



## Teaching Guide

| Teaching Guide           |                                                            |        |                      |           |
|--------------------------|------------------------------------------------------------|--------|----------------------|-----------|
| Identifying Data         |                                                            |        |                      | 2019/20   |
| Subject (*)              | Biomechanics                                               |        | Code                 | 730497227 |
| Study programme          | Mestrado Universitario en Enxeñaría Industrial (plan 2018) |        |                      |           |
| Descriptors              |                                                            |        |                      |           |
| Cycle                    | Period                                                     | Year   | Type                 | Credits   |
| Official Master's Degree | 1st four-month period                                      | Second | Optional             | 3         |
| Language                 | Spanish                                                    |        |                      |           |
| Teaching method          | Face-to-face                                               |        |                      |           |
| Prerequisites            |                                                            |        |                      |           |
| Department               | Enxeñaría Naval e Industrial                               |        |                      |           |
| Coordinador              | Lugris Armesto, Urbano                                     | E-mail | urbano.lugris@udc.es |           |
| Lecturers                | Lugris Armesto, Urbano                                     | E-mail | urbano.lugris@udc.es |           |
| Web                      | moodle.udc.es                                              |        |                      |           |
| General description      |                                                            |        |                      |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                               |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A3   | ETI3 - Ability to design and test machines.                                                                                                                                                                                               |
| B1   | CB6 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.                                                                 |
| B2   | CB7 - That students know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.                         |
| B5   | CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.                                                                                             |
| B6   | G1 - Have adequate knowledge of the scientific and technological aspects in Industrial Engineering.                                                                                                                                       |
| B13  | G8 - Apply the knowledge acquired and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts.                                                                                                     |
| B16  | G11 - Possess the learning skills that allow to continue studying in a self-directed or autonomous way.                                                                                                                                   |
| C1   | ABET (a) - An ability to apply knowledge of mathematics, science, and engineering.                                                                                                                                                        |
| C2   | ABET (b) - An ability to design and conduct experiments, as well as to analyze and interpret data.                                                                                                                                        |
| C3   | ABET (c) - An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. |
| C8   | ABET (h) - The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.                                                                                    |
| C9   | ABET (i) - A recognition of the need for, and an ability to engage in life-long learning.                                                                                                                                                 |
| C11  | ABET (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.                                                                                                                     |

## Learning outcomes

| Learning outcomes                                         | Study programme competences |                                         |
|-----------------------------------------------------------|-----------------------------|-----------------------------------------|
| Estudo das características da marcha humana               | BJ1<br>BJ6<br>BJ13<br>BJ16  | CJ1<br>CJ8<br>CJ9<br>CJ11               |
| Cofecemento e manexo dun laboratorio de análise de marcha | BJ1<br>BJ6<br>BJ13<br>BJ16  | CJ1<br>CJ2<br>CJ3<br>CJ8<br>CJ9<br>CJ11 |



|                                                                                 |     |                                          |                                         |
|---------------------------------------------------------------------------------|-----|------------------------------------------|-----------------------------------------|
| Modelización e análise dinámica do corpo humano como sistema de sólidos ríxidos | AJ3 | BJ1<br>BJ2<br>BJ5<br>BJ6<br>BJ13<br>BJ16 | CJ1<br>CJ2<br>CJ3<br>CJ8<br>CJ9<br>CJ11 |
|---------------------------------------------------------------------------------|-----|------------------------------------------|-----------------------------------------|

| Contents                         |                                                                                             |
|----------------------------------|---------------------------------------------------------------------------------------------|
| Topic                            | Sub-topic                                                                                   |
| Introdución á Biomecánica        | Características e fases da marcha humana<br>Modelos cinemáticos e dinámicos do corpo humano |
| Análise cinemática da marcha     | Pares cinemáticos<br>Cálculo de velocidades e aceleracións angulares                        |
| Sistemas de captura de movemento | Sistemas de captura óptica<br>Placas de forza<br>Outros sensores                            |
| Análise dinámica da marcha       | Ecuacións da dinámica<br>Parámetros dinámicos do sistema<br>Dinámica inversa e directa      |
| Análise de esforzos musculares   | Problema da repartición muscular: optimización<br>Modelo muscular de Hill                   |

| Planning                       |                                                 |                      |                               |             |
|--------------------------------|-------------------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests          | Competencies                                    | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | A3 B1 B2 B5 B6 C1<br>C3 C8 C9 C11               | 6                    | 0                             | 6           |
| Laboratory practice            | A3 B1 B2 B13 B16 C2<br>C3 C8 C9 C11             | 6                    | 0                             | 6           |
| ICT practicals                 | A3 B1 B2 B5 B13 B16<br>B6 C1 C2 C3 C8 C9<br>C11 | 6                    | 9                             | 15          |
| Supervised projects            | A3 B1 B2 B5 B13 B16<br>B6 C1 C2 C3 C8 C9<br>C11 | 10                   | 36                            | 46          |
| Personalized attention         |                                                 | 2                    | 0                             | 2           |

