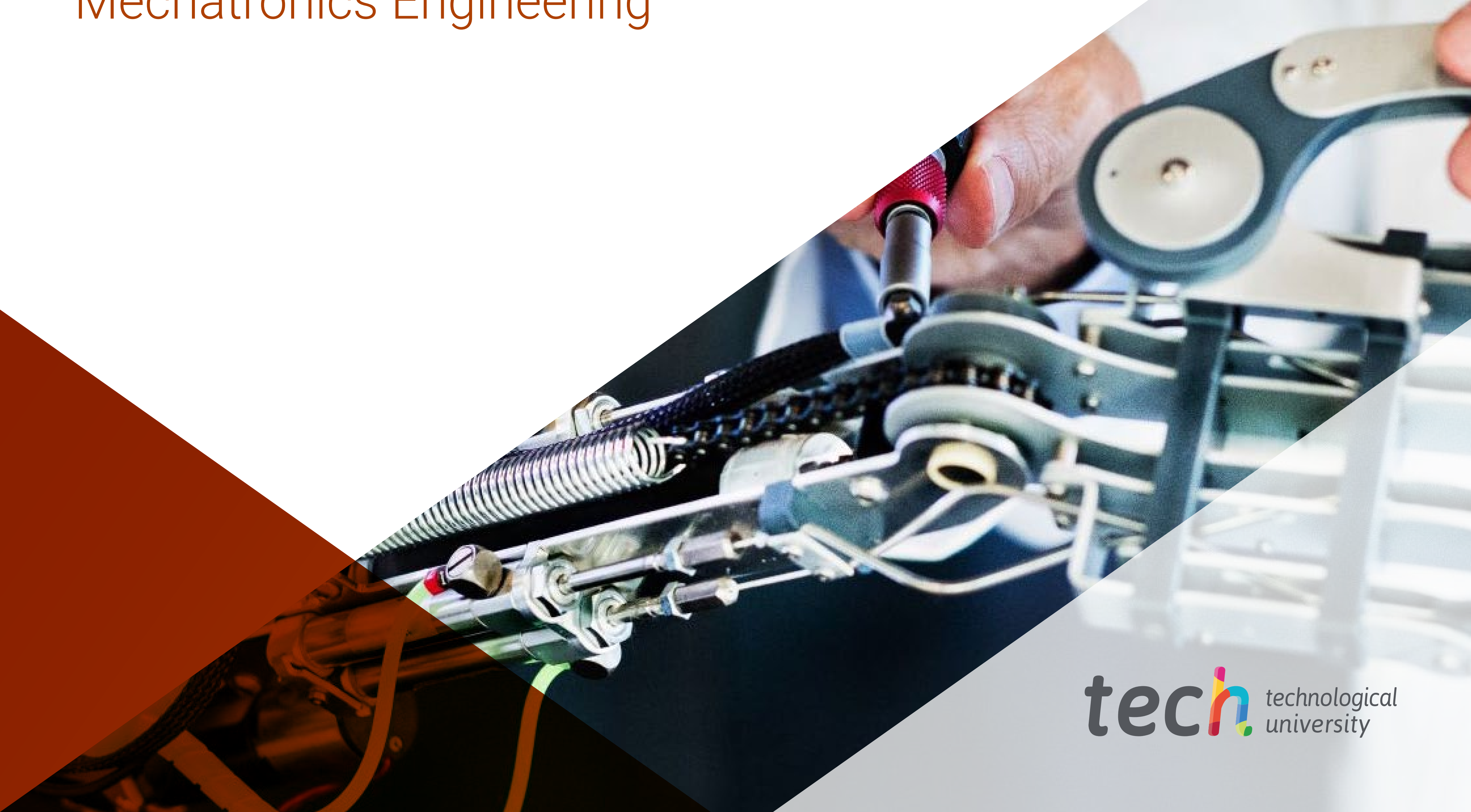
Professional Master's Degree
Mechatronics Engineering



Professional Master's Degree
Mechatronics Engineering

» Modality: **online**
» Duration: **12 months**
» Certificate: **TECH Technological University**
» Dedication: **16h/week**
» Schedule: **at your own pace**
» Exams: **online**

Website: **www.techtitute.com/in/engineering/professional-master-degree/master-mechatronics-engineering**

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01
Introduction

The development of Artificial Intelligence and its daily life, which is becoming more and more rooted in today's society and its processes, has boosted Mechatronics Engineering, turning it into an area with infinite possibilities in terms of the design of agile systems and products. Advances in robotics, process automation and technological integration have marked a before and after in the industrial sector. In view of this situation, TECH has decided to launch a program focused on this sector, on its novelties and on the necessary guidelines to master it. In this way, through a 100% online program designed by the best experts in Mechatronics, the graduates will implement the most exhaustive knowledge into their practice in less than 12 months.

Access a Professional Master's Degree of the highest level and master Mechatronics Engineering from the best experts with TECH"

The technology industry is advancing by leaps and bounds. Every year millions of dollars are invested in this sector, a small figure compared to the benefits it brings. One of the emerging focuses that has generated the greatest impact has been Mechatronics Engineering, especially for the versatility it encompasses, as well as for the wide range of applications and challenges it proposes. In short: it has become an endless opportunity for innovation. However, it is also a challenge for all professionals, especially because of the dizzying pace at which mechanics, electronics and computer science are advancing in the design of intelligent systems and products.

In view of this, TECH has developed this Professional Master's Degree in Mechatronics Engineering, a complete and comprehensive program that brings together the advances in this field in 1,500 hours of the best theoretical, practical and additional content. This is an unparalleled academic experience with which the professionals will be able to delve into the interdisciplinary nature of this area, learning the most effective techniques and methods for system design, axis control, automation or numerical simulation. In addition, students will be able to delve into the assisted manufacturing of components, being updated on the latest developments of the most effective materials in the current engineering market.

All this over 12 months, during which you will have unlimited access to a state-of-the-art virtual platform, without schedules or on-site classes, offering you an academic experience that adapts to your total and absolute availability. In addition, it is supported by a convenient 100% online format, as well as the Relearningmethodology, aspects that have allowed TECH to position itself as the best digital university in the world. It is, therefore, a unique opportunity to begin a program that will raise the knowledge and talent of the engineer to the highest level in an area in expansion and with great expectations for the future, such as Mechatronics Engineering.

This **Professional Master's Degree in Mechatronics Engineering** contains the most complete and up-to-date program on the market. The most important features include:

- The development of case studies presented by experts in computer engineering and technology
- The graphic, schematic and practical contents of the book provide technical and practical information on those disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

After the course of this Professional Master's Degree you will stand out for your exhaustive handling of electronics and mechanics in less than 12 months"

Master the best instrumentation strategies by delving into the development of controlled variables in today's computer environment"

Implement to your skills the exhaustive management of the most advanced techniques in product design and prototyping with TECH.

More than 1,500 hours of the best theoretical, practical and additional content compacted in a convenient 100% online format.

The program's teaching staff includes professionals from the field who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise during the academic year For this purpose, the students will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

