

Course guide

205605 - 205605 - Multibody System Dynamics

Last modified: 24/04/2023

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering		
Teaching unit:	712 - EM - Department of Mechanical Engineering.		
Degree:	MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Compulsory subject).		
Academic year: 2023	ECTS Credits: 3.0	Languages: Catalan	

LECTURER

Coordinating lecturer:	Rosa Pàmies Vilà
Others:	Albert Peiret Gimenez

PRIOR SKILLS

Knowledge of the kinematics and dynamics (vector formulation) of rigid bodies.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE7-MUREM. Use numerical simulation tools for the design, calculation and manufacture of components, systems and mechanical installations.

CE9-MUREM. Identify research trends in the area of Mechanical Engineering, the different models of research units, as well as the mechanisms for managing, disseminating and protecting R&D&i.

Generical:

CG1-MUREM. Solve problems of Mechanical Engineering through the application of mathematical, analytical, scientific, instrumental, technological and management aspects.

CG4-MUREM. Research and innovate in the field of Mechanical Engineering.

CG8-MUREM. Develop the learning skills that allow mastering the current and future activities of Mechanical Engineering and the continuous development of the field.

TEACHING METHODOLOGY

- Theoretical and practical face-to-face class (classroom, computer room and laboratory).
- Guided autonomous learning.
- Cooperative learning.
- Learning based on projects, problems and case studies.

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives

The general learning objectives of the course are:

- Know tools for modelling mechanical multibody systems (types of coordinates, kinematic constraints, etc.).
- Apply computational algorithms to solve kinematic and dynamic problems.
- Use graphical interfaces for visualization of movement.

Attitudes, values and norms

This course unit will help students to develop in a number of areas, including effort, discipline, collaboration and teamwork, analysis of complex computational problems, spoken and written communication, and preparation of multimedia material.

STUDY LOAD

Type	Hours	Percentage
Hours small group	12,0	16.00
Hours large group	15,0	20.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Modelling of mechanical systems

Description:

Types of coordinates. Independent coordinates. Dependent coordinates. Restriction constraints. Join constraints. Rigid body constraints.

Related competencies :

CG1-MUREM. Solve problems of Mechanical Engineering through the application of mathematical, analytical, scientific, instrumental, technological and management aspects.

CE7-MUREM. Use numerical simulation tools for the design, calculation and manufacture of components, systems and mechanical installations.

Full-or-part-time: 9h

Theory classes: 3h

Laboratory classes: 1h

Self study : 5h

Kinematics

Description:

Kinematics of rigid bodies. Initial position problem. Velocity analysis. Acceleration analysis. kinematic simulation. Overdetermined mechanisms. Visualization.

Related competencies :

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CG8-MUREM. Develop the learning skills that allow mastering the current and future activities of Mechanical Engineering and the continuous development of the field.

CG4-MUREM. Research and innovate in the field of Mechanical Engineering.

CE7-MUREM. Use numerical simulation tools for the design, calculation and manufacture of components, systems and mechanical installations.

CE9-MUREM. Identify research trends in the area of Mechanical Engineering, the different models of research units, as well as the mechanisms for managing, disseminating and protecting R&D&i.

Full-or-part-time: 30h

Theory classes: 6h

Laboratory classes: 4h

Self study : 20h

Dynamics

Description:

Dynamic Analysis. Equations of Motion. Lagrange's equations. Mass matrix and vector of generalized forces. Dynamic formulations. Numerical integration of the equations of motion.

Related competencies :

CG1-MUREM. Solve problems of Mechanical Engineering through the application of mathematical, analytical, scientific, instrumental, technological and management aspects.

CG8-MUREM. Develop the learning skills that allow mastering the current and future activities of Mechanical Engineering and the continuous development of the field.

CG4-MUREM. Research and innovate in the field of Mechanical Engineering.

CE7-MUREM. Use numerical simulation tools for the design, calculation and manufacture of components, systems and mechanical installations.

CE9-MUREM. Identify research trends in the area of Mechanical Engineering, the different models of research units, as well as the mechanisms for managing, disseminating and protecting R&D&i.

Full-or-part-time: 36h

Theory classes: 6h

Laboratory classes: 7h

Self study : 23h

GRADING SYSTEM

Global course grade (NF) will be based on the following partial grades:

Nac = Continuous evaluation grade (deliveries, practices, works, projects and presentations)

Nef = Final exam grade

NF = 0.50 Nac + 0.50 Nef

Reevaluation:

Students enrolled in the subject who have obtained a final grade (NF) greater than or equal to 2.0 but less than 5.0 may apply. The reevaluation exam has the same format as the ordinary final exam. The reevaluation exam grade (Nre) and the continuous evaluation grade provide the reevaluation grade (NRevaluation)

$NRevaluation = 0.50 * Nac + 0.50 * Nre$

If $NRevaluation \geq 5$, the final grade of the subject will be passed, with a grade of 5.0.

If $Nreevaluation < 5$

BIBLIOGRAPHY

Basic:

- García de Jalón de la Fuente, Javier; Bayo, Eduardo. Kinematic and dynamic simulation of multibody systems: the real-time challenge [on line]. New York: Springer-Verlag, cop. 1994 [Consultation: 23/01/2023]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3076770>. ISBN 1461276012.

- Agulló i Batlle, Joaquim; Barjau Condomines, Ana. Rigid body kinematics [on line]. Cambridge, United Kingdom: Cambridge University Press, 2020 [Consultation: 23/01/2023]. Available on: <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/rigid-body-kinematics/39486736674235C90D0D4B4283EB286B>. ISBN 9781108479073.

- Agulló i Batlle, Joaquim. Mecànica de la partícula y del sòlid rígid. 3a ed. corr. i ampl. Barcelona: Publicacions OK Punt, 2002. ISBN 8492085061.

- Agulló i Batlle, Joaquim. Introducció a la mecànica analítica, percutiva i vibratòria. Barcelona: OK Punt, 1998. ISBN 8492085037.