Professional Master's Degree
Railroad Systems

tech global university

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Professional Master's Degree
Railroad Systems

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/professional-master-degree/master-railroad-systems**

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01

Introduction

The Railroad System has undergone many changes in recent years, a notable advance being the commitment of the state governments of a large number of countries to extend and modernize the system. Due to the new high-speed passenger services, the decongestion of cities through new urban rail systems and the necessary transfer of goods from other modes of transport to rail, a permanent evolution of this system is being contemplated. In addition, it is the most environmentally sustainable mode of transport, which is a highly important feature at this time. This makes it essential to have specialized professionals in this area. That's why the program in Railroad Systems is designed so that the student is able to start specializing in the new technologies that have an impact on this growing field.

It analyzes the new requirements and advances of the Railroad System from a dynamic perspective and is backed by the extensive experience of excellent teaching staff"

The railroad was not born from a spontaneous idea, but after a long process to improve the transportation of coal that began in the 17th century. In those days, the tracks were built with wooden beams that were supported and nailed to sleepers. Over time, this system has evolved and received greater support from state governments. This has favored its path to becoming an environmentally sustainable means of transport, something very much in demand in today's industry. Thus, it has become a fundamental requirement for engineers in this area to continue their academic studies and specialize in a field with a great international projection.

This Professional Master's Degree explores the engineering and operation of railroads from a traditional, technical and operational perspective, but taking into account the current international context, which establishes new specific requirements for professionals in this sector. Special emphasis is placed on the new trends and technologies towards which the railroad is moving, in order to increase its technical efficiency and its service to society. Likewise, an analysis of the new safety requirements that are substantially conditioning the design and operations of the Railroad Systems is proposed.

The program is applicable in all geographical areas related to railroads, with a clear international dimension. We have taken into account specific aspects of railroad networks, projects and services that represent an outstanding reference in the railroad field and therefore are of great interest for the student. The Professional Master's Degree has been planned in a practical way, so that the contents can be directly applied in the different professional fields of the railroad.

New technologies play an important role in this program. The railroad sector requires professionals who, already having technical competence in the traditional aspects of the sector, are familiar with, and know, the new challenges that the railroad is facing. For this reason, this program incorporates specific modules on research, development and innovation in the sector and on the digital transformation it is undergoing, all of which are key elements in the new strategy to be followed.

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

- Improve professional skills in the field of railroad systems
- Update and focus the student's company's strategies in these terms
- Demand new requirements in the technology acquisition processes
- Add value to the technical projects to be developed by student's companies and organizations
- The graphic, schematic, and eminently practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- 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

With the graphic and practical content, this Professional Master's Degree provides students all the knowledge they need in their daily work day"

Have access to a program that is applicable in all geographical areas related to railroads, and has a clear international dimension"

Become a professional in the railroad sector by possessing the technical competencies in the traditional aspects of the sector.

Apply the new concepts of safe design and modifications in the Railroad System in service to your professional field.

The program's teaching staff includes professionals from sector who contribute their work experience to this training 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 training programmed to train 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 professional will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

In order to acquire the competencies that the student needs to gain up-to-date knowledge in this sector, a program has been designed to deepen understanding of the key aspects of Railroad Systems. The knowledge gained in throughout the course will help the professional from a global point of view, with comprehensive training to help them achieve the proposed objectives. You will develop your skills in pursuit of reaching an eminently technological objective, gaining up-to-date knowledge of current trends in railroad systems.

Implement new strategies to manage the needs of the technological modernization of the Railroad System, fulfilling a series of objectives that will boost your professional career"

General objectives

- Gain in-depth knowledge of the different technical concepts of the railroad in its different fields
- Know the technological advances that the railroad sector is experiencing mainly due to the new digital revolution, but without forgetting the traditional approaches on which this mode of transport is based
- Understand the changes in the industry that have triggered the demand for new technical requirements
- Implement strategies based on the technological changes that have arisen in the sector
- Gain up-to-date knowledge in all aspects and trends of railroads

With a methodology based on practical cases, it meets the objectives that will help you grow in a highly demanded sector at a global level"

