UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	RIGID BODY MECHANICS	**Code:**	38309
Type:	BASIC	**ECTS credits:**	6
Degree:	345 - UNDERGRADUATE DEGREE PROGRAMME IN CIVIL ENGINEERING	**Academic year:**	2023-24
Center:	603 - E.T.S. CIVIL ENGINEERS OF CR	**Group(s):**	20
Year:	1	**Duration:**	C2
Main language:	Spanish	**Second language:**	English
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **ELISA POVEDA BAUTISTA** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Politécnico/2-D56	MECÁNICA ADA. E ING. PROYECTOS	6322	elisa.poveda@uclm.es	Monday: 10-13 h, Tuesday: 10-12 h, Friday: 11-12 h.

Lecturer: **GONZALO FRANCISCO RUIZ LOPEZ** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Politécnico/2-A61	MECÁNICA ADA. E ING. PROYECTOS	3257	gonzalo.ruiz@uclm.es	

2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

This subject is aimed to understand the behavior of solids through theoretical models (material point and rigid body models) and to apply them to particular cases and to predict mechanical phenomena. These concepts ground the discipline named "Mechanics of Materials", where other subjects are also classified, namely "Science and Technology of Materials in Civil Engineering", "Deformable Body Mechanics" and "Strength of Materials". This subject ("Rigid Body Mechanics") is essential to understand how to use engineering materials in construction.

4. Degree competences achieved in this course

Course competences

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CE06	Students have a basic knowledge of the use and programming of computers, operating systems, databases and software with engineering application.
CE07	Students reach understanding and mastery of the basic concepts on the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application for the solution of engineering problems.
CG02	Students can use proper oral and written communication

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Students recognize the relevant mechanical variables in each problem, learn how to measure them and calibrate the error in the measurement and results of their calculations.

Students understand the behavior of bodies and materials through theoretical models (material point, rigid solid body, deformable solid body). They apply these models to specific cases and use them to predict mechanical phenomena.

Additional outcomes

Introduction to the experimental methodologies and to the application of Laboratory results.

6. Units / Contents

Unit 1: Systems of sliding vectors.

Unit 1.1 Definition of a sliding vector. Point and axial moment of a sliding vector. Systems of sliding vectors: characterization parameters, equivalences, deduction, map of the point-moment field.

Unit 2: Particle kinematics.

Unit 2.1 Velocity and acceleration. 1st type of description: fixed coordinate system. 2nd type of description: intrinsic coordinate system.

Unit 3: Particle dynamics.

Unit 3.1 Definitions: mass, force. Fundamental laws (Newton). Inert vs. gravitational mass. Equations of motion. Examples (including harmonic motion and motion involving friction).

Unit 4: First integrals and conservation theorems.

Unit 4.1 Work of forces, kinetic and potential energy. Principle of work and energy. Conservative forces. Linear and angular moments. Motion under a

conservative central force. Impulsive motion. Impact. Systems gaining / losing mass.

Unit 5: Relative motion. Inertia forces.

Unit 5.1 Fixed / moving reference frames. Inertia forces.

Unit 6: Geometry of masses.

Unit 6.1 Center of mass. Moment and product of inertia. Radius of gyration. Parallel axis theorem. Principal axes and principal moments of inertia. Mohr¿s circle.

Unit 7: Rigid body kinematics.

Unit 7.1 Description and analysis of a rigid-body motion. Translation. Rotation about a fixed axis. Plane motion. Rotation about a fixed point. General motion.

Unit 8: Rigid body dynamics (plane motion).

Unit 8.1 Equations of motion for a rigid body. D¿Alembert¿s principle. Energy and momentum methods. Impulsive motion. Impact. Mechanical vibrations.

Unit 9: Rigid body statics.

Unit 9.1 Equilibrium. Reactions at supports and connections. Equilibrium of a rigid body in two / three dimensions. Statically indeterminate reactions. Laws of dry friction. Coefficients / angles of friction. Wedges. Belt friction.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CB01 CE07 CG02	1.2	30	N	-	Theory classes: The instructor explains the theoretical topics using the blackboard plus electronic presentations in case graphical support is necessary; simple exercises highlighting basic theoretical concepts are given; attentive listening, taking notes, examples workout.
Class Attendance (practical) [ON-SITE]	Project/Problem Based Learning (PBL)	CB01 CE07 CG02	0.76	19	N	-	Exercises classes: The instructor poses several series of problems so that students can solve as homework using the knowledge gained in theory classes and in personal study; the methodology to solve the problems is explained in these classes; moreover, the most representative problems of each series are solved in detail.
Study and Exam Preparation [OFF-SITE]	Other Methodologies	CB01 CE07	1.12	28	N	-	Personal study: This learning activity consists of personal study of the lessons explained in the theory classes, using the recommended books, the student notes and the copies of presentations or other material that can be handed out.
Study and Exam Preparation [OFF-SITE]	Project/Problem Based Learning (PBL)	CB01 CE07	2.18	54.5	N	-	Solving problems: Students work at solving the posed exercises using the learning gained in theory classes and personal study; this activity is complemented with the classes of exercises, since in them the student confirms that his/her solution is correct or, contrariwise, he/she may learn how to solve the problems that could not be completed on his/her own.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	CB01 CE06 CE07 CG02	0.32	8	Y	Y	Labwork: Students go to the Laboratory to do tests and measurements on them, which reinforce the theory and practical concepts; they must follow the methodology appropriate for the Laboratory work, the general safety procedures and those established for the particular tests they have to work on.
Practicum and practical activities report writing or preparation [OFF-SITE]	Practical or hands-on activities	CB01 CE06 CE07 CG02	0.3	7.5	Y	Y	Data analysis, elaboration of the Labwork report and presentation of the results: The instructor orients on how the Lab data have to be analyzed; he/she also teaches how to elaborate a report, following scientific standards, to inform about the measured data, discuss them and draw conclusions from them; writing the report and presenting its content reinforce the understanding of the Labwork and of the