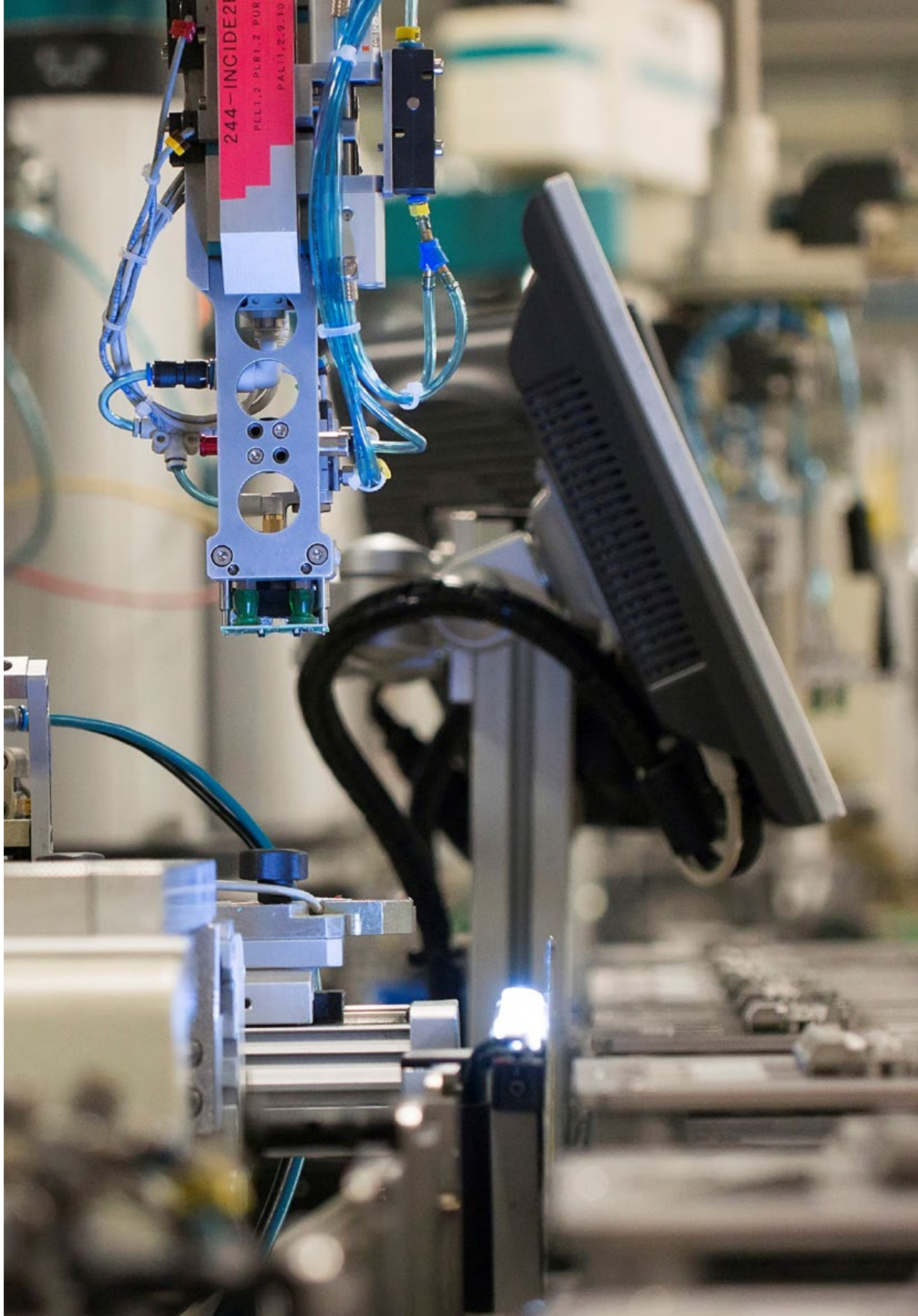
TECH and its team of experts have developed this program in Mechatronics Engineering with the objective of providing graduates with all the material they need to reach the highest professional level in this field in just 12 months. In this way, through 1,500 hours of theoretical, practical and additional material formed by the latest computer trends, you will achieve your most demanding work goals in a guaranteed way.

If your objectives include mastering the numerical simulation of mechanical systems, this Professional Master's Degree is what you were looking for"

General Objectives

- Develop the necessary basis to enable and facilitate versatile learning of new methodologies
- Identify and analyze the main types of industrial mechanisms
- Identify the sensors and actuators of a process according to their functionality
- Delve into CAD design methodology and apply it to mechatronic projects
- Identify the different equipment involved in the control of industrial processes
- Establish the analysis typology and FEM calculation model to reproduce the real test of a mechatronic component
- Present the elements that make up a robotic system
- Examine the mathematical models governing multibody mechanics
- Define the fundamentals of embedded systems, including their architecture, components and applications in modern engineering
- Determine the different models of embedded manufacturing present in the industrial world

Implement into your practice the latest strategies in embedded systems development through a Professional Master's Degree of the highest professional level"



Specific Objectives

Module 1. Mechatronics Machines and Systems

- Module 1. Mechatronics Machines and Systems
- Recognize the different methods of motion transmission and transformation
- Identify the main types of machines and mechanisms that allow the transmission and transformation of motion
- Define the bases for the study of static and dynamic stresses of mechanical systems
- Establish the basis for the study, design and evaluation of the following mechanical elements and systems: gears, shafts and shafts, bearings, springs, mechanical joints, flexible mechanical elements, brakes and clutches

Module 2. Assisted manufacturing of mechanical components in mechatronic systems

- Present the main fundamentals of mechatronic systems, as well as their context within today's technological development
- Establish a habit of integrating assisted manufacturing techniques in the day-to-day design of mechanical components
- Analyze the existing techniques, as well as the norms, regulations and standards in the assisted development of mechanical components
- Establish the quality and quality control criteria necessary for the correct development of the manufacturing process

Module 3. Sensors and Actuators

- Recognize and select the sensors and actuators involved in an industrial process according to their practical application
- Configure a sensor or an actuator according to the proposed technical requirements
- Design an industrial production process according to the proposed technical requirements

Module 4. Design of mechatronic systems

- Define relationships and equations to create parametric models that adapt to design changes in an agile way
- Finding and utilizing available resources from mechatronic element manufacturers or repositories and including them in the design to increase productivity
- Develop bent sheet metal parts efficiently
- Generate technical drawings and detailed plans from 3D models of parts and assemblies

Module 5. Axis control, mechatronic systems and automation

- Identify the elements that make up the controllers of industrial systems, relating their function with the elements that make up the automation processes
- Be able to configure and program a controller according to the technical requirements proposed in the process
- Work with the special characteristics of machine automation
- Be able to design an industrial production process according to the proposed technical requirements

Module 6. Structural calculation of mechanical systems and components

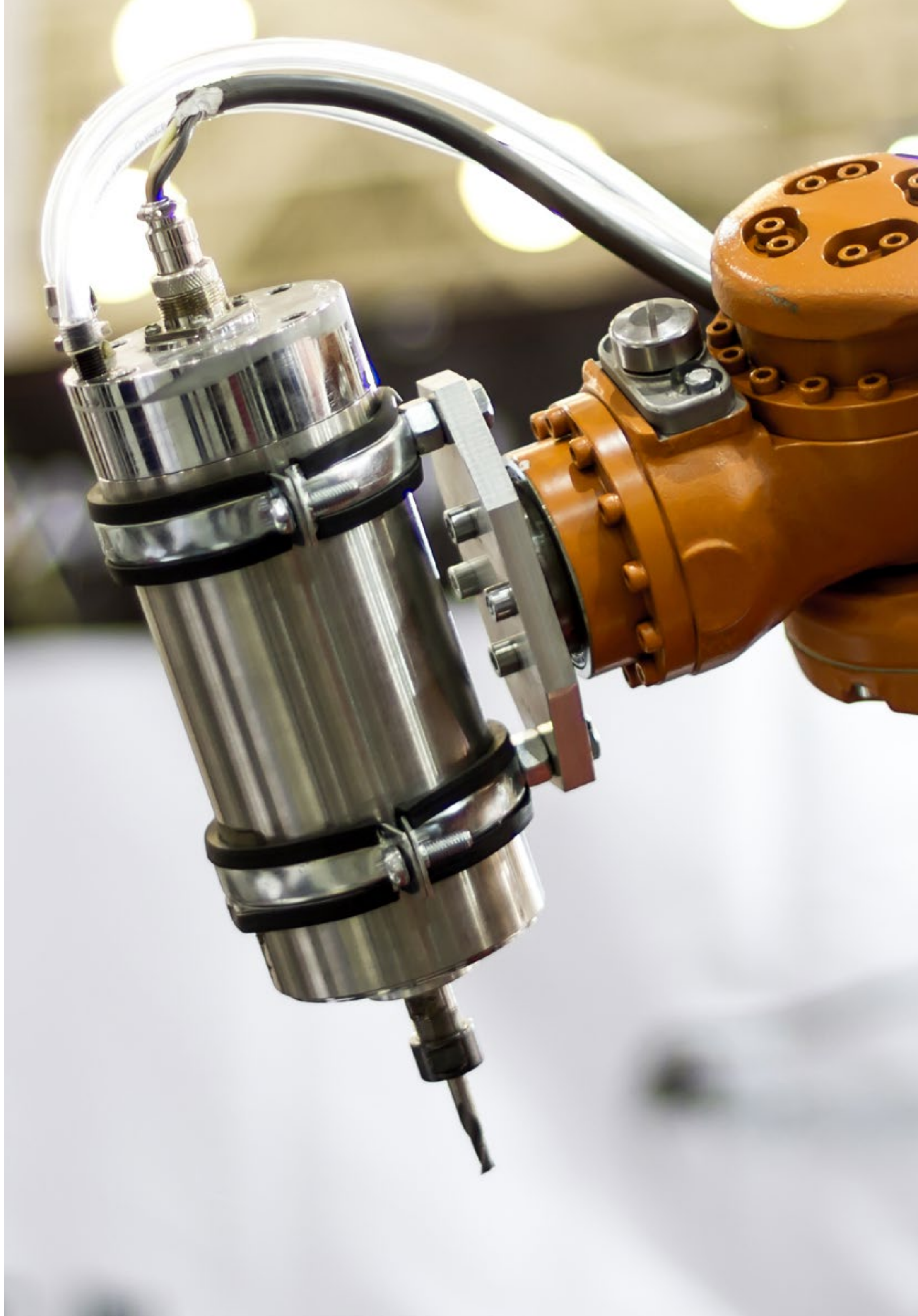
- Establish the most suitable material model to represent the behavior of a material under its test conditions
- Define the boundary conditions representing a real test
- Determine the results required in a finite element calculation to evaluate the feasibility of a design

