Postgraduate Diploma

Robotics in Industry 4.0

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Postgraduate Diploma
Robotics in Industry 4.0

- Modality: **online**
- Duration: **6 months**
- Certificate: **TECH Technological University**
- Dedication: **16h/week**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/in/engineering/postgraduate-diploma/postgraduate-diploma-robotics-industry-4-0**

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01

Introduction

The industrial and technological development that has taken place in recent years has positively and notoriously influenced the growth of robotic strategies that are increasingly present in society. From machines that paint cars automatically, to devices that help with household chores, the 4.0 revolution seems to have no limits. That is why TECH and its team of experts have considered it necessary to design this program, aimed at guiding the engineers and providing the technical keys to master Robotics and its applications in the current industrial context.
All this through a convenient 100% online format, so that you have the option to choose when and from where to connect at all times.

A dynamic, highly capacitating and 100% online option to learn in detail the ins and outs of Robotics in Industry 4.0 and to become an expert in this field, in just 6 months"

The integration of Robotics in society has occurred gradually and naturally, according to the technological development of each decade and scientific advances in Artificial Intelligence that make it possible that today many complex processes are performed in an automated and remotely controlled from the other side of the world. What was impossible for many just a decade ago is now part of everyday life for others.

All this has greatly benefited the industry, allowing it to increase its productivity exponentially and increasing the profitability of each process. Industry 4.0 has emerged, characterized by modernization and technology, in which manual processes are completely obsolete. That is why the profile of the professional who masters the implementation of innovative solutions and complete automation, as well as the configuration of equipment has become one of the most demanded.

For this reason, TECH has considered it necessary to design this Postgraduate Diploma in Robotics in Industry 4.0, a program that includes the keys to specialize in this area. It is an intensive and highly enabling program that covers from the keys to the design and modeling of robots, to the automation of industrial processes, with special emphasis on automatic control systems.

For this purpose, you will have the best syllabus, designed by engineers specialized in Robotics who will be at your disposal to solve any doubts that may arise during the course of the training. All the content, to which are added hours of additional high-quality material, you will find it in the Virtual Classroom, a space accessible from any electronic device with internet connection, which also allows you to download all the information and consult it whenever you need it, even after completing the Postgraduate Diploma.

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

Thanks to the completeness with which this program has been created, in less than 6 months, you will be able to create power and control circuits as an expert in advanced electronic design"

Understanding the ins and outs of Robotics in Industry 4.0 is fundamental to undertake successful and effective projects, that's why TECH delves, with its syllabus, into the key aspects of this frield from the foundation"

Enroll in a program that will not only teach you to design control techniques for advanced nonlinear systems, but will also give you the keys to master the different types.

Manipulator robots, terrestrial mobile, aerial mobile, aquatic or bio-inspired robots, you will work on their design and characterization with this Postgraduate Diploma.