Specific objectives

Module 1. The Railroad and Its Engineering in the Current Context

- Analyze the position of the railroad with respect to other modes of transportation, identifying its main advantages and areas for improvement
- Gain in-depth knowledge of the current structures and organizations on which the railroad sector is based (regulators, railroad managers, industry, institutions, groups, etc.)
- Discuss in detail the main technological trends that the sector is currently experiencing
- Gain in-depth knowledge of the characteristics of the different railroad operating systems, the main technical areas in the infrastructure and rolling stock
- Establish the technical interactions between infrastructure and rolling stock, as well as the existing technical criteria and conditions for the design of Railroad Systems
- Explain different worldwide references in terms of railroad networks, infrastructures and technical projects with high impact on the sector

Module 2. Electric Traction Energy

- Make an exhaustive analysis of the main technical aspects of electric traction energy in railroads, highlighting the most important milestones and their current situation
- Specify the technical characteristics of the installations associated with the electric traction energy according to the different Railroad Systems
- Gain a deeper understanding of the specific aspects related to the electric braking systems used on trains and their strategic importance for the railroad infrastructure
- Establish the technical characteristics of the different components that make up the railroad electrical system, including a detailed analysis of it
- Address the particularities of electrification in direct current and single-phase alternating current, emphasizing their operational advantages and disadvantages
- Analyze the characteristics that the engineering project associated with the traction electric power installations must have
- Direct the student in the practical application of the content presented

Module 3. Control, Command and Signaling (CCS)

- Explain in a clear and structured way the main technical aspects of the installations associated with railroad control, command and signaling
- Specify the technical characteristics of the different components that make up the CCS system
- Provide an in-depth breakdown of the specific characteristics of ERTMS and CBTC signaling systems, as the newest standardized systems in the current context
- Specify in detail the technical characteristics of the CCS installations according to the different Railroad Systems
- Analyze the characteristics that the engineering project associated with CCS installations must have
- Direct the student in the practical application of the content presented

Module 4. Telecommunications

- Identify the main technical aspects of the railroad telecommunications in the current moment
- Specify the technical characteristics of the different components that make up fixed railroad telecommunications
- Gain in-depth knowledge of the technical characteristics of the different components that make up the rail mobile telecommunications, including future migration to the FRMCS standard
- Reflect on how telecommunications on the railroad is currently focused on a commercial business where third parties use the railroad's own infrastructure
- Analyze the characteristics that the engineering project associated with telecommunication installations must have
- Direct the student in the practical application of the content presented

Module 5. Civil Infrastructure

- Gain deeper understanding of the interaction of the vehicle with the civil infrastructure, analyzing in detail the dynamic phenomena that occur, in order to determine the design parameters of the platform and the rest of the components
- Specify the technical characteristics of the different components that make up the infrastructure subsystem, such as platform, tunnels, bridges and viaducts
- Specify the characteristics of the road as the main component of the civil infrastructure Taking into account its traditional typology as a ballastless track, analyzing the different elements involved
- Establish the characteristics of the track devices, highlighting the turnouts, switches and crossings, as well as other auxiliary elements associated with the operation of the track
- Address the technical characteristics of the civil infrastructure according to the different Railroad Systems
- Integrate the concept of infrastructure resilience to external events, analyzing its current importance in the strategy of railroad infrastructure management companies
- Direct the student in the practical application of the content presented

Module 6. Rolling Stock

- Perform an in-depth study of the main technical aspects of rail vehicles
- Explain in a clear and structured way the technical characteristics of the different components that make up the railroad rolling stock
- Specify the technical characteristics of railroad dynamics from a rolling stock point of view
- Analyze the aspects governing the maintenance of railroad vehicles
- Direct the student in the practical application of the content presented

Module 7. Risks and Safety

- Make the student reflect on the importance that this aspect has nowadays in railroad engineering and operation
- Master the various regulations governing the application of this type of process on the different railroad systems and subsystems undergoing a change that may have safety implications
- Specify the different agents involved in the risk and safety management process
- Gain in-depth knowledge in the different steps to be followed to apply the process on the design of a system or in the case of a modification when it is already in service
- Apply the concepts learned in a practical way in real cases

Module 8. Operation

- Establish the main technical aspects of rail operation activities at the present time
- Specify the main factors affecting rail traffic regulation, including the corresponding capacity analyses
- Analyze the particularities of passenger and freight rail transport
- Address the economic criteria currently governing the management of railroad companies, both in terms of infrastructure management companies and railroad transport companies
- Make the student reflect on the importance of energy consumption in the railroad sector and how energy efficiency measures need to be incorporated into the business strategy, while analyzing each of these measures
- Specify how the different operational incidents in the service should be managed through plans, resources and decision centers
- Analyze the scope of safety and civil protection in the railroad sector, specifying the different plans, resources and decision centers

