Postgraduate Diploma
Robot Navigation Systems

tech technological university

Postgraduate Diploma
Robot Navigation Systems

- » 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-robot-navigation-systems**

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01

Introduction

Mobility and autonomy are two fundamental characteristics that enable robots to operate efficiently in complex environments, make decisions and perform tasks without human intervention. Vision systems also play an important role in this process. Throughout this creation process, the engineer becomes a key element. This 100% online program and its specialized teaching team provide students with extensive knowledge in a field that requires highly qualified personnel with creative skills. In this way, this program will show, throughout its 600 hours of duration, the most avant-garde and up-to-date content in Robotics that will lead them to advance in their career.

Advance in your professional career with a specialization that will provide you with all the necessary knowledge about Robotics and Industry 4.0"

Robots can make decisions and act autonomously, taking into account all the information from the environment, whether acquired by sensors or not. The engineering professionals bring to the development and creation phase all their knowledge in this field, with a mastery of algorithms, which allow the proper planning of tasks and movements.

This Postgraduate Diploma focuses on the complex algorithmic world to analyze the main problems in the autonomy and movements of the robot, applying the most optimal strategies to solve them. With an eminently practical approach, the students of this program will approach an industry that also requires in-depth knowledge of the techniques that enable perception and vision systems.

Likewise, in this program, the engineering professionals will be accompanied by a teaching staff specialized in this field that will provide the latest technical advances achieved in the process of simultaneous localization and mapping, the so-called SLAM. In this way, students are faced with an extensive program where they can obtain a broad learning in a field of Robotics that demands more and more qualified professionals.

This program is an opportunity for students who want a specialization, which allows flexibility when accessing the syllabus. Thus, TECH offers in this Postgraduate Diploma a complete program from day one with downloadable multimedia content to be viewed at any time and a Relearning system, based on repetition, which will facilitate learning.

This **Postgraduate Diploma in Robot Navigation Systems** 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

"A 100% online program that adapts to you. Access it at any time and with just a device with an internet connection"

Register now and learn more about the latest techniques in optical sensor optimization for Robotics"

The Relearning teaching method and multimedia content will allow you to reach your goals more easily. Click and enroll now.

Design more advanced digital image processing algorithms 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.

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

At the end of this Postgraduate Diploma, the engineering professionals will have achieved a preparation in the field of robot navigation, which will allow them to be part of the teams of large companies in the industry This is possible thanks to the deep knowledge that this teaching provides in the design and modeling of robots, Artificial Vision techniques and visual SLAM. The teaching team with extensive experience in the industry will provide students with all the necessary tools to progress in their career.

With this program, you will be able to master the use of the URDF robot modeling language"

General Objectives

- Understand the mathematical foundations for kinematic and dynamic modeling of robots
- Delve into the use of specific technologies for the creation of robot architectures, robot modeling and simulation
- Generate specialized knowledge on Artificial Intelligence
- Develop the technologies and devices most commonly used in industrial automation
- Identify the limits of current techniques to identify bottlenecks in robotic applications

“With this Postgraduate Diploma, you will acquire the knowledge that will lead you to solve any robot motion problem”

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. Robot Planning Algorithms

- Establish the different types of planning algorithms
- Analyze the complexity of motion planning in robotics
- Develop techniques for environment modeling
- Examine the pros and cons of different planning techniques
- Analyze centralized and distributed algorithms for robot coordination
- Identify the different elements in decision theory
- Propose learning algorithms for solving decision problems

Module 3. Artificial Vision Techniques in Robotics: Image Processing and Analysis

- Analyze and understand the importance of vision systems in robotics
- Establish the characteristics of the different perception sensors in order to choose the most appropriate ones according to the application
- Determine the techniques for extracting information from sensor data
- Apply visual information processing tools
- Design digital image processing algorithms
- Analyze and predict the effect of parameter changes on algorithm performance
- Assess and validate the developed algorithms in terms of results

Module 4. Visual SLAM. Robot Localization and Simultaneous Mapping by Artificial Vision Techniques

- Specify the basic structure of a Simultaneous Localization and Mapping (SLAM) system
- Identify the basic sensors used in Simultaneous Localization and Mapping (visual SLAM)
- Establish the boundaries and capabilities of visual SLAM
- Compile the basic notions of projective and epipolar geometry to understand imaging projection processes
- Identify the main visual SLAM technologies: Gaussian Filters, Optimization and Loop Closure Detection
- Describe in detail the operation of the main visual SLAM algorithms
- Analyze how to carry out the tuning and parameterization of SLAM algorithms

03

Course Management

Robotics is expanding thanks to technological advances. Its rapid momentum requires, however, precise and updated knowledge. In this sense, the teaching team of this Postgraduate Diploma has a high academic qualification in Engineering and extensive experience in the field of Robotics. All their knowledge will benefit the students, who will learn first-hand the latest advances in this area from professionals who have a great mastery in this area.

