Postgraduate Diploma

Robotics in Industry 4.0

tech global university

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Postgraduate Diploma
Robotics in Industry 4.0

- Modality: **online**
- Duration: **6 months**
- Certificate: **TECH Global University**
- Credits: **18 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: www.techtitute.com/us/information-technology/postgraduate-diploma/postgraduate-diploma-robotics-industry-4-0

Index

01 Introduction p. 4

02 Objectives p. 8

03 Course Management p. 12

04 Structure and Content p. 18

05 Methodology p. 24

06 Certificate p. 32

01

Introduction

A few decades ago, it was almost futuristic to think that in homes, there would be machines that help people perform household chores or machines that automatically speed up work processes in any sector, which previously required many more hours or days. This scenario is brought about by Industry 4.0.

This progress has led TECH to incorporate a team of experts to make a 100% online program aimed at IT professionals whose objective is to enter the field of Robotics and its applications in the industrial context. All through a program that can be accessed at any time, without fixed schedules and only with an electronic device with internet connection.

Discover the latest advances in Robotics and start up any project you have in mind with this Postgraduate Diploma"

Automation, the search for the reduction of time when manufacturing or performing tasks, as well as the optimization of profits of companies has caused Robotics to develop extensively in recent decades. A momentum that accompanies professionals from various areas such as Information Technology, who find in this sector ample job opportunities.

In this expansion scenario, Industry 4.0 arises, which is mainly characterized by modernization and the use of the latest technology, in which manual processes hardly exist. For this reason, highly qualified personnel oriented to technological progress are in demand in the sector.

This Postgraduate Diploma in Robotics in Industry 4.0 addresses the fundamental pieces of this field, where special emphasis will be placed on the design and modeling of the robot, automatic control systems in Robotics, with great impact on industrial processes. Thus, during the 450 teaching hours of this program, students will achieve a deep knowledge guided at all times by a teaching team with extensive professional experience in this field.

An excellent opportunity that TECH offers to all IT professionals who also seek to combine their personal responsibilities with an elite education available to all. You will have at your disposal an extensive library of multimedia resources with video summaries of each topic, essential readings and videos in detail that you can access at any time of the day through an electronic device with internet connection.

This **Postgraduate Diploma in Robotics in Industry 4.0** contains the most complete and up-to-date program on the market. The most important features include:

- Development of case studies presented by experts in robotic engineering
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used 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

Enroll in a 100% online program that will allow you to program and configure equipment in industrial plants”

A highly qualified teaching team will guide you through the 6 months of this program, so that you can immerse yourself with guarantees in the Robotics sector"

Develop state-of-the-art control techniques such as predictive or based on machine learning.

Be able to create terrestrial and aerial mobile robots or simulate aquatic mobile robots with this Postgraduate Diploma.

The program's teaching staff includes professionals from the sector 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 This will be done with the help of an innovative system of interactive videos made by renowned experts.

02

Objectives

This Postgraduate Diploma has been designed so that the IT professionals will be able, upon completion of this 6-month program, to master the use of the modeling language, model and simulate manipulator robots, terrestrial, aerial or aquatic mobile robots, develop clean programming techniques and design non-linear controllers. All this thanks to the case studies presented by the teaching team and a learning system, Relearning, provided by TECH in its online programs.

Looking for Robotics training? You are just a click away from getting into Industry 4.0. Enroll and advance in your professional career"

General Objectives

- Develop the theoretical and practical foundations necessary to carry out a robot design and modeling project
- Provide the graduates with an exhaustive knowledge of the automation of industrial processes that will allow them to develop their own strategies
- Acquire the professional skills of an expert in automatic control systems in Robotics

TECH provides you with quality online education that is compatible with your personal responsibilities. Click and enroll"

Specific Objectives

Module 1. Robotics. Robot Design and Modeling

- Delve into the use of Gazebo Simulation Technology
- Master the use of the URDF Robot Modeling language
- Develop specialized knowledge in the use of Robot Operating System technology
- Model and simulate manipulator robots, land mobile robots, air mobile robots and model and simulate aquatic mobile robots