Module 9. Research, Development and Innovation (R&D&I)

- Make the student reflect on the importance of developing a business strategy based on research, development and innovation in railroad technology, identifying the new technological challenges posed
- Analyze the current situation with respect to research, development and innovation programs, as well as the different policies and strategies to promote and finance them
- We will place special emphasis on the different phases and stages of the research, development and innovation process, including the management of the final results obtained
- Specify, for each technical area analyzed, the particularities in terms of research, development and innovation, highlighting the main lines of work, associated initiatives and existing working groups
- Address the most disruptive Railroad Systems, i.e., those that do not use traditional techniques for their operation, such as magnetic levitation systems and those based on the new *Hyperloop* concept

Module 10. The Digital Revolution in Railroads

- Reflect on the technological evolution of the railroad, including the new digital revolution it is currently undergoing
- Analyze the different digital technologies applicable to the railroad sector, specifically detailing the most strategic ones
- Master the application of new digital technologies in different areas of the railroad, identifying the associated improvements: traction energy, passenger stations, railroad logistics, maintenance and traffic management
- Reflect on the importance of cybersecurity in the railroad sector
- Analyze digitization programs and strategies in different world railroads

03

Skills

This Professional Master's Degree complies with the designed structure so that the professional is able to identify and solve problems related to the Railroad System, following a unique methodology and with the support of the experts who have developed the content of the course. TECH guarantees students quality content that meets their expectations, giving them the opportunity to excel in their field. Additionally, the student will be able to perform the various functions related to this Professional Master's Degree, along with the most innovative proposals in this field of action, thus guiding them towards excellence. A series of topics demanded by industry professionals and today's world.

With a specific criterion of practical training, this program will allow you to convert your learning into real professional skills, almost immediately"

General skills

- Master the different technical concepts that have been addressed in the railroad field
- Apply the knowledge acquired in technological advances and improve their problem-solving skills in current and global environments within broader industry contexts
- Know how to integrate knowledge and gain an in-depth view of the different traditional and modern approaches to management in a railroad system
- Understand the changes in the industry that have triggered the demand for new technical requirements
- Be capable of implementing new strategies based on the technological advances of the sector

Boost your professional career by fulfilling the competencies of a Professional Master's Degree designed by excellent experts in the Railroad System"