A teaching team made up of engineers with extensive experience in Robotics will guide you to achieve your goals"

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
- Professional 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
- Master's Degree in Software Engineering and Technology

Dr. Alejo Teissière, David

- Telecommunications Engineer.with Specialization in Robotics
- Postdoctoral Researcher in the European projects SIAR and NIx ATEX at Pablo de Olavide University
- Systems Developer at Aertec
- PhD in Automation, Robotics and Telematics at the University of Seville
- Graduated in Telecommunication Engineering at the University of Seville
- Master's Degree in Automation, Robotics and Telematics from the University of Seville

Dr. Caballero Benítez, Fernando

- Researcher in the European projects COMETS, AWARE, ARCAS and SIAR
- Degree in Telecommunications Engineering from the University of Seville
- PhD in Telecommunications Engineering at the University of Seville
- Full Professor of Systems Engineering and Automatics at the University of Seville
- Associate editor of the journal Robotics and Automation Letters

Dr. Pérez Grau, Francisco Javier

- Head of the Perception and Software Unit at CATEC
- R&D Project Manager at CATEC
- R&D Project Engineer at CATEC
- Associate Professor at the University of Cadiz
- Associate Professor at the University International of Andalucia
- Researcher in the Robotics and Perception group at the University of Zurich
- Researcher at the Australian Centre for Field Robotics at the University of Sydney
- PhD in Robotics and Autonomous Systems from the University of Seville
- Graduate in Telecommunications Engineering and Computer and Network Engineering from the University of Seville

04
Structure and Content

The syllabus of this Postgraduate Diploma has been designed by a team of professionals with extensive experience in Industry 4.0. That is why this program is structured in 4 modules, where students will have a wide range of audiovisual material that will take them through the main concepts of design and modeling, algorithms, vision in Robotics or Simultaneous Mapping by means of Artificial Vision techniques. Essential reading and case studies of real examples provided by the teaching staff complete this program.

You have at your fingertips the main tools to create robot designs and modeling. Click and specialize"

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. Robot Planning Algorithms

2.1. Classical Planning Algorithms
  - 2.1.1. Discrete Planning: State Space
  - 2.1.2. Planning Problems in Robotics. Robotic Systems Models
  - 2.1.3. Classification of Planners

2.2. The Trajectory Planning Problem in Mobile Robots
  - 2.2.1. Forms of Environment Representation: Graphs
  - 2.2.2. Search Algorithms in Graphs
  - 2.2.3. Introduction of Costs in Networks
  - 2.2.4. Search Algorithms in Heavy Networks
  - 2.2.5. Algorithms with any Angle Approach

Module 3. Artificial Vision Techniques in Robotics: Image Processing and Analysis

3.8. Image Feature Detection
  3.8.1. Point of Interest Detection
  3.8.2. Feature Descriptors
  3.8.3. Feature Matching
3.9. 3D Vision Systems
  3.9.1. 3D Perception
  3.9.2. Feature Matching between Images
  3.9.3. Multiple View Geometry
3.10. Computer Vision-Based Localization
  3.10.1. The Robot Localization Problem
  3.10.2. Visual Odometry
  3.10.3. Sensory Fusion

Module 4. Visual SLAM. Robot Localization and Simultaneous Mapping by Artificial Vision Techniques

4.1. Simultaneous Localization and Mapping (SLAM)
  4.1.1. Simultaneous Localization and Mapping. SLAM
  4.1.2. SLAM Applications
  4.1.3. SLAM Operation
4.2. Projective Geometry
  4.2.1. Pin-Hole Model
  4.2.2. Estimation of Intrinsic Parameters of a Chamber
  4.2.3. Homography, Basic Principles and Estimation
  4.2.4. Fundamental Matrix, Principles and Estimation
4.3. Gaussian Filters
  4.3.1. Kalman Filter
  4.3.2. Information Filter
  4.3.3. Adjustment and Parameterization of Gaussian Filters
4.4. Stereo EKF-SLAM
  4.4.1. Stereo Camera Geometry
  4.4.2. Feature Extraction and Search
  4.4.3. Kalman Filter for Stereo SLAM
  4.4.4. Stereo EKF-SLAM Parameter Setting
4.5. Monocular EKF-SLAM
  4.5.1. EKF-SLAM Landmark Parameterization
  4.5.2. Kalman Filter for Monocular SLAM
  4.5.3. Monocular EKF-SLAM Parameter Tuning
4.6. Loop Closure Detection
  4.6.1. Brute Force Algorithm
  4.6.2. FABMAP
  4.6.3. Abstraction Using GIST and HOG
  4.6.4. Deep Learning Detection
4.7. Graph-SLAM
  4.7.1. Graph-SLAM
  4.7.2. RGBD-SLAM
  4.7.3. ORB-SLAM
4.8. Direct Visual SLAM
  4.8.1. Analysis of the Direct Visual SLAM Algorithm
  4.8.2. LSD-SLAM
  4.8.3. SVO
4.9. Visual Inertial SLAM
  4.9.1. Integration of Inertial Measurements
  4.9.2. Low Coupling: SOFT-SLAM
  4.9.3. High Coupling: Vins-Mono
4.10. Other SLAM Technologies
  4.10.1. Applications Beyond Visual SLAM
  4.10.2. Lidar-SLAM
  4.10.2. Range-only SLAM