Module 2. Robotics in the Automation of Industrial Processes

- Analyze the use, applications and limitations of industrial communication networks
- Establish machine safety standards for correct design
- Develop clean and efficient programming techniques in PLCs
- Propose new ways of organizing operations using state machines
- Demonstrate the implementation of control paradigms in real PLC applications
- Fundamentalize the design of pneumatic and hydraulic installations in automation
- Identify the main sensors and actuators in robotics and automation

Module 3. Automatic Control Systems in Robotics

- Generate specialized knowledge for the design of nonlinear controllers
- Analyze and study control problems
- Master control models
- Design nonlinear controllers for robotic systems
- Implement controllers and assess them in a simulator
- Determine the different existing control architectures
- Examine the fundamentals of vision control
- Develop state-of-the-art control techniques such as predictive control or machine learning based control

03

Course Management

The Robotics field requires a mastery of the latest technologies. That is why TECH has counted for this program with a group of professionals from different fields of engineering, who have not only knowledge, but also an extensive career in the management of technological projects. It is, therefore, a faculty that will be able to provide a content that is very close to the reality of the industry, which will serve for the progress of all students.

You will have the confidence of being able to resolve any doubts you may have with the teaching team through individualized tutoring"

International Guest Director

Seshu Motamarri is an expert in automation and robotics with more than 20 years of experience in various industries such as e-commerce, automotive, oil and gas, food and pharmaceutical. Throughout his career, he has specialized in engineering management and innovation and in the implementation of new technologies, always looking for scalable and efficient solutions. He has also made important contributions in the introduction of products and solutions that optimize both safety and productivity in complex industrial environments.

He has also held key positions, including Senior Director of Automation and Robotics at 3M, where he leads cross-functional teams to develop and implement advanced automation solutions. At Amazon, his role as Technical Lead led him to manage projects that significantly improved the global supply chain, such as the "SmartPac" semi-automated bagging system and the robotic smart picking and stowage solution. His skills in project management, operational planning and product development have enabled him to generate great results in large-scale projects.

Internationally, he is recognized for his achievements in IT. He has been awarded the prestigious Amazon Door Desk Award by Jeff Bezos, and has received the Excellence in Manufacturing Safety Award, reflecting his hands-on engineering approach. In addition, he has been a "Bar Raiser" at Amazon, participating in over 100 interviews as an objective evaluator in the hiring process.

In addition, he has several patents and publications in electrical engineering and functional safety, reinforcing his impact on the development of advanced technologies. His projects have been implemented globally, with highlights in regions such as North America, Europe, Japan and India, where he has driven the adoption of sustainable solutions in the industrial and e-commerce sectors.

Mr. Motamarri, Seshu

- Senior Director of Global Manufacturing Technology at 3M, Arkansas, United States
- Director of Automation and Robotics at Tyson Foods
- Hardware Development Manager III at Amazon
- Automation Leader at Corning Incorporated
- Founder and member of Quest Automation LLC
- Master of Science (MS), Electrical and Electronics Engineering at University of Houston
- Bachelor of Engineering (B.E.), Electrical and Electronics Engineering, University of Andhra
- Certification in Machinery, TÜV Rheinland Group

Thanks to TECH, you will be able to learn with the best professionals in the world"

Management

Dr. Ramón Fabresse, Felipe

- Senior Software Engineer at Acurable
- NLP Software Engineer at Intel Corporation
- Software Engineer in CATEC, Indisys
- Researcher in Aerial Robotics at the University of Seville
- PhD Cum Laude in Robotics, Autonomous Systems and Telerobotics at the University of Seville
- Degree in Computer Engineering at the University of Seville
- Master's Degree in Robotics, Automation and Telematics at the University of Seville

Professors

Dr. Íñigo Blasco, Pablo

- Software Engineer at PlainConcepts
- Robotics Engineer at CATEC Advanced Center for Aerospace Technologies
- Developer and consultant at Syderis
- PhD in Industrial Informatics Engineering at the University of Seville
- Degree in Computer Engineering at the University of Seville
- Master in Software Engineering and Technology