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

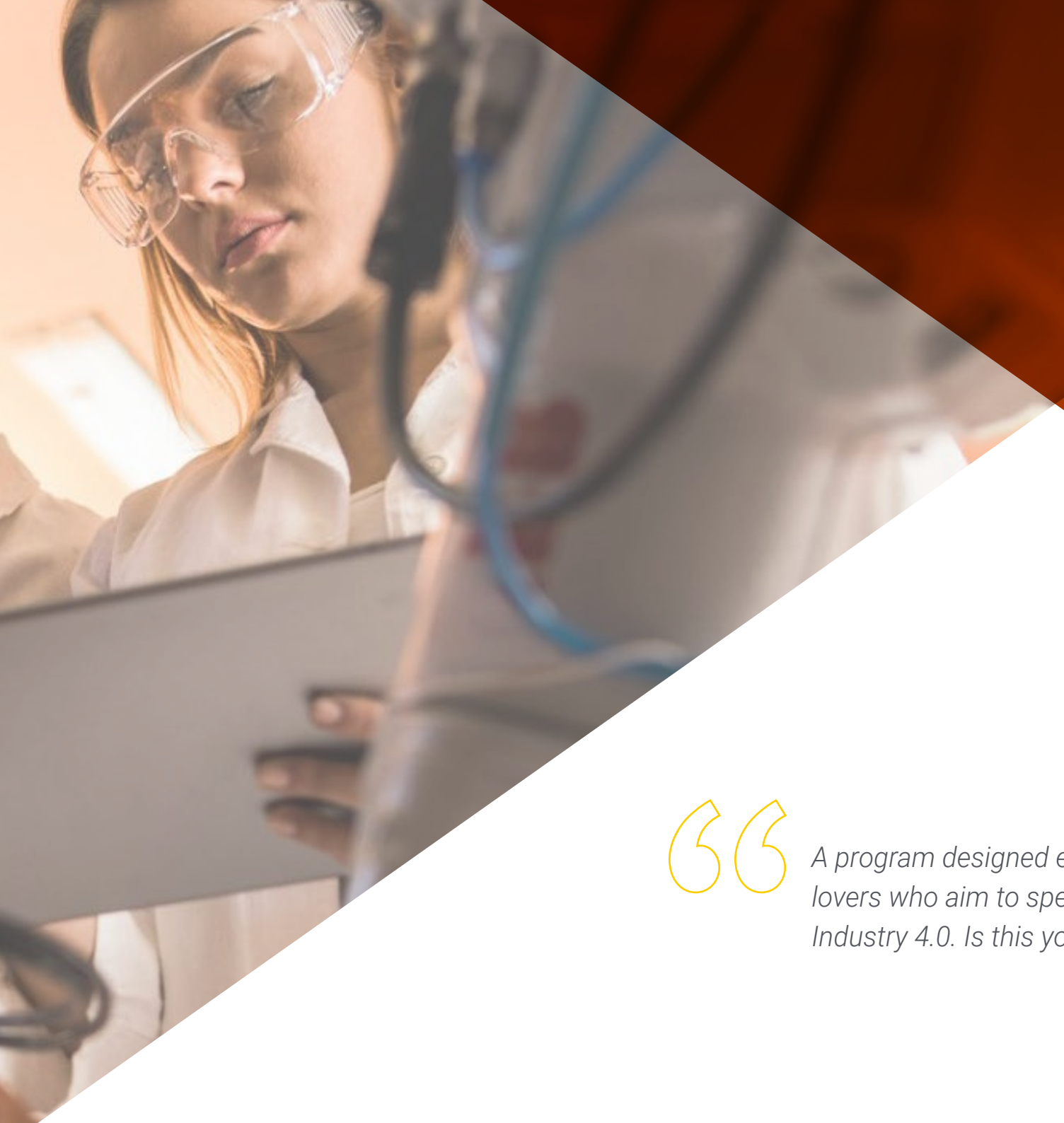
Its multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide an immersive education programmed to learn in real situations.

The design of this program focuses on Problem-Based Learning, by means of which the professionals must try to solve the different professional practice situations that are presented throughout the program. For this purpose, the student will be assisted by an innovative interactive video system created by renowned experts.

02

Objectives

This program has been created with the aim that the student who accesses it will find in its syllabus all the information that will allow him to specialize in a comprehensive manner in Robotics in Industry 4.0 in just 6 months. For this reason, TECH will provide you with the best and most advanced academic tools, which not only have a positive influence on learning, but also provide this program with an extra dynamism and quality that will motivate you to get the most out of this educational experience.



A program designed exclusively for Robotics lovers who aim to specialize their activity in Industry 4.0. Is this your case?"

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 an online and quality education compatible with your personal responsibilities

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

Whatever your academic goals are, TECH will give you the tools, not only to achieve them, but to surpass them”

03

Course Management

To master such a complex sector as Robotics, it is necessary to have a highly qualified teaching team versed in the field that knows the industry in detail. That is why for this Postgraduate Diploma, TECH has selected a group of professionals from different branches of Engineering, who have a long and extensive professional experience in the management of technological projects. It is, therefore, a unique opportunity to continue growing from the hand of experts in the field who will put their experience in the hands of the students.

