full-or-part-time: 45h

Theory classes: 45h

# 2-Synthesis of Mechanisms.

# **Description:**

Analytical methods: Vector position. Closing equation. Position analysis. Grashof's condition. Graphic methods. Synthesis of positional relationships and driving synthesis. Angle of transmission. Mechanical advantage.

# Full-or-part-time: 36h

Theory classes: 11h 15m Laboratory classes: 3h 45m Self study : 21h

#### 3-Kinematic and dynamic analysis of mechanisms.

#### **Description:**

3.1 Analysis of mechanisms.3.2 Speed and acceleration in mechanisms.

# Specific objectives:

At the end of this teaching unit, the student must be able to: - Perform cinematic study of mechanisms.

**Full-or-part-time:** 36h Theory classes: 11h 15m Laboratory classes: 3h 45m Self study : 21h



#### 4-Transmission of forces into mechanisms.

#### **Description:**

Graphical decomposition of forces. Calculation of the actions on the different points connected to the bench.

Full-or-part-time: 45h

Theory classes: 45h

#### 5-Dynamic analysis of flat mechanisms.

#### Description:

Consideration of the inertia of the bars. D'Alembert's theorem. Calculation of forces and motor or resistive torques by the Virtual Powers Method Calculation of forces and pairs transmitted to the bench by the Free Body Diagram Method (dcl)

# **Full-or-part-time:** 45h Theory classes: 45h

GRADING SYSTEM Laboratory practices 25% Partial Evaluation 1 30% Partial Evaluation 2 45% Re Evaluation 75%

For the approval of the subject it is necessary to carry out and present the reports of 80% of the laboratory practices.

# **EXAMINATION RULES.**

Standards for exams:

- The Re-evaluation includes all the content of the subject.
- You should not use notes, or calculator, not mobiles.
- Do not write in red color.

Other conditions of completion of each test will be specified in Atenea, with sufficient notice.

# **BIBLIOGRAPHY**

#### **Basic:**

- Norton, Robert L. Diseño de maquinaria : síntesis y análisis de máquinas y mecanismos [on line]. 6a ed. Aravaca: McGraw Hill/Interamerica de España, 2020 [Consultation: 19/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB BooksVis?cod primaria=1000187&codigo libro=5701. ISBN 9788448620998.

- Budynas, Richard G.; Nisbett, J. Keith. Diseño en ingeniería mecánica de Shigley [on line]. 10a ed. Ciudad de México: McGraw-Hill, 2018 [Consultation: 14/02/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5485 813. ISBN 9781456262112.

- Nápoles Alberro, Amelia; Sánchez Egea, Antonio J.; Zayas Figueras, Enrique E. Teoria de mecanismos : ejercicios resueltos [on line]. Barcelona: Iniciativa Digital Politècnica, Oficina de Publicacions Acadèmiques Digitals de la UPC, 2017 [Consultation: 02/05/2022]. Available on: <u>https://upcommons.upc.edu/handle/2117/108321</u>. ISBN 9788498806533.

- Nápoles Alberro, Amelia. Análisis de mecanismos : cinemática y dinámica. Madrid: Delta Publicaciones, 2010. ISBN 9788492954179.

- Nápoles Alberro, Amelia. Autoaprendizaje del análisis de mecanismos. Barcelona: Delta publicaciones universitarias, 2010. ISBN 9788492954193.

#### **Complementary:**



- Olivares Benítez, Tania. Manual práctico NX7 CAD. Vizcaya: Servicios Informáticos DAT, S.L, 2009. ISBN 9788461367689.

# **RESOURCES**

### **Other resources:**

1. "DRIVE.GOOGLE" shared server:

<u>https://drive.google.com/drive/folders/1uy4axrpy1sTHkS5AE0QRczIW0hYB-OOg?usp=sharing</u> />In this link, the student can download two information for the study.

I. "Multimedia folder for self-learning mechanisms" folder.

• This study material, allows to study the theoretical concepts interactively (consult it before the start of each topic). In addition, the MEDIACATECA must be consulted, which is useful for understanding the movements in the mechanisms.

- Run file \* .EXE: Program Player klcodec345
- Run Interactive file.swf
- II. DIME Videos Mechanisms:
- Gallery of mechanisms and Guide with information to perform the Deliverable Assignment.

2. Digital campus "ATENEA": Documentation to track the subject:

a) Slides class: <u>https://ocw.upc.edu/curs\_publicat/820429/2015/1/apunts</u> />b) Weekly dedication guide: Before the theory class, the student must study the theoretical concepts indicated. In theory classes, emphasis will be placed on the theoretical aspects and exercises will be developed.

c) Collection of exams.