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

| Methodologies                  |                                                                                       |
|--------------------------------|---------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                           |
| Guest lecture / keynote speech | Explicación dos conceptos teóricos en clases interactivas                             |
| Laboratory practice            | Realización de capturas de movemento na sala experimental                             |
| ICT practicals                 | Análise dos datos de captura                                                          |
| Supervised projects            | Realización dunha análise de marcha completa, desde a captura aos esforzos musculares |

| Personalized attention |             |
|------------------------|-------------|
| Methodologies          | Description |



|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supervised projects | <p>Todas as prácticas serán realizadas baixo a tutela do profesor. Tamén se poderán resolver dúbidas durante o horario de tutorías.</p> <p>No caso de estudantes con dispensa académica, proporcionarase ao estudante material para que poida realizar a maioría das prácticas de forma non presencial, e o profesor atenderao durante as tutorías sempre que este soliciteo, ou noutro horario se non puidese acudir no horario de tutorías.</p> |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Assessment          |                                           |                                                                                                                                                 |               |
|---------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies       | Competencies                              | Description                                                                                                                                     | Qualification |
| Laboratory practice | A3 B1 B2 B13 B16 C2 C3 C8 C9 C11          | Valorarase a comprensión dos procesos implicados na captura de movemento                                                                        | 15            |
| ICT practicals      | A3 B1 B2 B5 B13 B16 B6 C1 C2 C3 C8 C9 C11 | Os alumnos deberán comprender ben o procesamento dos datos de captura para obter esforzos articulares e musculares                              | 25            |
| Supervised projects | A3 B1 B2 B5 B13 B16 B6 C1 C2 C3 C8 C9 C11 | Comprobarase que os alumnos sexan capaces de realizar unha análise de marcha completa, resolvendo os problemas técnicos que se poidan presentar | 60            |

| Assessment comments                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>No caso de estudantes con dispensa académica, a avaliación basearase nun seguimento do traballo realizado durante o curso, e no proxecto final que devanditos alumnos tamén terán que realizar.</p> |

| Sources of information |                                                                                                                                                                                                                                                                                                                           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic                  | <ul style="list-style-type: none"> <li>- Winter, D.A. (2009). Biomechanics and Motor Control of Human Movement. John Wiley &amp; Sons</li> <li>- Levine, D., Richards, J., Whittle, M.W. (2012). Whittle's Gait Analysis. Churchill Livingstone</li> </ul>                                                                |
| Complementary          | <ul style="list-style-type: none"> <li>- Beer, F.P. and Johnston, E.R. (2013). Mecánica vectorial para ingenieros: Estática. McGraw-Hill</li> <li>- Beer, F.P. and Johnston, E.R. (2013). Mecánica vectorial para ingenieros: Dinámica. McGraw-Hill</li> <li>- Goldstein, H. (2009). Mecánica clásica. Reverté</li> </ul> |

| Recommendations                                          |
|----------------------------------------------------------|
| Subjects that it is recommended to have taken before     |
| Subjects that are recommended to be taken simultaneously |
| Subjects that continue the syllabus                      |
| Other comments                                           |



Para axudar a conseguir unha contorna inmediata sostida e cumprir co obxectivo da acción número 5: "Docencia e investigación saudable e sustentable ambiental e social" do "Plan de Acción Green Campus Ferrol":

A entrega de traballos que se realicen nesta materia:- Solicitarase en formato virtual e/ou soporte informático.- Realizarase a través da web da materia, en formato dixital, sen necesidade de imprimilos.-

En caso de ser necesario realízalos en papel: non se empregarán plásticos; realizaranse impresións a dobre cara; empregarase papel

reciclado; evítase a impresión de borradores. Débese facer un uso sustentable dos recursos e a prevención de impactos negativos sobre o medio natural.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.