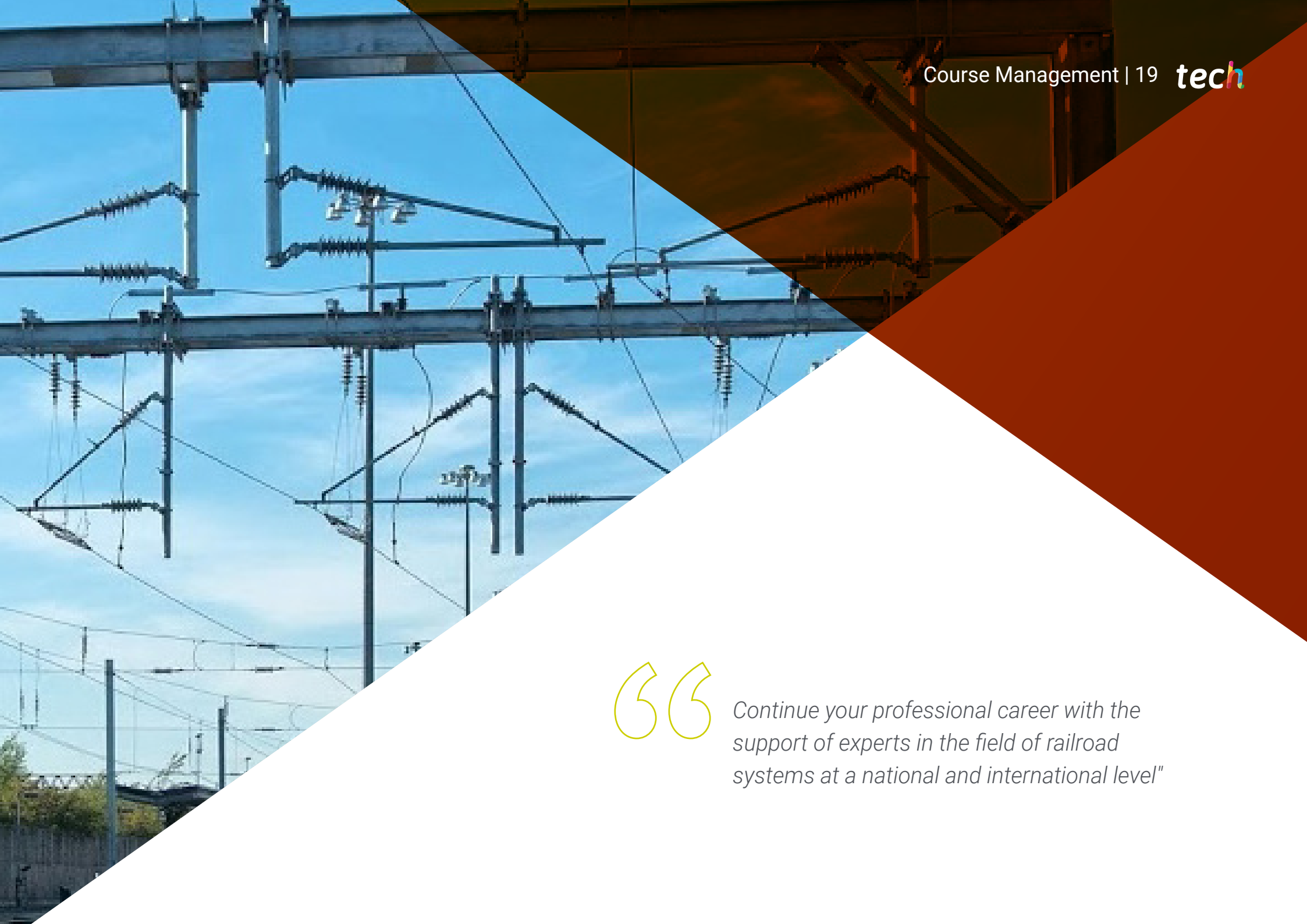
Specific skills

- Be able to analyze the position of the railroad with respect to the rest of the modes of transport, deepening understanding of the current structures and transport organizations that are involved in the sector
- Develop an exhaustive analysis of the main technical aspects of electric power and specify the technical characteristics of traction electrical installations
- Gain knowledge on the particularities of direct and alternating current electrification, emphasizing their operational advantages and disadvantages
- Develop the necessary communication skills to explain in a clear and structured way the main technical aspects of the installations associated with railroad control, command and signaling
- Analyze in detail the characteristics that the engineering project associated with the CCS installations must have
- Master the identification of the main technical aspects of railroad communications in today's world
- Be able to delve into the technical characteristics of the various components that make up rail mobile components of railroad mobile telecommunications, including future migration to the FRMCS standard
- Reflect on how telecommunications in railroads is currently focused on a commercial business in which third parties use the railroad's own infrastructure
- Analyze the interaction of the vehicle with the civil infrastructure, taking into account the dynamic phenomena that occur, in order to determine the design parameters of the platform and the rest of the components
- Analyze in a clear and structured way the technical characteristics of the different components that make up the railroad rolling stock
- Analyze the economic criteria currently governing the management of railroad companies, both in terms of infrastructure management companies and railroad transport companies
- Understand the importance of energy consumption in the railroad sector and how the various measures adopted are necessary to improve the business strategy
- Analyze the current situation with respect to research, development and innovation programs, as well as the different policies and strategies to promote and finance them
- Know and specify the different phases and stages of the research, development and innovation process, including the management of the final results obtained
- Reflect on the technological evolution of the railroad, including the new digital revolution it is currently undergoing
- Master the application of new digital technologies in different areas of railroad systems, identifying the associated improvements

04

Course Management

In accordance with its maxim of offering an elite education for all, TECH counts on renowned professionals in order for the student to acquire solid knowledge in the specialty of Railroad Systems. For this reason, this Professional Master's Degree has a highly qualified team with extensive experience in the sector, which will offer the best possible resources for students in the development of their skills during the course. In this way, students have the guarantees they need to specialise at an international level in a booming sector that will catapult them to professional success.