Module 7. Robotics applied to Mechatronic Engineering

- Identify the components that are part of a robot
- Fundamentals of the mathematical principles used in the study of the kinematics and dynamics of a robot
- Specify the mechanical formulation used in the analysis and design of a robot
- Develop the trajectory planning techniques used in kinematic control
- Analyze the linear dynamic control of a DC motor

Module 8. Numerical simulation of mechanical systems

- Develop the kinematic equations of multibody systems and the dynamic equations of multibody systems
- Be able to select a suitable contact or collision model
- Simulate motion transmissions using commercial software
- Be able to simulate robotic systems using commercial software



Module 9. Embedded Systems

- Delve into the study and analysis of microprocessors, including architectures, instruction sets and programming strategies specific to embedded microprocessors
- Develop skills in the design and implementation of real-time embedded systems, addressing applications such as industrial process control, signal filtering, pattern detection, and real-time data acquisition
- Develop competencies in the design and programming of programmable hardware, such as FPGAs, and in the use of single board computers (SBCs) for the creation of embedded systems
- Develop skills to design, develop, and deploy IoT solutions, including connecting embedded devices to the cloud, managing data, and creating IoT applications

Module 10. Mechatronic Systems Integration

- Evaluate the possibilities of integrated manufacturing that exist today
- Analyze the different types of communication networks available and assess which type of communication network is the most suitable in given scenarios
- Examine human-machine interface systems that allow centralized control and monitoring of processes, verifying their operation
- Fundamentals of new manufacturing technologies based on Industry 4.0
- Integrate the different control equipment involved in mechatronic systems

03

Skills

One of the key elements of each and every one of the programs TECH offers is the implementation of skills that allow its graduates to stand out as highly specialized professionals in their area of study. Therefore, overcoming this program will help the engineers to master to perfection the skills of the best experts in mechatronics. All this through the best theoretical and practical content, the most advanced and updated of the moment, developed by experts in this sector.

An academic experience that will give you the keys to handle mechatronic systems with the most advanced techniques of the moment"

General Skills

- Generate the ability to write and interpret technical documentation
- Evaluate and analyze the stresses to which the main types of mechanical systems and elements are subjected
- Select and configure the required type of sensor and actuator involved in a process depending on the parameter to be measured or controlled
- Generate well-defined sketches as a basis for design operations
- Select and program the mechatronic equipment involved in a process according to the machine or process to be automated
- Solve a representative analysis of a real test using engineering tools based on the finite element method
- Analyze the mathematical models used in the analysis and design of a robot
- Compile the numerical integration techniques used to solve dynamic problems
- Analyze the main architectures and programming languages used in the design of embedded systems
- Fundamentals of the possibilities of system integration through industrial communications

Specific Skills

- Design an industrial process and to establish its operating requirements
- Use solid and surface design techniques effectively
- Create complex assemblies using mating relationships
- Understand machine automation
- Design an industrial process and to establish its operating requirements
- Critically analyze the results obtained from a finite element calculation
- Develop control methods used in a robot
- Model mechanical systems using multibody simulation software
- Explore the specific applications of embedded systems in various engineering fields, such as process control, industrial automation, communications, and signal processing
- Examine the different possibilities of supervision in processes

Through real case studies you will work on strengthening conflict resolution, an essential skill in today's workplace"

04

Course Management

TECH does its utmost to create the best faculty. This is an asset that guarantees an academic experience of the highest level, since having the support of renowned professionals allows us to offer unparalleled content. For this Professional Master's Degree, a team of multidisciplinary engineers has been selected, all of them versed in the management of mechanical, electronic, computer and industrial automation technologies.

The teaching team of this Professional Master's Degree will bring to your career a multidisciplinary vision encompassing mechanics, electronics and industrial computing in a single program"

Management

Dr. López Campos, José Ángel

- Specialist in design and numerical simulation of mechanical systems
- Calculation engineer at ITERA TÉCNICA S.L
- PhD in Industrial Engineering from the University of Vigo
- Professional Master's Degree in Automotive Engineering from the University of Vigo
- Professional Master's Degree in Competition Vehicle Engineering, Antonio de Nebrija University
- University Specialist FEM by the Polytechnic University of Madrid
- Degree in Mechanical Engineering from the University of Vigo

Professors

Mr. Bretón Rodríguez, Javier

- Industrial Engineering Specialist
- Industrial Technical Engineer at FLUNCK S.A
- Industrial Technical Engineer at the Ministry of Education and Science of the Government of Spain
- University teacher in the area of Systems and Automatic Engineering at the University of La Rioja
- Industrial Technical Engineer at the University of Zaragoza
- Industrial Engineer, University of La Rioja

Ms. Suárez García, Sofía

- Researcher and specialist in Industrial Engineering
- Mechanical engineer in preparation and calculation of models by the Finite Element Method at the University of Vigo
- University teaching assistant in several undergraduate courses
- Professional Master’s Degree in in Industrial Engineering at the University of Vigo
- Degree in Mechanical Engineering from the University of Vigo

Mr. Peláez Rodríguez, César

- Specialist in Information and Communications Technologies
- Visiting Assistant in Research at Yale University
- R&D Engineer at SEADAM - Valladolid
- Researcher in several projects at the University of Alcalá de Henares
- Degree in Industrial Technologies Engineering from the University of Valladolid
- Professional Master's Degree in Industrial Engineering from the University of Valladolid
- Collaborator in several scientific publications

Mr. Agudo del Río, David

- Specialist in Mechanics, Energy and Sustainability
- Simulation Engineer in CTAG-IDIADASAFETY Technology
- Simulation engineer at MAKROSS Simulation and Testing
- Industrial Technical Engineer at the Granite Technological Center
- Researcher at the University of Vigo
- Degree in Mechanical Engineering at the Catholic University of Ávila
- Specialization in Technical Industrial and Mechanical Engineering at the University of Vigo
- Professional Master's Degree in Energy and Sustainability from the University of Vigo

Dr. González Baldonado, Jacobo

- Specialist in Industrial Technologies and Mathematical Engineering
- Professor of several undergraduate courses in Mechanical Engineering
- Assistant Professor and predoctoral university researcher
- PhD in Engineering from the University of Vigo
- Graduate in Industrial Technologies Engineering, University of Vigo
- Professional Master's Degree in Mathematical Engineering, University of Vigo

Dr. Segade Robleda, Abraham

- Specialist in Mechanics and Intensification in Machinery
- Professor of Industrial Engineering
- PhD in Industrial Engineering
- Degree in Industrial Engineering
- University Specialist in Theory and Practical Application of Finite Elements
- Advanced Studies in Mechanical, Energy and Fluid Systems Analysis