Mr. Rosado Junquera, Pablo J

- R&D Automation and Control Engineer at Becton Dickinson & Company
- Amazon Logistic Control Systems Engineer at Dematic
- Automation and Control Engineer at Aries Engineering & Systems
- Graduate in Energy and Materials Engineering at Rey Juan Carlos University
- Master's Degree in Robotics and Automation at the Polytechnic University of Madrid
- Master's Degree in Industrial Engineering at the Alcalá University

Dr. Jiménez Cano, Antonio Enrique

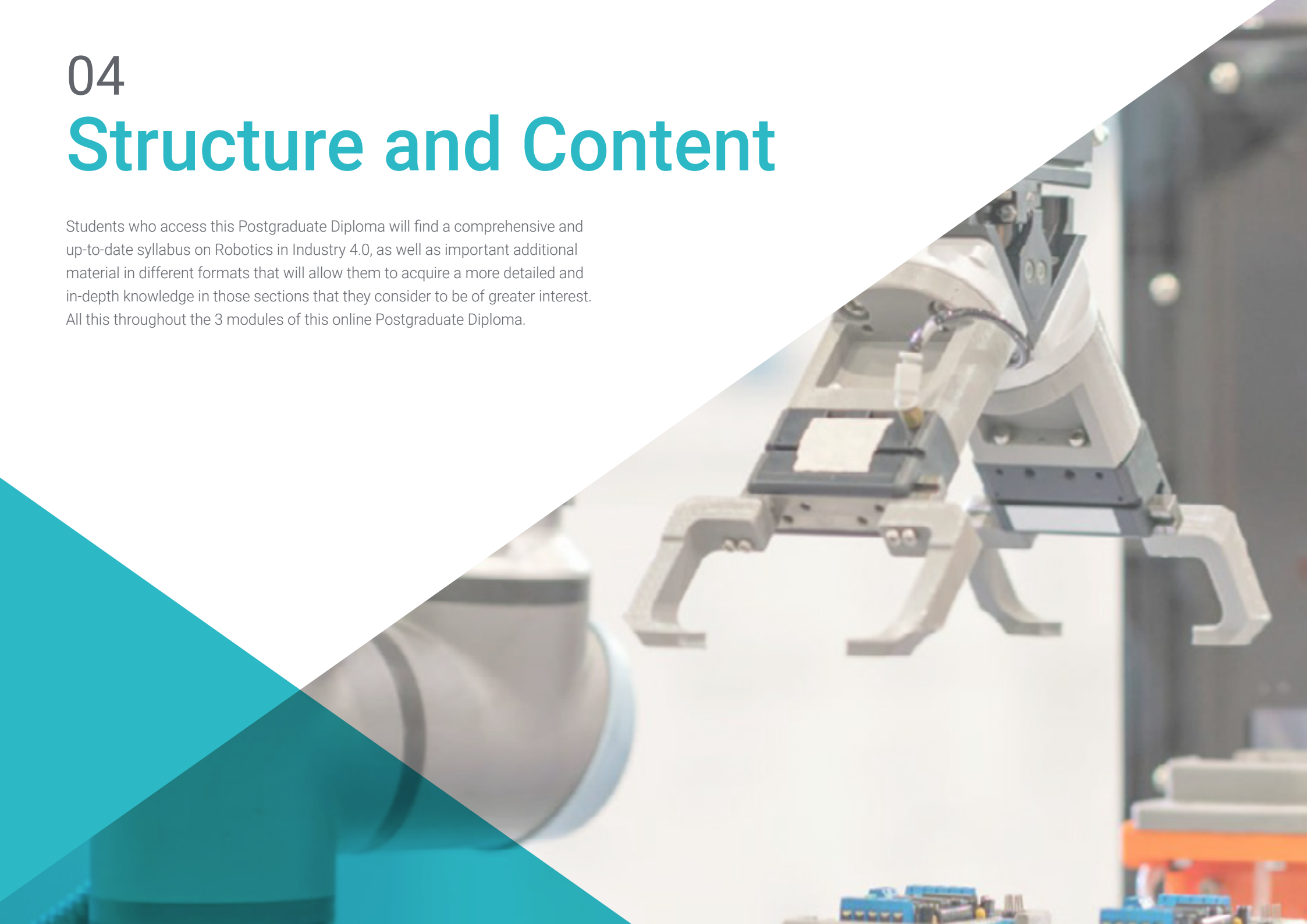
- Post-doctoral researcher in Navigation Systems at CNRS-LAAS
- Researcher in European projects (ARCAS, AEROARMS and AEROBI) at the University of Seville
- PhD in Automatics, Electronics and Telecommunications at the University of Seville
- Graduated in Automatic Engineering and Industrial Electronics at the University of Seville
- Degree in Technical Engineering in Computer Systems at the University of Seville