Continue your professional career with the support of experts in the field of railroad systems at a national and international level"

Management

Mr. Martínez Acevedo, José Conrado

- Experience in the public railroad sector, occupying various positions in construction, operation and technological development of the Spanish high-speed and conventional railroad networks
- Head of Research, Development and Innovation projects at Administrador de Infraestructuras Ferroviarias (Adif), a state-owned company attached to the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA)
- Coordinator of more than 90 technology projects and initiatives in all areas of the railroad
- Industrial Engineer and Master's Degree in Specialization in Railroad Technologies and in Construction and Maintenance of Railroad Infrastructures
- Professor in the Master's Degree courses on railroads at the Pontificia de Comillas University (ICAI) and the University of Cantabria
- Member of the IEEE (Institute of Electrical and Electronics Engineers) and member of the Editorial Committee of Electrification Magazine at the same institution (magazine specialized in transportation electrification)
- Member of the AENOR group CTN 166 "Research, Technological Development and Innovation Activities (R&D&I)"
- Adif representative in the MITMA R&D&I and EGNSS (Galileo) working groups
- Speaker at more than 40 congresses and seminars

Professors

Dr. Martínez Lledó, Mariano

- Experience in the public railroad sector, occupying various positions in construction, operation and technological development of the Spanish high-speed and conventional railroad networks
- Head of Research, Development and Innovation projects at Administrador de Infraestructuras Ferroviarias (Adif), a state-owned company attached to the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA)
- PhD in Spanish Philology, specialized in applied linguistics (Doctoral thesis: The specialized language of railroads) and a Master's Degree Degree in International Strategic Management. Several specialization courses in technological surveillance and competitive intelligence
- Internal trainer in the area of railroad R&D&i (Integral Training Program for Technicians)
- International trainer in the area of operation, traffic control and railroad innovation (Morocco, Mexico, France)
- Professor in the Master's Degree in International Strategic Management offered by Adif, Indra and the Polytechnic University of Madrid
- Speaker at several congresses and seminars with papers on terminology and linguistics applied to railroads

Mr. Fernández Sánchez, Angel

- Control, Command and Signaling Technician at Administrador de Infraestructuras Ferroviarias (Adif), a state-owned company attached to the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA)
- Director of Control, Command and Signaling Projects, including: suppression of telephone blockades, installation of automatic banalized blockades, standardization and modernization of blockades and modernization of interlocks and interlockings, and effects on the CCS subsystem derived from infrastructure projects
- Responsible for the analysis and study of blocking systems based on alternative technologies in Adif's Conventional Network. Case study, Cáceres-Valencia de Alcántara
- Industrial Engineer and Master's Degree in Engineering and Land Transportation Management

Mr. García Ruiz, Mariano

- Head of Telecommunications in the General Directorate of Conservation and Maintenance at Administrador de Infraestructuras Ferroviarias (Adif), a state-owned company attached to the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA)
- Experience in the railroad sector, having held various positions of responsibility in several projects and construction works of the Spanish high-speed rail network: GSM-R Mobile Telecommunications on the Madrid-Lleida, Córdoba-Málaga and Madrid-Valencia-Albacete-Alicante High Speed Lines; GSM-R Fixed and Mobile Telecommunications on the Madrid-Toledo and Madrid-Segovia-Valladolid High Speed Lines
- Responsible for Maintenance and Operation of the Fixed Telecommunications, GSM-R Mobile, Energy Remote Control and Public Mobile Telephone Operator facilities of the Spanish high-speed network
- Telecommunications Engineer and Master's Degree in Construction and Maintenance in Railroad Infrastructures

Mr. Morales Arquero, Ramón

- MBA in Business Administration from the National Distance Education University
- Industrial Engineer from the Polytechnic University of Madrid
- Expert in Railway Technology, National Distance Education University

Mr. de Bustos Ferrero, David

- Experience in the private railroad sector His professional career has been spent with leading rail manufacturers and technologists, as well as safety assessment and certification companies
- Focused on the execution and management of critical safety projects, mainly rolling stock and signaling systems, during his last phase he has focused on the development of new propulsion technologies such as LNG and H2 (Liquefied Natural Gas and Hydrogen)
- Industrial Engineer and a Master's MBA General Management Training Program GMTP

Complete, up-to-date and highly efficient training. This Professional Master's Degree is the opportunity to take a leap in your professional skills and compete among the best in the sector"

05

Structure and Content

The syllabus has been designed according to the requirements of the Railroad System, complying with the requirements proposed by the teaching team of the Professional Master's Degree. Thus, a syllabus has been established whose modules offer a broad perspective of the railroad and its engineering in the current context, dealing with the main technological proposals of the sector in detail. All this, from a global perspective for the sake of its application at an international level, incorporating all the fields of work involved in professional development in this type of work environment. From module 1, students will see their knowledge expanding, which will enable them to develop professionally, knowing that they can count on the support of a team of experts.