Mr. Elvira Izurrategui, Carlos

- Specialist in Electrical Engineering and Systems and Automation Engineering
- Deputy Director of the Industrial Engineering Section of the Center for Scientific and Technical Education of the University of La Rioja
- Director of the Center for Scientific and Technical Education of the University of La Rioja
- University Professor in various master's and undergraduate programs
- Industrial Engineer from the University of Cantabria
- Industrial Technical Engineer (specializing in Electricity) from the University of Zaragoza
- Director of several teaching research projects

Mr. Madalin Marina, Cosmin

- Researcher and specialist in Computer Engineering
- Graduate in Computer Engineering from the University of Alcalá, Spain
- Mention in Computer Science by the University of Alcalá
- Professional Master's Degree in Artificial Intelligence Research from the UNED (Spanish National Distance Education University)
- University Extension Course: Functional Analysis

05

Structure and Content

Both the development of the content and the structuring of this Professional Master's Degree were the responsibility of the teaching team. Thanks to this, it has been possible to create a program of the highest level consisting of more than 1,000 hours of the best theoretical, practical and additional content compacted in a convenient 100% online format. Graduates will be able to expand their knowledge in Mechatronics Engineering in an adapted way, allowing them to learn in detail the latest developments in integration, development and manufacturing from wherever they want and with a schedule fully adapted to their availability.

Connect from wherever you want and whenever you want through a program that adapts to your needs"

Module 1. Mechatronics Machines and Systems

1.1. Motion transformation systems
- 1.1.1. Complete circular transformation: reciprocating circular
- 1.1.2. Full circular transformation: continuous rectilinear
- 1.1.3. Intermittent motion
- 1.1.4. Straight line mechanisms
- 1.1.5. Stopping mechanisms

1.2. Machines and mechanisms: motion transmission
- 1.2.1. Linear motion transmission
- 1.2.2. Circular motion transmission
- 1.2.3. Transmission of flexible elements: belts and chains

1.3. Machine stresses
- 1.3.1. Static stresses
- 1.3.2. Failure criteria
- 1.3.3. Fatigue in machines

1.4. Gears
- 1.4.1. Types of gears and manufacturing methods
- 1.4.2. Geometry and kinematics
- 1.4.3. Gear trains
- 1.4.4. Force analysis
- 1.4.5. Gear strength

1.5. Shafts
- 1.5.1. Stresses in shafts
- 1.5.2. Design of shafts and axles
- 1.5.3. Rotodynamics

1.6. Bearings
- 1.6.1. Types of rolling bearings
- 1.6.2. Bearing calculation
- 1.6.3. Selection Criteria
- 1.6.4. Mounting, lubrication and maintenance techniques

1.7. Springs
- 1.7.1. Types of springs
- 1.7.2. Helical springs
- 1.7.3. Energy storage by means of springs

1.8. Mechanical connecting elements
- 1.8.1. Types of joints
- 1.8.2. Design of Non-Permanent Joints
- 1.8.3. Design of Permanent Connections

1.9. Transmissions by means of flexible elements
- 1.9.1. Straps
- 1.9.2. Roller chains
- 1.9.3. Wire ropes
- 1.9.4. Flexible shafts

1.10. Brakes and clutches
- 1.10.1. Types of brakes/clutches
- 1.10.2. Friction materials
- 1.10.3. Calculation and sizing of clutches
- 1.10.4. Brake calculation and sizing

Module 2. Assisted manufacturing of mechanical components in mechatronic systems

2.1. Mechanical manufacturing in mechatronic systems
- 2.1.1. Mechanical manufacturing technologies
- 2.1.2. Mechanical manufacturing in the mechatronics industry
- 2.1.3. Advances in mechanical manufacturing in the mechatronics industry

2.2. Material removal processes
- 2.2.1. Theory of metal cutting
- 2.2.2. Traditional machining processes
- 2.2.3. CNC and automation in manufacturing

2.3. Sheet metal forming technologies
- 2.3.1. Sheet metal cutting technologies: laser, water and plasma
- 2.3.2. Technology selection criteria
- 2.3.3. Sheet metal bending

2.4. Abrasion processes
- 2.4.1. Manufacturing techniques by abrasion
- 2.4.2. Abrasive tools
- 2.4.3. Shot blasting and sandblasting processes

2.5. Advanced technologies in mechanical manufacturing
- 2.5.1. Additive manufacturing and its applications
- 2.5.2. Micro-manufacturing and nanotechnology
- 2.5.3. Electrical discharge machining

2.6. Rapid prototyping techniques
- 2.6.1. 3D printing in rapid prototyping
- 2.6.2. Rapid prototyping applications
- 2.6.3. 3D printing solutions

2.7. Design for manufacturing in mechatronic systems
- 2.7.1. Manufacturing-oriented design principles
- 2.7.2. Topological optimization
- 2.7.3. Design innovation for manufacturing in mechatronics systems

2.8. Plastic forming technologies
- 2.8.1. Injection molding processes
- 2.8.2. Blow molding
- 2.8.3. Compression and transfer molding

2.9. Advanced technologies in plastic forming
- 2.9.1. Metrology
- 2.9.2. Units of measurement and international standards
- 2.9.3. Measuring instruments and tools
- 2.9.4. Advanced metrology techniques

2.10. Quality Control
- 2.10.1. Measuring methods and sampling techniques
- 2.10.2. Statistical Process Control (SPC)
- 2.10.3. Regulations and quality standards
- 2.10.4. Total Quality Management (TQM)

Module 3. Sensors and Actuators

3.1. Sensors
- 3.1.1. Sensor Selection
- 3.1.2. Sensors in mechatronic systems
- 3.1.3. Application Examples

3.2. Presence or proximity sensors
- 3.2.1. Limit switches: principle of operation and technical characteristics
- 3.2.2. Inductive detectors: operating principle and technical characteristics
- 3.2.3. Capacitive detectors: principle of operation and technical characteristics
- 3.2.4. Optical detectors: principle of operation and technical characteristics
- 3.2.5. Ultrasonic detectors: operating principle and technical characteristics
- 3.2.6. Selection Criteria
- 3.2.7. Application Examples

3.3. Position sensors
- 3.3.1. Incremental encoders: principle of operation and technical characteristics
- 3.3.2. Absolute encoders: principle of operation and technical characteristics
- 3.3.3. Laser sensors: principle of operation and technical characteristics
- 3.3.4. Magnetostrictive sensors and linear potentiometers
- 3.3.5. Selection Criteria
- 3.3.6. Application Examples

3.4. Temperature Sensors
- 3.4.1. Thermostats: operating principle and technical characteristics
- 3.4.2. Resistance thermometers: principle of operation and technical characteristics
- 3.4.3. Thermocouples: principle of operation and technical characteristics
- 3.4.4. Radiation pyrometers: principle of operation and technical characteristics
- 3.4.5. Selection Criteria
- 3.4.6. Application Examples

3.5. Sensors for the measurement of physical variables in processes and machines
- 3.5.1. Pressure operating principle
- 3.5.2. Flow rate: operating principle
- 3.5.3. Level: operating principle
- 3.5.4. Sensors for Other Physical Variables
- 3.5.5. Selection Criteria
- 3.5.6. Application Examples

3.6. Actuators
- 3.6.3. Actuator selection
- 3.6.4. Actuators in mechatronic systems
- 3.6.5. Application Examples

3.7. Electric actuators
- 3.7.1. Relays and contactors: principle of operation and technical characteristics
- 3.7.2. Rotary motors: principle of operation and technical characteristics
- 3.7.3. Stepper motors: operating principle and technical characteristics
- 3.7.4. Servomotors: principle of operation, technical characteristics
- 3.7.5. Selection Criteria
- 3.7.6. Application Examples

3.8. Pneumatic actuators
- 3.8.1. Valves and servovalves principle of operation and technical characteristics
- 3.8.2. Pneumatic cylinders: principle of operation and technical characteristics
- 3.8.3. Pneumatic motors: operating principle and technical characteristics
- 3.8.4. Vacuum clamping: working principle and technical characteristics
- 3.8.5. Selection Criteria
- 3.8.6. Application Examples