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

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

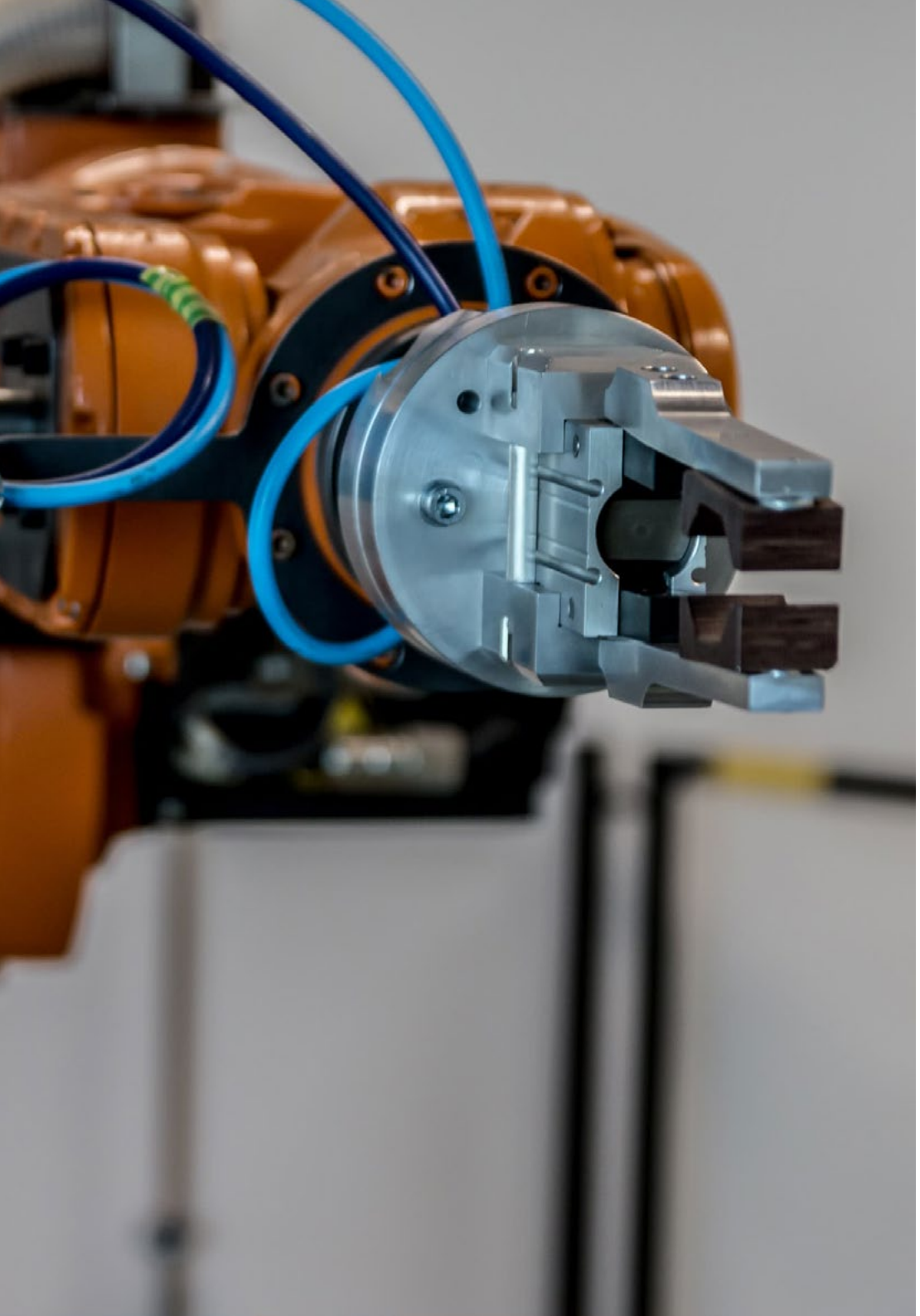
Professors

Dr. Íñigo Blasco, Pablo

- Software Engineer at PlainConcepts
- Founder of Intelligent Behavior Robots
- 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
- Professional Master's Degree in Software Engineering and Technology

Mr. Rosado Junquera, Pablo J.

- Engineer Specialist in Robotics and Automatization
- R&D Automation and Control Engineer at Becton Dickinson & Company
- Amazon Logistic Control Systems Engineer at Dematic
- Automation and Control Engineer at Aries Ingeniería y Sistemas
- 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 University of Alcalá



Dr. Jiménez Cano, Antonio Enrique

- Engineer at Aeronautical Data Fusion Engineer
- Researcher in European projects (ARCAS, AEROARMS and AEROBI) at the University of Seville
- Researcher in Navigation Systems at CNRS-LAAS
- LAAS MBZIRC2020 System Developer
- Group of Robotics, Vision and Control (GRVC) of 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

Take the opportunity to learn about the latest advances in this field in order to apply it to your daily practice"

04

Structure and Content

TECH employs in all of its degrees the most cutting-edge and accurate content that exists on the subject in question. For this reason, the graduates who access this program will find the best syllabus based on the application of Robotics in Industry 4.0, plus a significant amount of additional material in different formats, with which, not only can contextualize the most complex concepts, but can deepen in those sections that are of greatest interest. In this way, you will be able to customize not only the timetable, but also the level of deepening.