A unique, key, and decisive educational experience to boost your professional development"

04

Structure and Content

Students who access this Postgraduate Diploma will find a comprehensive and up-to-date syllabus on Robotics in Industry 4.0, as well as important additional material in different formats that will allow them to acquire a more detailed and in-depth knowledge in those sections that they consider to be of greater interest. All this throughout the 3 modules of this online Postgraduate Diploma.



Discover a wide range of Robotics applications and succeed with your own project thanks to this Postgraduate Diploma"

Module 1. Robotics. Robot Design and Modeling

1.1. Robotics and Industry 4.0
- 1.1.1. Robotics and Industry 4.0
- 1.1.2. Application Fields and Use Cases
- 1.1.3. Sub-Areas of Specialization in Robotics

1.2. Robot Hardware and Software Architectures
- 1.2.1. Hardware Architectures and Real-Time
- 1.2.2. Robot Software Architectures
- 1.2.3. Communication Models and Middleware Technologies
- 1.2.4. Robot Operating System (ROS) Software Integration

1.3. Mathematical Modeling of Robots
- 1.3.1. Mathematical Representation of Rigid Solids
- 1.3.2. Rotations and Translations
- 1.3.3. Hierarchical State Representation
- 1.3.4. Distributed Representation of the State in ROS (TF Library)

1.4. Robot Kinematics and Dynamics
- 1.4.1. Kinematics
- 1.4.2. Dynamics
- 1.4.3. Underactuated Robots
- 1.4.4. Redundant Robots

1.5. Robot Modeling and Simulation
- 1.5.1. Robot Modeling Technologies
- 1.5.2. Robot Modeling with URDF
- 1.5.3. Robot Simulation
- 1.5.4. Modeling with Gazebo Simulator

1.6. Robot Manipulators
- 1.6.1. Types of Manipulator Robots
- 1.6.2. Kinematics
- 1.6.3. Dynamics
- 1.6.4. Simulation

1.7. Terrestrial Mobile Robots
- 1.7.1. Types of Terrestrial Mobile Robots
- 1.7.2. Kinematics
- 1.7.3. Dynamics
- 1.7.4. Simulation

1.8. Aerial Mobile Robots
- 1.8.1. Types of Aerial Mobile Robots
- 1.8.2. Kinematics
- 1.8.3. Dynamics
- 1.8.4. Simulation

1.9. Aquatic Mobile Robots
- 1.9.1. Types of Aquatic Mobile Robots
- 1.9.2. Kinematics
- 1.9.3. Dynamics
- 1.9.4. Simulation

1.10. Bioinspired Robots
- 1.10.1. Humanoids
- 1.10.2. Robots with Four or More Legs
- 1.10.3. Modular Robots
- 1.10.4. Robots with Flexible Parts (Soft-Robotics)

Module 2. Robotics in the Automation of Industrial Processes

2.1. Design of Automated Systems
- 2.1.1. Hardware Architectures
- 2.1.2. Programmable Logic Controllers
- 2.1.3. Industrial Communication Networks

2.2. Advanced Electrical Design I: Automation
- 2.2.1. Design of Electrical Panels and Symbology
- 2.2.2. Power and Control Circuits Harmonics
- 2.2.3. Protection and Grounding Elements

2.3. Advanced Electrical Design II: Determinism and Safety
- 2.3.1. Machine Safety and Redundancy
- 2.3.2. Safety Relays and Triggers
- 2.3.3. Safety PLCs
- 2.3.4. Safe Networks

2.4. Electrical Actuation
- 2.4.1. Motors and Servomotors
- 2.4.2. Frequency Inverters and Controllers
- 2.4.3. Electrically Actuated Industrial Robotics