3.9. Hydraulic actuators
- 3.9.1. Valves and servovalves principle of operation and technical characteristics
- 3.9.2. Hydraulic cylinders: principle of operation and technical characteristics
- 3.9.3. Hydraulic motors: operating principle and technical characteristics
- 3.9.4. Selection Criteria
- 3.9.5. Application Examples

3.10. Example of application of sensor and actuator selection in machine design
- 3.10.1. Description of the machine to be designed
- 3.10.2. Sensor Selection
- 3.10.3. Actuator selection

Module 4. Design of mechatronic systems

4.1. CAD in engineering
- 4.1.1. CAD in engineering
- 4.1.2. 3D Parametric Design
- 4.1.3. Types of software on the market
- 4.1.4. SolidWorks. Inventor

4.2. Work Environment
- 4.2.1. Work Environment
- 4.2.2. Menus
- 4.2.3. Visualization
- 4.2.4. Default settings of the working environment

4.3. Layout and work structure
- 4.3.1. 3D computer-aided design
- 4.3.2. Parametric design methodology
- 4.3.3. Methodology for the design of assemblies of parts. Assemblies

4.4. Sketching
- 4.4.1. Basics of Sketch design
- 4.4.2. 2D Sketch Creation
- 4.4.3. Sketch editing tools
- 4.4.4. Sketch dimensioning and relationships
- 4.4.5. 3D Sketch Creation

4.5. Mechanical design operations
- 4.5.1. Mechanical design methodology
- 4.5.2. Mechanical design operations
- 4.5.3. Other operations

4.6. Surfaces
- 4.6.1. Creating surfaces
- 4.6.2. Tools for creating surfaces
- 4.6.3. Tools for surface editing

4.7. Assemblies
- 4.7.1. Creation of assemblies
- 4.7.2. The relationships in position
- 4.7.3. Tools for the creation of assemblies

4.8. Normalization and design tables. Variables
- 4.8.1. Component library. Toolbox
- 4.8.2. Online repositories/element manufacturers
- 4.8.3. Design tables

4.9. Folded sheet metal
- 4.9.1. Folded sheet metal module in CAD software
- 4.9.2. Sheet metal operations
- 4.9.3. Developments for sheet metal cutting

4.10. Drawing generation
- 4.10.1. Creation of drawings
- 4.10.2. Drawing Formats
- 4.10.3. Creation of views
- 4.10.4. Dimensioning
- 4.10.5. Annotations
- 4.10.6. Lists and tables

Module 5. Axis control, mechatronic systems and automation

5.1. Automation of production processes
- 5.1.1. Automation of production processes
- 5.1.2. Classification of control systems
- 5.1.3. Technologies used
- 5.1.4. Machine automation and/or process automation

5.2. Mechatronic systems: elements
- 5.2.1. Mechatronic systems
- 5.2.2. The programmable logic controller as a discrete process control element
- 5.2.3. The controller as a control element for continuous process control
- 5.2.4. Axis and robot controllers as position control elements

5.3. Discrete control with programmable logic controllers (PLC's)
- 5.3.1. Hardwired logic vs. programmed logic
- 5.3.2. Control with PLC's
- 5.3.3. Field of application of PLCs
- 5.3.4. Classification of PLCs
- 5.3.5. Selection Criteria
- 5.3.6. Application Examples

5.4. PLC programming
- 5.4.1. Representation of control systems
- 5.4.2. Cycle of operation
- 5.4.3. Configuration possibilities
- 5.4.4. Variable identification and address assignment
- 5.4.5. Programming Languages
- 5.4.6. Instruction set and programming software
- 5.4.7. Programming example

5.5. Methods of describing sequential drives
- 5.5.1. Design of sequential drives
- 5.5.2. GRAFCET as a method for describing sequential drives
- 5.5.3. Types of GRAFCET
- 5.5.4. GRAFCET elements
- 5.5.5. Standard symbology
- 5.5.6. Application Examples

5.6. Structured GRAFCET
- 5.6.1. Structured design and programming of control systems
- 5.6.2. Modes of operation
- 5.6.3. Security/Safety
- 5.6.4. Hierarchical GRAFCET diagrams
- 5.6.5. Structured design examples

5.7. Continuous control by means of controllers
- 5.7.1. Industrial controllers
- 5.7.2. Scope of application of the regulators. Classification
- 5.7.3. Selection Criteria
- 5.7.4. Application Examples

5.8. Machine Automation
- 5.8.1. Machine Automation
- 5.8.2. Speed and position control
- 5.8.3. Safety systems
- 5.8.4. Application Examples

5.9. Position control by axis control
- 5.9.1. Position control
- 5.9.2. Field of application of axis controllers. Classification
- 5.9.3. Selection Criteria
- 5.9.4. Application Examples

5.10. Example of application of equipment selection in machine design
- 5.10.1. Description of the machine to be designed
- 5.10.2. Equipment selection
- 5.10.3. Resolved application

Module 6. Structural calculation of mechanical systems and components

6.1. Finite Element Method
- 6.1.1. The Finite Element Method
- 6.1.2. Discretization and mesh convergence
- 6.1.3. Shape functions. Linear and quadratic elements
- 6.1.4. Formulation for bars. Stiffness matrix method
- 6.1.5. Nonlinear problems. Sources of nonlinearity. Iterative methods

6.2. Linear static analysis
- 6.2.1. Preprocessing: geometry, material, mesh, boundary conditions: forces, pressures, remote loads
- 6.2.2. Solution
- 6.2.3. Post-processing: stress and strain maps
- 6.2.4. Application Examples

6.3. Geometry preparation
- 6.3.1. Types of import files
- 6.3.2. Geometry preparation and cleaning
- 6.3.3. Conversion to surfaces and beams
- 6.3.4. Application Examples

6.4. Mesh
- 6.4.1. One-dimensional, two-dimensional, three-dimensional elements
- 6.4.2. Mesh control parameters: local meshing, mesh growth
- 6.4.3. Meshing methodologies: structured meshing, swept meshing
- 6.4.4. Mesh quality parameters
- 6.4.5. Application Examples

6.5. Material modeling
- 6.5.1. Elastic-linear materials
- 6.5.2. Elasto-plastic materials. Plasticity criteria
- 6.5.3. Hyperelastic materials. Models in isotropic hyperelasticity: Mooney Rivlin, Yeoh, Ogden, Arruda-Boyce
- 6.5.4. Application Examples

6.6. Contact
- 6.6.1. Linear contacts
- 6.6.2. Non-linear contacts
- 6.6.3. Formulations for contact resolution: Lagrange, Penalty
- 6.6.4. Preprocessing and postprocessing of the contact
- 6.6.5. Application Examples

6.7. Connectors
- 6.7.1. Bolted Joints
- 6.7.2. Beams
- 6.7.3. Kinematic torques: rotation and translation
- 6.7.4. Example of Application. Loads on connectors

6.8. Solver. Solving the problem
- 6.8.1. Solving parameters
- 6.8.2. Convergence and definition of residuals
- 6.8.3. Application Examples

6.9. Post-Process
- 6.9.1. Stress and deformation mappings. Isosurfaces
- 6.9.2. Forces in connectors
- 6.9.3. Safety coefficients
- 6.9.4. Application Examples

6.10. Vibration analysis
- 6.10.1. Vibrations: stiffness, damping, resonance
- 6.10.2. Free vibrations and forced vibrations
- 6.10.3. Time domain or frequency domain analysis
- 6.10.4. Application Examples

Module 7. Robotics applied to Mechatronic Engineering

7.1. The Robot
- 7.1.1. The Robot
- 7.1.2. Robot applications
- 7.1.3. Classification of Robots
- 7.1.4. Mechanical structure of a robot
- 7.1.5. Specifications of a robot

7.2. Technological Components
- 7.2.1. Electric, pneumatic and hydraulic actuators
- 7.2.2. Sensors internal and external to the robot
- 7.2.3. Vision Systems
- 7.2.4. Selection of motors and sensors
- 7.2.5. Terminal elements and grippers

7.3. Transformations
- 7.3.1. Robot architecture
- 7.3.2. Position and orientation of a solid
- 7.3.3. Euler orientation angles
- 7.3.4. Homogeneous transformation matrices