Predictive control and control based on automatic learning techniques are the future. If you wish to delve and specialize in these fields, don't think twice and enroll now"

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 by Unsupervised 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 designed for future experts in Robotics to become the successful engineer you've always wanted to be"

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 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

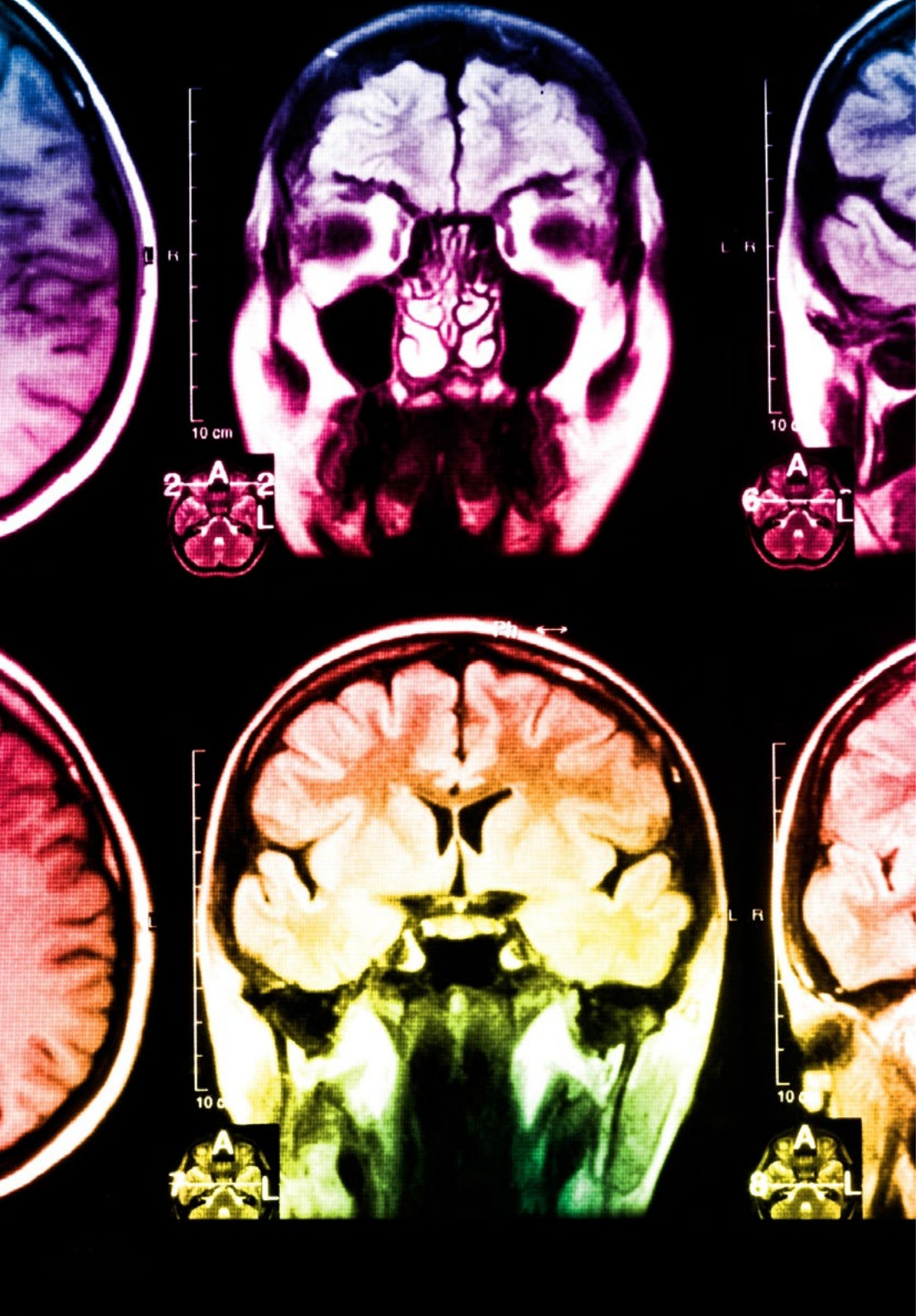
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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.