2.5. Hydraulic and Pneumatic Actuation
- 2.5.1. Hydraulic Design and Symbology
- 2.5.2. Pneumatic Design and Symbology
- 2.5.3. ATEX Environments in Automation

2.6. Transducers in Robotics and Automation
- 2.6.1. Position and Velocity Measurement
- 2.6.2. Force and Temperature Measurement
- 2.6.3. Presence Measurement
- 2.6.4. Vision Sensors

2.7. Programming and Configuration of Programmable Logic Controllers PLCs
- 2.7.1. PLC Programming: LD
- 2.7.2. PLC Programming: ST
- 2.7.3. PLC Programming: FBD and CFC
- 2.7.4. PLC Programming: SFC

2.8. Programming and Configuration of Equipment in Industrial Plants
- 2.8.1. Programming of Drives and Controllers
- 2.8.2. HMI Programming
- 2.8.3. Programming of Manipulator Robots

2.9. Programming and Configuration of Industrial Computer Equipment
- 2.9.1. Programming of Vision Systems
- 2.9.2. SCADA/Software Programming
- 2.9.3. Network Configuration

2.10. Automation Implementation
- 2.10.1. State Machine Design
- 2.10.2. Implementation of State Machines in PLCs
- 2.10.3. Implementation of Analog PID Control Systems in PLCs
- 2.10.4. Automation Maintenance and Code Hygiene
- 2.10.5. Automation and Plant Simulation

Module 3. Automatic Control Systems in Robotics

3.1. Analysis and Design of Nonlinear Systems
- 3.1.1. Analysis and Modeling of Nonlinear Systems
- 3.1.2. Feedback Control
- 3.1.3. Linearization by Feedback

3.2. Design of Control Techniques for Advanced Non-linear Systems
- 3.2.1. Sliding Mode control
- 3.2.2. Lyapunov and Backstepping Control
- 3.2.3. Control Based on Passivity

3.3. Control Architectures
- 3.3.1. The Robotics Paradigm
- 3.3.2. Control Architectures
- 3.3.3. Applications and Examples of Control Architectures

3.4. Motion Control for Robotic Arms
- 3.4.1. Kinematic and Dynamic Modeling
- 3.4.2. Control in Joint Space
- 3.4.3. Control in Operational Space

3.5. Actuator Force Control
- 3.5.1. Force Control
- 3.5.2. Impedance Control
- 3.5.3. Hybrid Control

3.6. Terrestrial Mobile Robots
- 3.6.1. Equations of Motion
- 3.6.2. Control Techniques for Terrestrial Robots
- 3.6.3. Mobile Manipulators

3.7. Aerial Mobile Robots
- 3.7.1. Equations of Motion
- 3.7.2. Control Techniques in Aerial Robots
- 3.7.3. Aerial Manipulation

3.8. Control Based on Machine Learning Techniques
- 3.8.1. Control Using Supervised Learning
- 3.8.2. Control Using Reinforced Learning
- 3.8.3. Control Using Non-Supervised Learning

3.9. Vision-Based Control
- 3.9.1. Position-Based Visual Servoing
- 3.9.2. Image-Based Visual Servoing
- 3.9.3. Hybrid Visual Servoing

3.10. Predictive Control
- 3.10.1. Models and State Estimation
- 3.10.2. MPC Applied to Mobile Robots
- 3.10.3. MPC Applied to UAVs

"A program that will give you the opportunity to delve into the Robotics industry"

05

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 has been the most widely used learning system among the world's leading Information Technology schools for as long as they have existed. 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 course, students 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