							conclusions drawn.
Mid-term test [ON-SITE]	Project/Problem Based Learning (PBL)	CB01 CE06 CE07 CG02	0.12	3	Y	Y	Exams during continuous evaluation. This part can be made-up in the final exams.
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Laboratory sessions	16.80%	0.00%	The grading is done by reviewing the Lab report complemented with a presentation on the Lab results. The report must follow the guidelines that will be given at the beginning of the semester. This part can be made-up in the final exams.
Assessment of problem solving and/or case studies	16.60%	0.00%	Problems proposed to reinforce the concepts explained in class and which are evaluated throughout the course.
Mid-term tests	50.00%	0.00%	Exams during continuous evaluation. This part can be made-up in the final exams.
Assessment of active participation	16.60%	0.00%	Active participation of the student in the classes is considered in the continuous evaluation.
Final test	0.00%	100.00%	Final exam.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The continuous evaluation consists of four marks, all of them scored from 0 to 10 points. The first corresponds to the average mark of three partial tests, being necessary to achieve a minimum of 4 in each of them. The second mark corresponds to the labwork, being necessary to obtain 4 or more points. The third and fourth marks correspond, respectively, to the proposed problems and the activity developed in class. The subject will be passed in continuous assessment when the weighted average of the four marks is equal to or greater than 5 points, provided the minimum grades indicated are met.

The partials, the proposed problems and the labwork can be made-up in the final exams. The marks of these parts equal to or greater than 4 points are kept until the end of the academic year, although students may also take the finals to improve their grades on these parts. If the labwork mark is equal to or greater than 5 points, it is also kept for the following academic year, although the student may choose to do the labwork anew or take the corresponding exercises in the final exams of said course.

Non-continuous evaluation:

The final exams, ordinary and extraordinary, will consist of a single test that will cover the entire subject. They will be evaluated from 0 to 10 points, being necessary to reach a grade equal to or greater than 5 points to pass the subject.

In the final exams of the same academic year, students can choose to take only those recoverable parts in which they have not passed the minimum mark. They can also take them to raise their grade. The final grade will be the most favorable between (1) the final grade as a single exam; and (2) the continuous assessment grade considering the best grade obtained in each part at the final or throughout the course.

Specifications for the resit/retake exam:

Same as specified above.

Specifications for the second resit / retake exam:

The evaluation of this special call will consist of a single exam that will cover all the subject. It will be evaluated from 0 to 10 points, being necessary to reach a mark equal to or greater than 5 points to pass the subject.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

Unit 1 (de 9): Systems of sliding vectors.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2.5
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	4
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.36

Unit 2 (de 9): Particle kinematics.

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	3
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 3 (de 9): Particle dynamics.

Activities	**Hours**

Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	3
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	2.68
Practicum and practical activities report writing or preparation [AUTÓNOMA][Practical or hands-on activities]	2.5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 4 (de 9): First integrals and conservation theorems.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	2
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 5 (de 9): Relative motion. Inertia forces.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	1
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	1.5
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5.5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 6 (de 9): Geometry of masses.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2.5
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	3
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	6
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	2.66
Practicum and practical activities report writing or preparation [AUTÓNOMA][Practical or hands-on activities]	2.5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 7 (de 9): Rigid body kinematics.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	1
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	2
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	8
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 8 (de 9): Rigid body dynamics (plane motion).

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	6
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	10
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	2.66
Practicum and practical activities report writing or preparation [AUTÓNOMA][Practical or hands-on activities]	2.5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Unit 9 (de 9): Rigid body statics.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	2
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	3.5
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	.33

Global activity

Activities	hours
Mid-term test [PRESENCIAL][Project/Problem Based Learning (PBL)]	3
Study and Exam Preparation [AUTÓNOMA][Other Methodologies]	28
Study and Exam Preparation [AUTÓNOMA][Project/Problem Based Learning (PBL)]	54.5
Practicum and practical activities report writing or preparation [AUTÓNOMA][Practical or hands-on activities]	7.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	8
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	19
Class Attendance (theory) [PRESENCIAL][Lectures]	30
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Beer, Ferdinand P.	Mecánica vectorial para ingenieros : Dinámica	McGraw-Hill Interamericana		978-607-15-0261-2	2010	
Beer, Ferdinand P.	Mecánica vectorial para ingenieros : Estática	McGraw-Hill Interamericana		978-607-15-0277-3	2010	

Marsden, Jerrold E.	Cálculo vectorial	Pearson Educación	84-7829-069-9	2004
Shames, Irving H.	Mecánica para ingenieros : estática	Prentice Hall	84-8322-044-X	2001
Shames, Irving H.	Mecánica para ingenieros : dinámica	Prentice Hall	84-8322-045-8	1999
Valiente Cancho, Andrés	Física para ingeniería civil : 101 problemas útiles	García Maroto editores	978-84-936712-0-4	2008
F.P. Beer, E.R. Johnston, D. Mazurek	Vector Mechanics for Engineers: Statics (11th Edition)	McGraw-Hill Education	978-0077687304	2015
F.P. Beer, E.R. Johnston, P.J. Cornwell, B. Self	Vector Mechanics for Engineers: Dynamics (11th Edition)	McGraw-Hill Education	978-0077687342	2015
Beer, Ferdinand P.	Instructor's and solutions manual to accompany Vector mechan	McGraw-Hill	0-07-296264-X (v.2)	2004