7.4. Kinematics of position and orientation
- 7.4.1. Denavit-Hartenberg formulation
- 7.4.2. Direct Kinematic Problem
- 7.4.3. Inverse Kinematic Problem

7.5. Kinematics of velocities and accelerations
- 7.5.1. Velocity and acceleration of a solid
- 7.5.2. Jacobian matrix
- 7.5.3. Singular configurations

7.6. Statics
- 7.6.1. Force and moment equilibrium equations
- 7.6.2. Calculation of statics. Recursive method
- 7.6.3. Static analysis using the Jacobian matrix

7.7. Dynamics
- 7.7.1. Dynamic properties of a solid
- 7.7.2. Newton-Euler formulation
- 7.7.3. Lagrange-Euler formulation

7.8. Kinematic control
- 7.8.1. Trajectory planning
- 7.8.2. Interpolators in joint space
- 7.8.3. Trajectory planning in Cartesian space

7.9. Monoarticular linear dynamic control
- 7.9.1. Control Techniques
- 7.9.2. Dynamic systems
- 7.9.3. Transfer function model and state space representation
- 7.9.4. Dynamic model of a DC motor
- 7.9.5. Control of a d.c. motor

7.10. Programming
- 7.10.1. Programming systems
- 7.10.2. Programming Languages
- 7.10.3. Programming techniques

Module 8. Numerical simulation of mechanical systems

8.1. Rigid Solid Mechanics
- 8.1.1. Plane mechanics of rigid solids
- 8.1.2. 3D Orientation
- 8.1.3. Three-dimensional mechanics of the rigid solid

8.2. Multibody systems
- 8.2.1. Multibody systems
- 8.2.2. Mobility and degrees of freedom
- 8.2.3. Kinematic torques, types and effects
- 8.2.4. Redundancy of constraints

8.3. Kinematics of multibody systems
- 8.3.1. Motion with constraints
- 8.3.2. Initial position problem
- 8.3.3. Newton-Raphson method
- 8.3.4. Finite displacement

8.4. Velocity and acceleration in multibody systems
- 8.4.1. Jacobian matrix
- 8.4.2. Direct kinematics
- 8.4.3. Inverse Kinematics

8.5. Advanced tools for the study of 3D system kinematics
- 8.5.1. Kinematic relations in 3D
- 8.5.2. Transformation matrices
- 8.5.3. The Denavit Hartenberg representation

8.6. General dynamics of multibody systems
- 8.6.1. Newton-Euler equations
- 8.6.2. Lagrange Equations
- 8.6.3. Constraint equations

8.7. Simulation tools for multibody systems
- 8.7.1. Simulation by means of explicit and implicit methods
- 8.7.2. Euler methods
- 8.7.3. Runge-Kutta family of methods
- 8.7.4. Stability and accuracy

8.8. Contact and collision detection
- 8.8.1. Contact models
- 8.8.2. Penalty models
- 8.8.3. Implementation of the contact problem in simulation

8.9. Simulation of flexible elements
- 8.9.1. Kinematics of deformable solids
- 8.9.2. Equilibrium equations
- 8.9.3. Principle of virtual works

8.10. Optimization tools applied to multibody systems
- 8.10.1. Optimization problem formulation
- 8.10.2. Optimization methods applied to multibody systems
- 8.10.3. Synthesis of mechanisms through optimization

Module 9. Embedded Systems

9.1. Embedded systems in engineering
- 9.1.1. Embedded systems
- 9.1.2. Embedded systems in engineering
- 9.1.3. Importance of embedded systems in modern engineering

9.2. Microcontrollers
- 9.2.1. Microcontrollers
- 9.2.2. Differences between microcontrollers and development boards
- 9.2.3. Microcontrollers and development boards
- 9.2.4. Programming languages for microcontrollers

9.3. Sensors and Actuators
- 9.3.1. Industrial sensors
- 9.3.2. Industrial actuators
- 9.3.3. Communication between sensors and the central unit
- 9.3.4. Actuator Control in Embedded Systems

9.4. Embedded Systems for Real-Time Control
- 9.4.1. Hard real time system (hard real time)
- 9.4.2. Soft real time systems (soft real time)
- 9.4.3. Programming of real time systems

9.5. Embedded digital signal processing systems
- 9.5.1. Digital Signal Processing (DSP)
- 9.5.2. Design of DSP algorithms in embedded systems
- 9.5.3. Applications of DSP in engineering by means of embedded systems

9.6. Programmable hardware in embedded systems
- 9.6.1. Programmable Logic and FPGAs
- 9.6.2. Design of logic circuits in programmable hardware
- 9.6.3. Programmable hardware technologies

9.7. Single Board Computers (SBC)
- 9.7.1. Parts of single board computers
- 9.7.2. Main architectures
- 9.7.3. Single-board computers vs. desktop computers

9.8. Embedded Systems in the Internet of Things (IoT)
 9.8.1. Internet of things (IoT)
 9.8.2. Integration of Embedded Systems in the IoT
 9.8.3. Sensors and IoT Devices
 9.8.4. Use cases and practical applications
9.9. Security and reliability in embedded systems
 9.9.1. Threats and Vulnerabilities in Embedded Systems
 9.9.2. Secure design and coding practices
 9.9.3. Maintenance and security updates
9.10. Embedded Systems Communication and Connectivity
 9.10.1. Communication Protocols for Embedded Systems
 9.10.2. Sensor networks and wireless communication
 9.10.3. Integration with the Internet and the cloud

Module 10. Mechatronic Systems Integration

10.1. Integrated manufacturing systems
 10.1.1. Integrated manufacturing systems
 10.1.2. Industrial communications in systems integration
 10.1.3. Integration of control equipment in the production processes
 10.1.4. New production paradigm: Industry 4.0
10.2. Industrial communication networks
 10.2.1. Industrial communications. Evolution
 10.2.2. Structure of industrial networks
 10.2.3. Current situation of industrial communications
10.3. Communication networks at the process interface level
 10.3.1. AS-i: elements
 10.3.2. IO-Link: elements
 10.3.3. Integration of equipment
 10.3.4. Selection Criteria
 10.3.5. Application Examples
10.4. Communication networks at the control and regulation level
 10.4.1. Communication networks at the command and control level
 10.4.2. Profibus: elements
 10.4.3. Canbus: elements
 10.4.4. Equipment integration
 10.4.5. Selection Criteria
 10.4.6. Application Examples
10.5. Communication networks at centralized supervisory and command level
 10.5.1. Centralized supervisory and command level networks
 10.5.2. Profinet: elements
 10.5.3. Ethercat: elements
 10.5.4. Equipment integration
 10.5.5. Application Examples
10.6. Process monitoring and control systems
 10.6.1. Process monitoring and control systems
 10.6.2. Human Machine Interfaces (HMIs)
 10.6.3. Examples of use
10.7. Operator panels
 10.7.1. The operator panel as a human-machine interface
 10.7.2. Membrane panels
 10.7.3. Touch panels
 10.7.4. Communication possibilities of the operator panels
 10.7.5. Selection Criteria
 10.7.6. Application Examples
10.8. SCADA Packages
 10.8.1. SCADA packages as man-machine interface
 10.8.2. Selection Criteria
 10.8.3. Application Examples
10.9. Industry 4.0. Intelligent manufacturing
 10.9.1. Industry 4.0
 10.9.2. Architecture of the new factories
 10.9.3. Industry 4.0 technologies
 10.9.4. Examples of manufacturing based on Industry 4.0
10.10. Example of application of equipment integration in an automated process
 10.10.1. Description of the process to be automated
 10.10.2. Selection of control equipment
 10.10.3. Integration of equipment

06
Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**
This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"

You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.

The student will learn to solve complex situations in real business environments through collaborative activities and real cases.