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

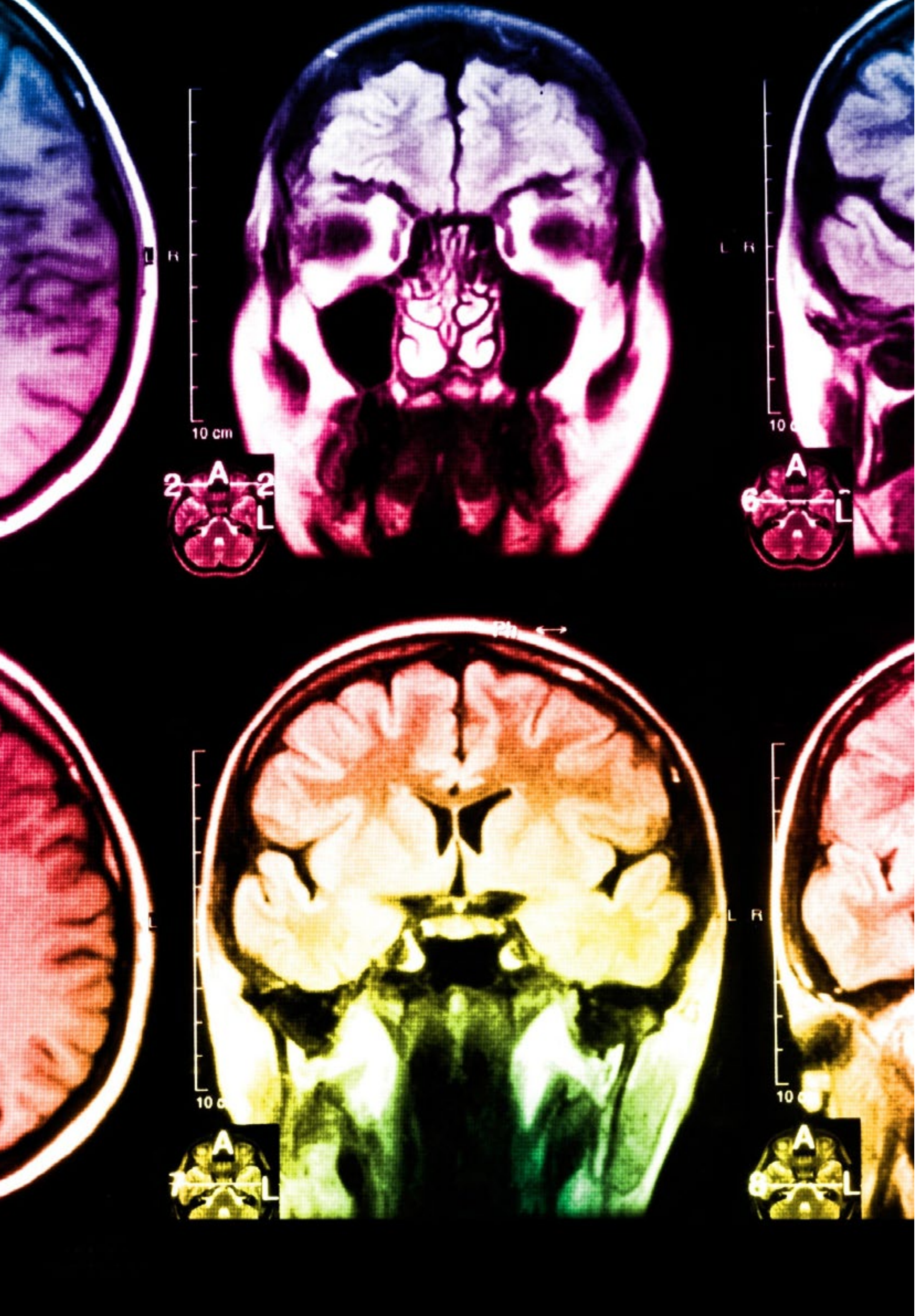
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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.