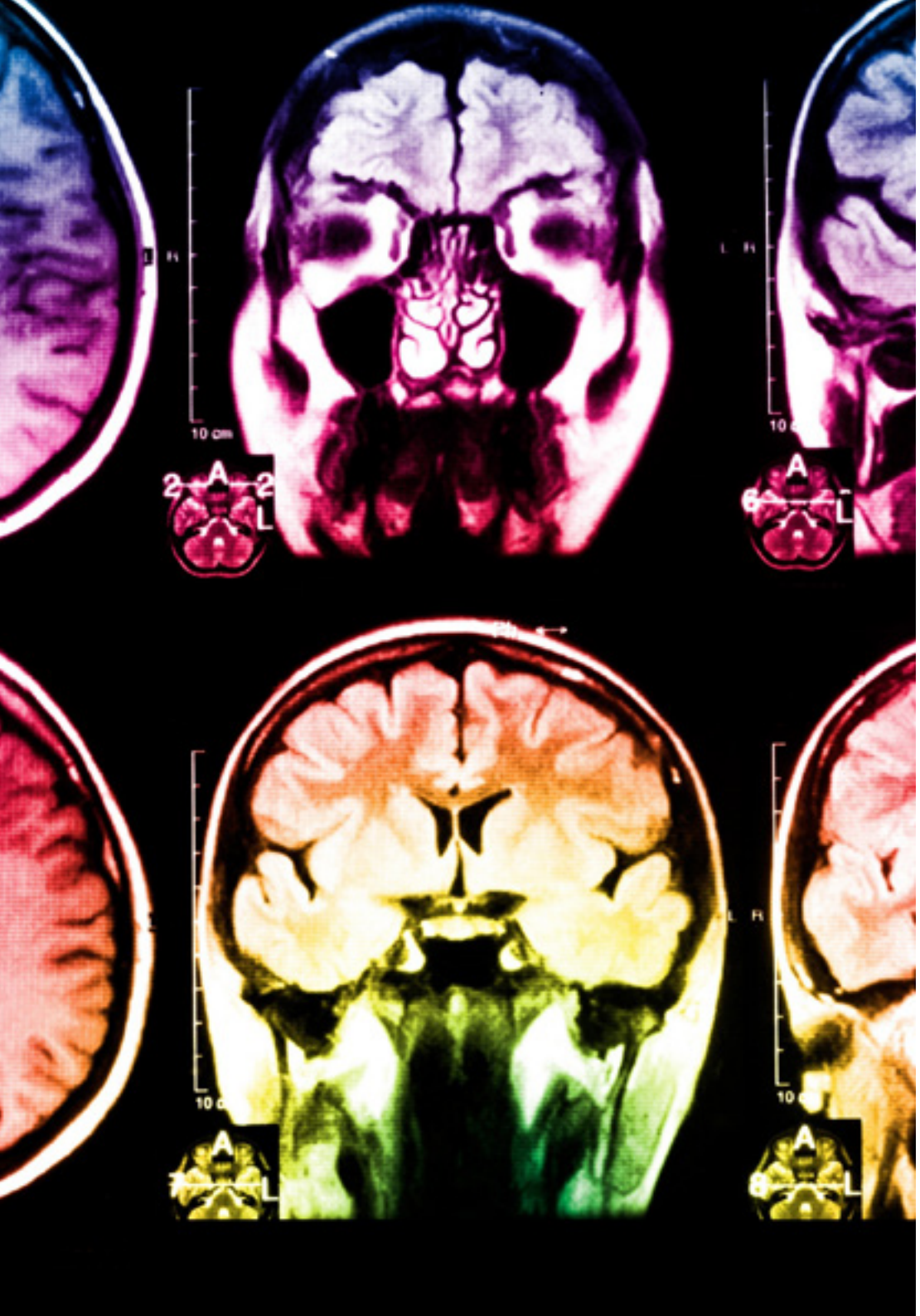
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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.