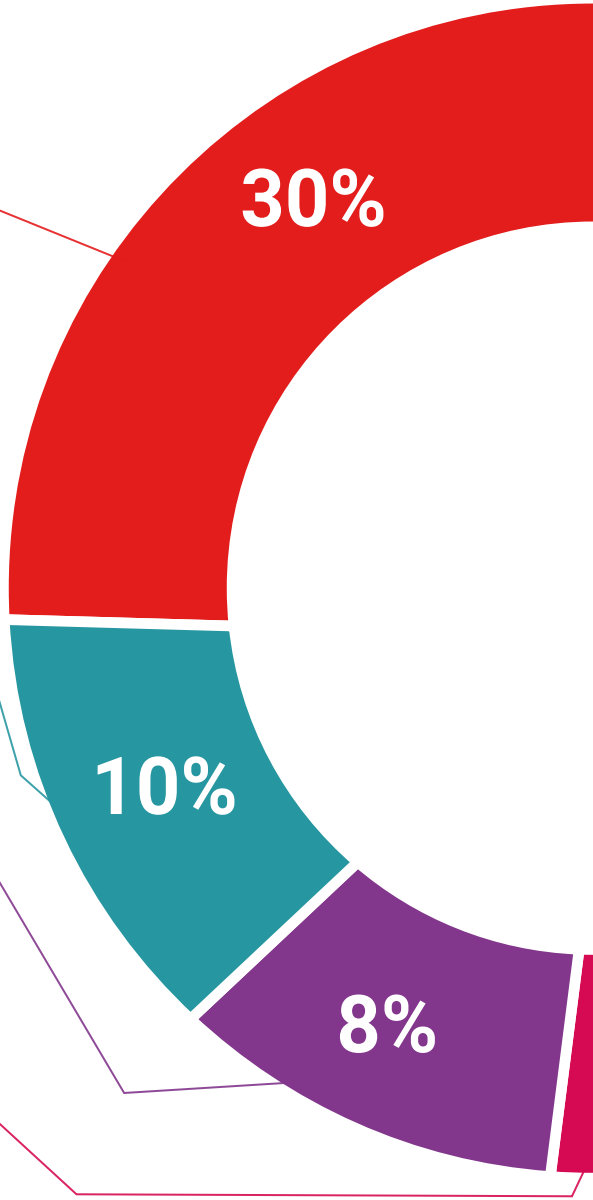
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

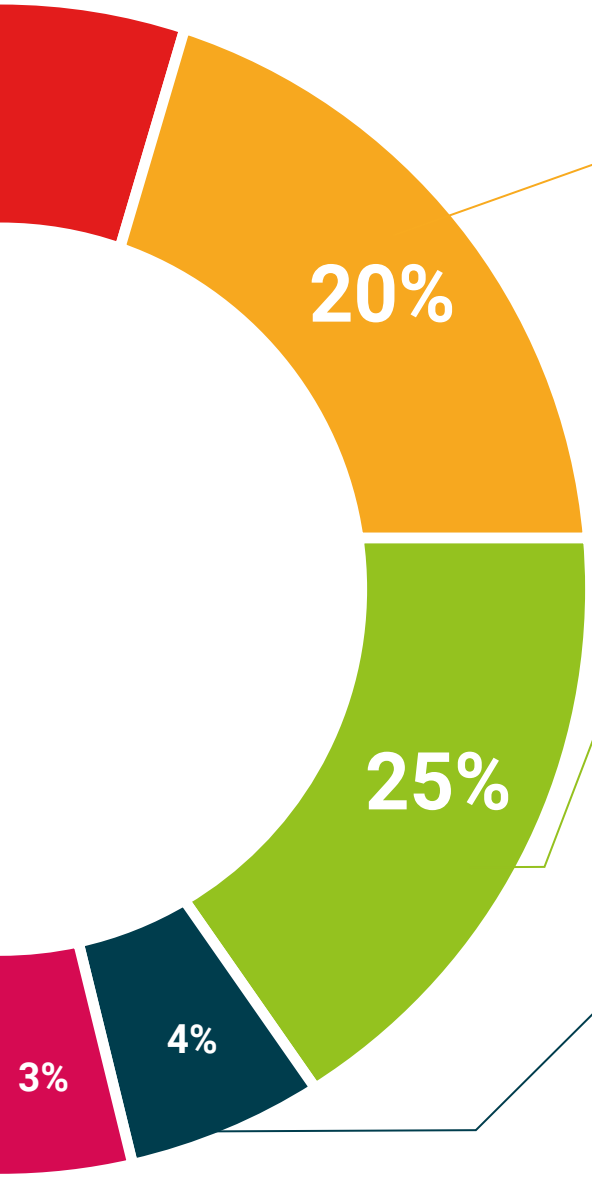
Practising Skills and Abilities

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.

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 Certificate issued by TECH Technological University.

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

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

After the student has passed the assessments, they will receive their corresponding **Postgraduate Diploma** issued by **TECH Technological University** via tracked delivery*.

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

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

Official Nº of Hours: **450 h.**


tech technological university

Awards the following

CERTIFICATE

to

Mr./Ms. _____, with identification number _____.

For having passed and accredited the following program

POSTGRADUATE DIPLOMA

in

Robotics in Industry 4.0

This is a qualification awarded by this University, equivalent to 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

*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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