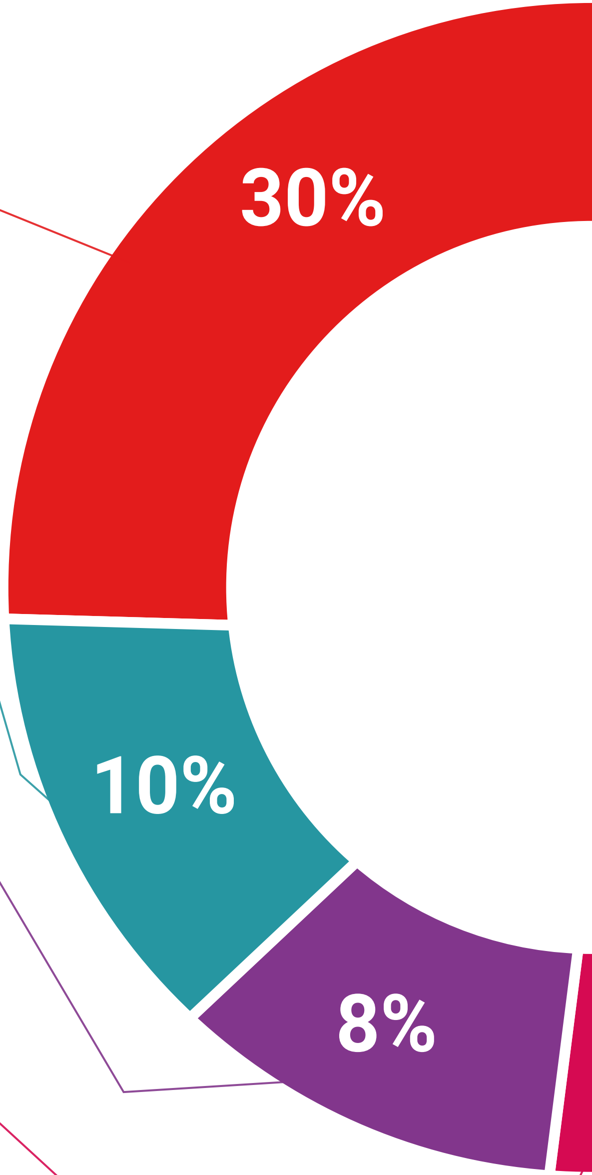
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

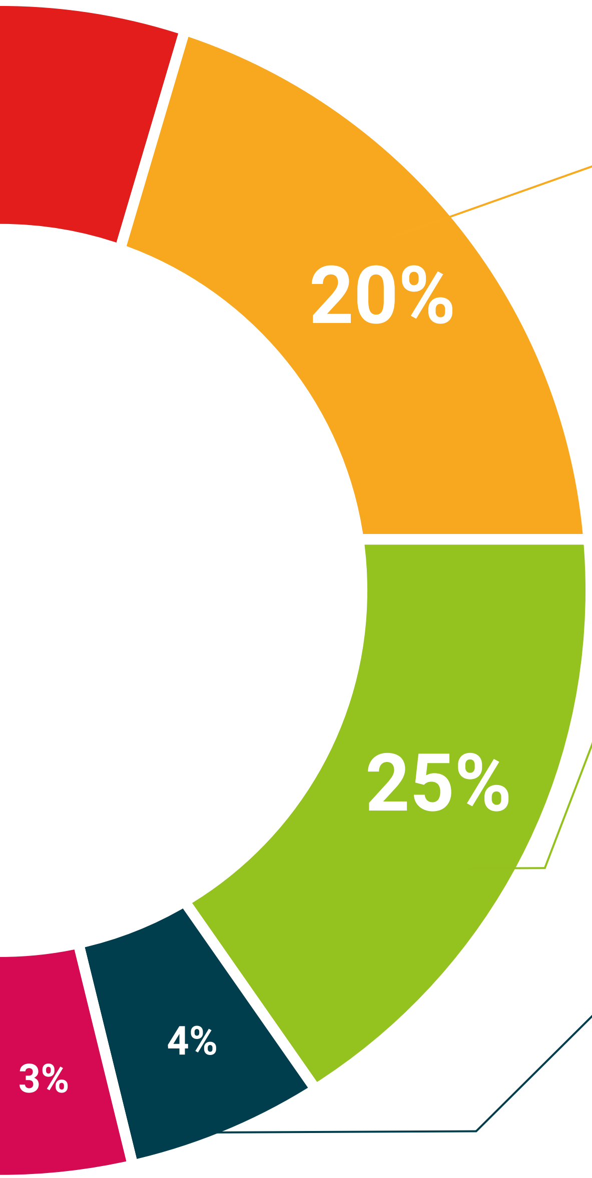
Practising Skills and Abilities

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 Robot Navigation Systems guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Diploma issued by TECH Technological University.

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

This **Postgraduate Diploma in Robot Navigation Systems** 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 Robot Navigation Systems**

Official Nº of Hours: **600 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

Robot Navigation Systems

This is a qualification awarded by this University, equivalent to 600 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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