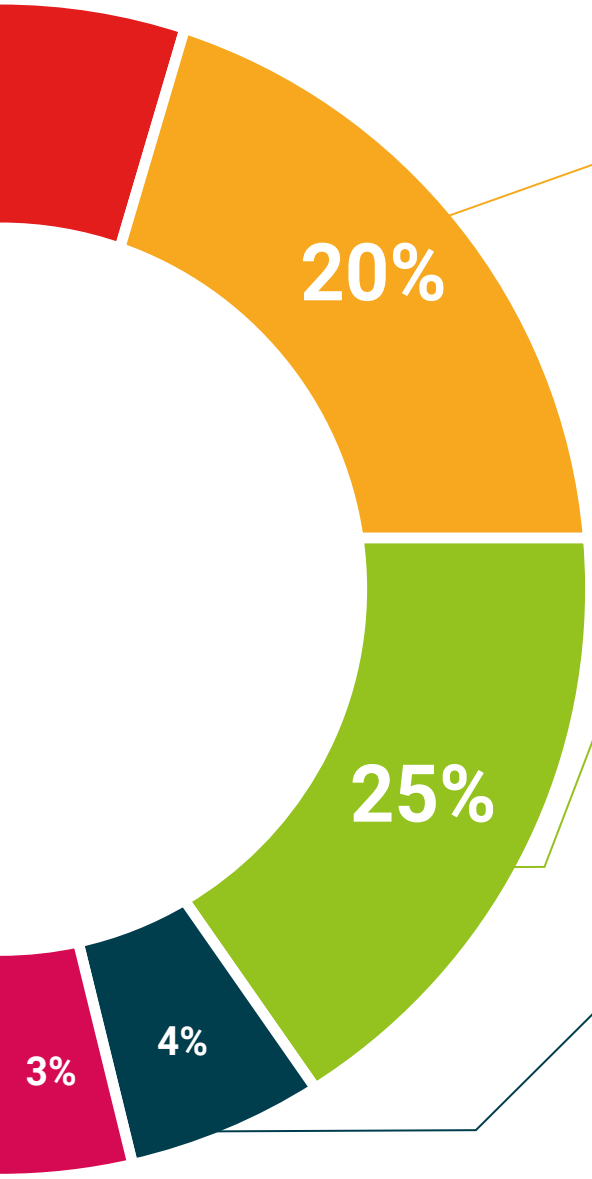
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

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.

06

Certificate

The Postgraduate Diploma in Robotics in Industry 4.0 guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Diploma issued by TECH Global University.

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

This program will allow you to obtain your **Postgraduate Diploma in Robotics in Industry 4.0** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

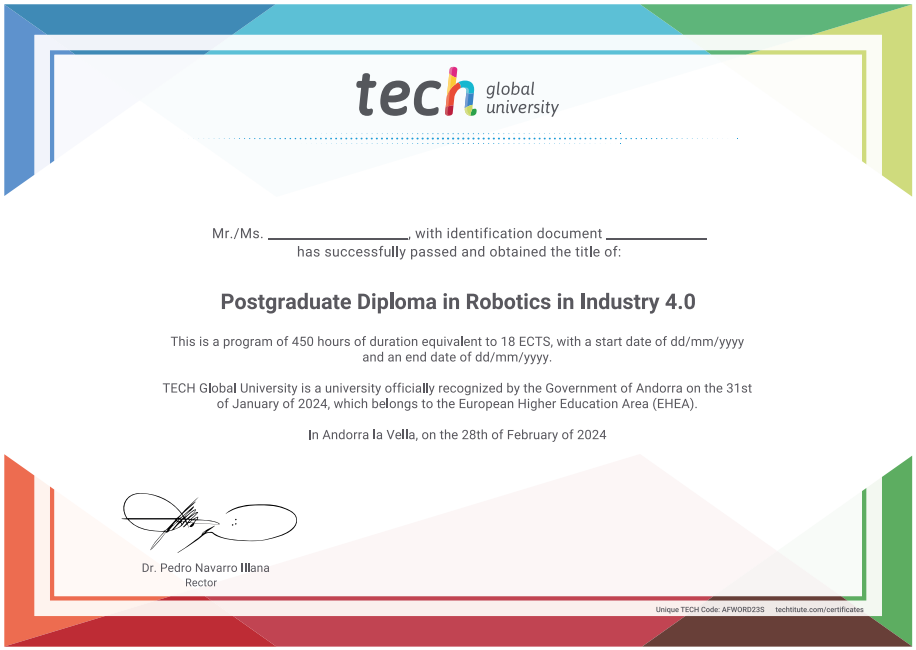
This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Postgraduate Diploma in Robotics in Industry 4.0**

Modality: **online**

Duration: **6 months**

Accreditation: **18 ECTS**


tech global university

Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

Postgraduate Diploma in Robotics in Industry 4.0

This is a program of 450 hours of duration equivalent to 18 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

Unique TECH Code: AFWORD23S techtitute.com/certificates

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

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