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

Our program prepares you to face new challenges in uncertain environments and achieve success in your career"

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

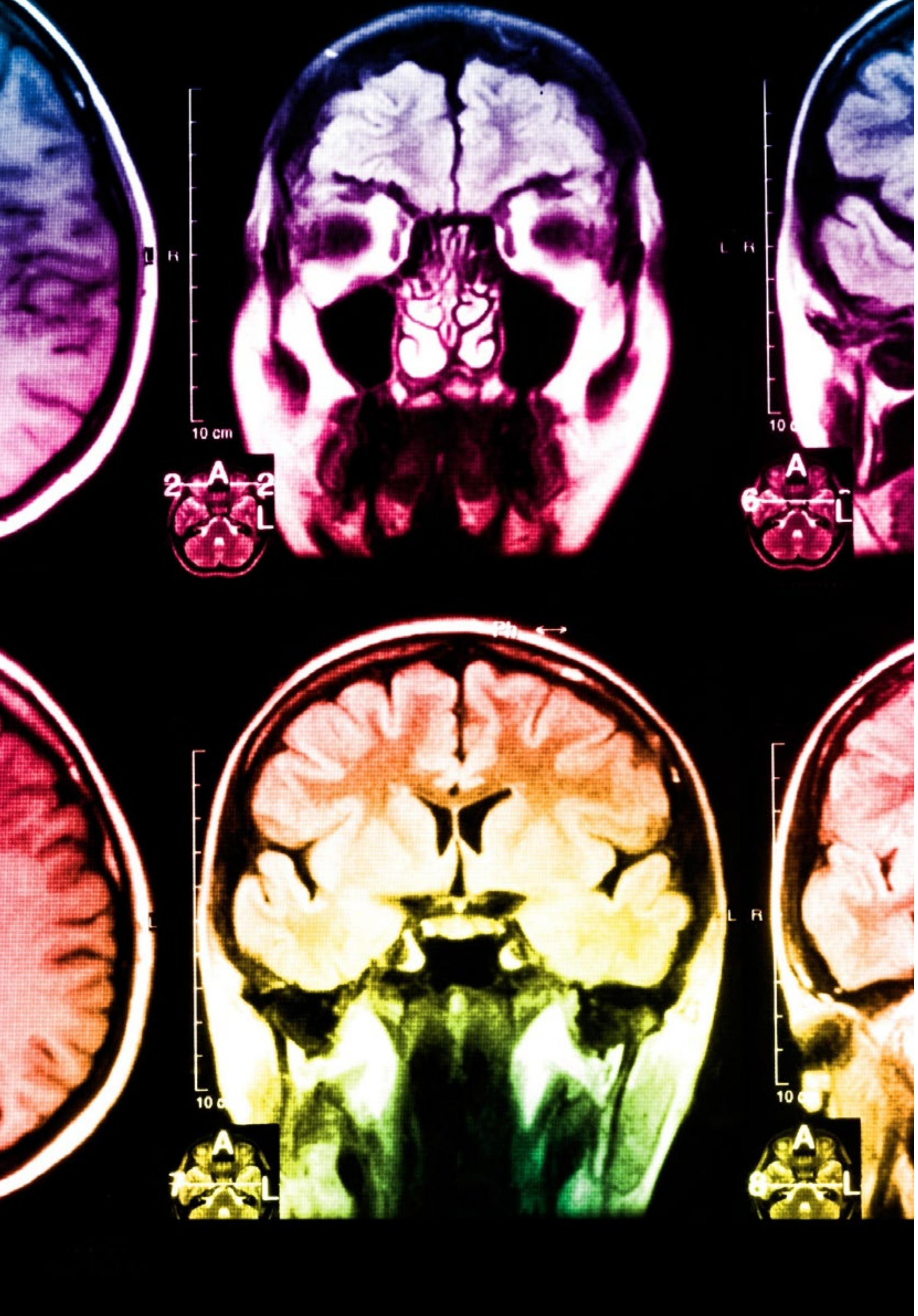
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

> *In 2019, we obtained the best learning results of all online universities in the world.*

At TECH, you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

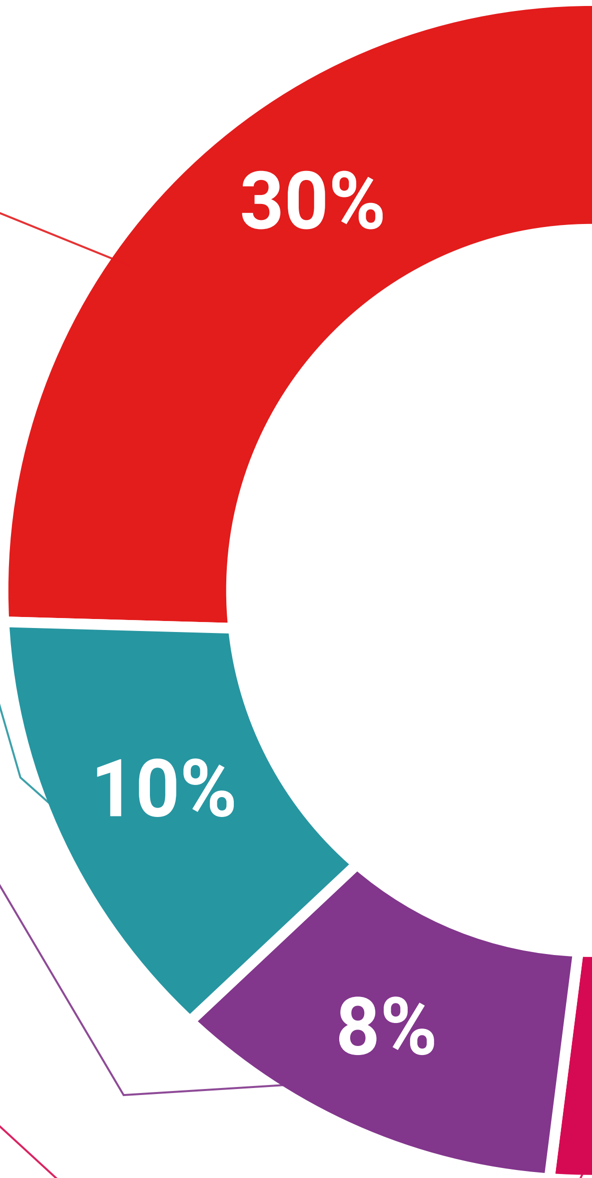
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

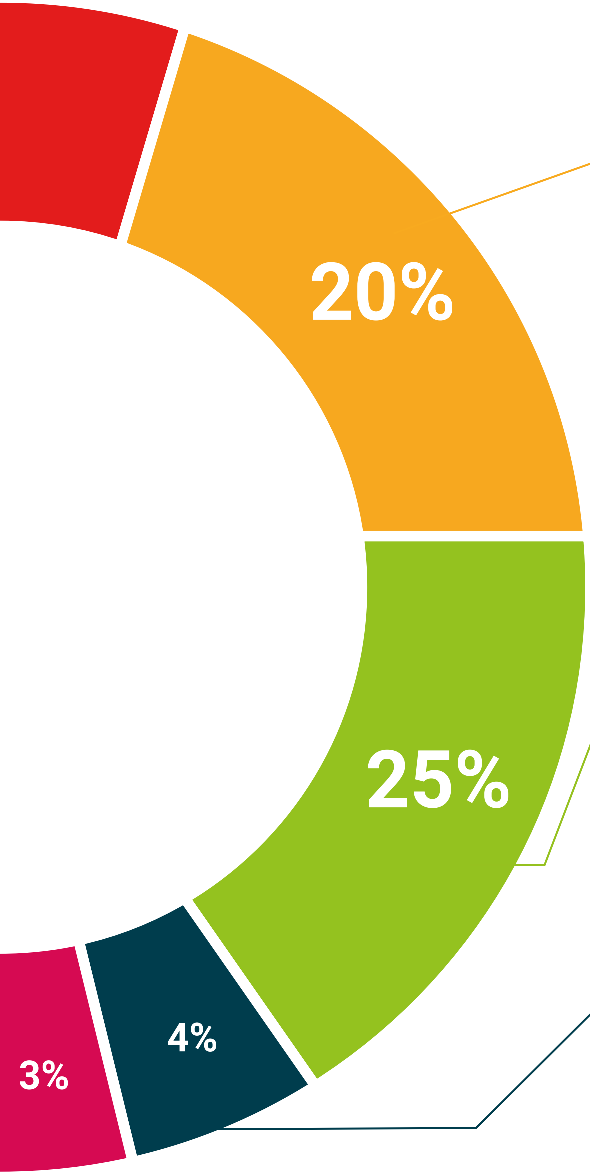
Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

07

Certificate

The Professional Master's Degree in Mechatronics Engineering guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree issued by TECH Technological University.

Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork"

This **Professional Master's Degree in Mechatronics Engineering** contains the most complete and up-to-date program on the market.

After the students have passed the assessments, they will receive their corresponding **Professional Master's Degree** issued by **TECH Technological University** via tracked delivery*.

The certificate issued by **TECH Technological University** will reflect the qualification obtained in the Professional Master's Degree, and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Title: **Professional Master's Degree in Mechatronics Engineering**

Official Nº of Hours: **1,500 h.**

tech technological university

Awards the following

CERTIFICATE

to

Mr./Ms. _______________, with identification number ____________.

For having successfully passed and accredited the following program

PROFESSIONAL MASTER'S DEGREE

in

Mechatronics Engineering

This is a qualification awarded by this University, equivalent to 1,500 hours, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

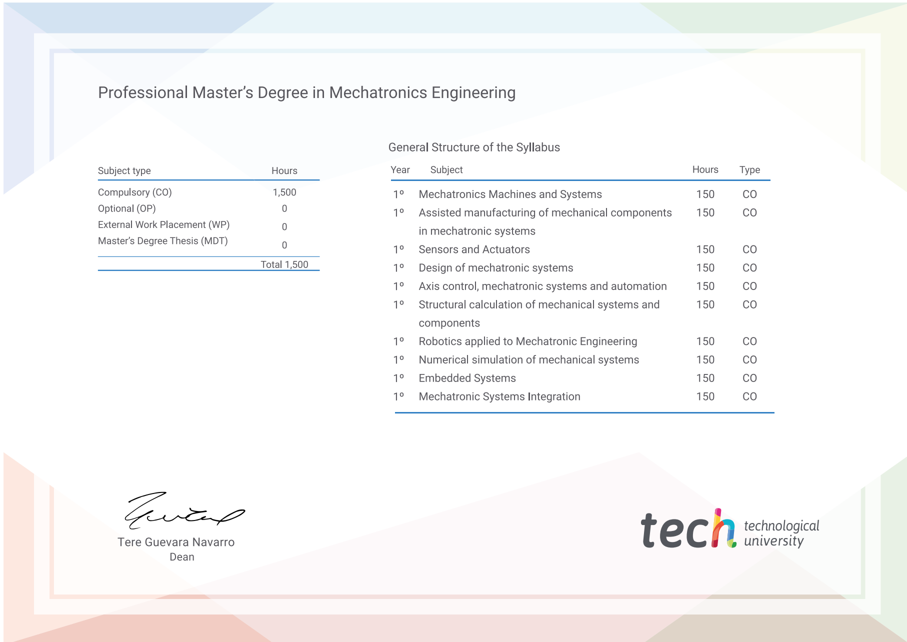
TECH is a Private Institution of Higher Education recognized by the Ministry of Public Education as of June 28, 2018.

June 17, 2020

Tere Guevara Navarro
Dean

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country.

Unique TECH Code: AFWORD23S techtitute.com/certificates



Professional Master's Degree in Mechatronics Engineering

Subject type	Hours
Compulsory (CO)	1,500
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
	Total 1,500

General Structure of the Syllabus

Year	Subject	Hours	Type
1º	Mechatronics Machines and Systems	150	CO
1º	Assisted manufacturing of mechanical components in mechatronic systems	150	CO
1º	Sensors and Actuators	150	CO
1º	Design of mechatronic systems	150	CO
1º	Axis control, mechatronic systems and automation	150	CO
1º	Structural calculation of mechanical systems and components	150	CO
1º	Robotics applied to Mechatronic Engineering	150	CO
1º	Numerical simulation of mechanical systems	150	CO
1º	Embedded Systems	150	CO
1º	Mechatronic Systems Integration	150	CO

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*Apostille Convention. In the event that the student wishes to have their paper certificate issued with an apostille, TECH EDUCATION will make the necessary arrangements to obtain it, at an additional cost.

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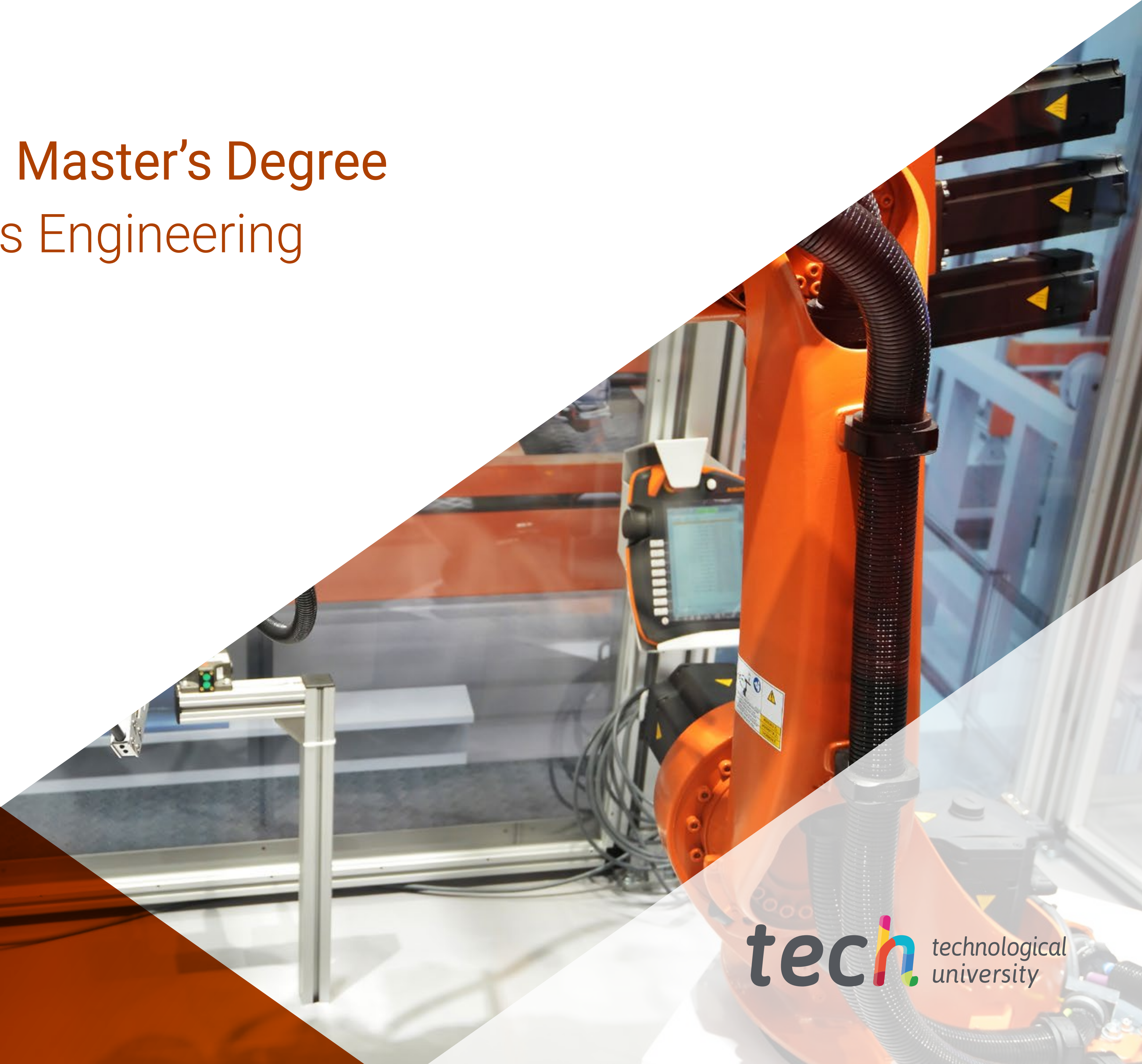
Professional Master's Degree
Mechatronics Engineering

» Modality: **online**
» Duration: **12 months**
» Certificate: **TECH Technological University**
» Dedication: **16h/week**
» Schedule: **at your own pace**
» Exams: **online**

Professional Master's Degree
Mechatronics Engineering



technological university