Fulfill a curriculum that will propel your career to an international level in a field that is growing every day"

Module 1. The Railroad and Its Engineering in the Current Context

1.1. The Railroad in Transport
- 1.1.1. Its Position and Competency With Other Modes of Transport
- 1.1.2. Sectorial Analysis
- 1.1.3. Financing
- 1.1.4. Specialty Railroad Language and Terminology

1.2. Organization
- 1.2.1. Regulatory Organizations and Supervisors
- 1.2.2. Industry
- 1.2.3. Administrators of Infrastructure
- 1.2.4. Railroad Transport Companies
- 1.2.5. Institutions and Associations

1.3. New Trends and Strategies
- 1.3.1. Interoperability of Different Technological Systems
- 1.3.2. Towards Digitalization: Railroad 4.0
- 1.3.3. A New Service Model for Society

1.4. Description of Railroad Services
- 1.4.1. Urban Services
- 1.4.2. Mid- and Long-Distance Services
- 1.4.3. High-Speed Services
- 1.4.4. Freight Services

1.5. Classification and Main Infrastructure Systems
- 1.5.1. Electric Traction Energy
- 1.5.2. Control, Command and Signaling
- 1.5.3. Telecommunications
- 1.5.4. Civil Infrastructure

1.6. Classification and Main Rolling Stock Systems
- 1.6.1. Main Types
- 1.6.2. Traction
- 1.6.3. Braking
- 1.6.4. Control, Command and Signaling
- 1.6.5. Rolling

1.7. Interaction Between Vehicle and Infrastructure
- 1.7.1. Different Interactions
- 1.7.2. Technical Compatibility of the Vehicle With the Infrastructure
- 1.7.3. The Problem of the Width of the Track and Its Main Solutions

1.8. Criteris and Technical Conditions of the Railroad
- 1.8.1. Maximum Speed
- 1.8.2. Typology of the Rolling Stock
- 1.8.3. The Capacity of the Transport
- 1.8.4. Interrelation Between the Different Subsystems

1.9. Cases of Global References
- 1.9.1. Rail Networks and Services
- 1.9.2. Infrastructures in Construction and in Service
- 1.9.3. Technological Projects

Module 2. Electric Traction Energy

2.1. Electric Energy and Railroads
- 2.1.1. The Power Semiconductor
- 2.1.2. Electrical Voltage and Current on the Railroad
- 2.1.3. Overall Assessment of Railroad Electrification in the World

2.2. Relationship Between Rail Services and Electrification
- 2.2.1. Urban Services
- 2.2.2. Interurban Services
- 2.2.3. High-Speed Services

2.3. Electrification and Braking of the Train
- 2.3.1. Electric Brake Performance at the Traction Level
- 2.3.2. Electric Brake Performance at the Infrastructure Level
- 2.3.3. General Influence of the Electric Regenerative Brake

2.4. Electric Railroad System
- 2.4.1. Constituent Elements
- 2.4.2. Electrical Environment
- 2.4.3. TPS (Traction Power System)

2.5. TPS (Traction Power System)
- 2.5.1. Components

2.5.2. Types of TPS Depending on the Electrical Operating Frequency
2.5.3. SCADA
2.6. Traction Power Substation (TPSS)
2.6.1. Function
2.6.2. Types
2.6.3. Architecture and Components
2.6.4. Electrical Connections
2.7. Transmission Line
2.7.1. Function
2.7.2. Types
2.7.3. Architecture and Components
2.7.4. The Uptake of Electrical Energy by the Train
2.7.5. The Overhead Elastic Transmission Line (Catenary)
2.7.6. The Overhead Rigid Transmission Line
2.8. The Direct Current Railroad Electric System
2.8.1. Specific Particularities
2.8.2. Technical Parameters
2.8.3. Use
2.9. The Single-Phase Alternating Current Railroad Electric System
2.9.1. Specific Particularities
2.9.2. Technical Parameters
2.9.3. Disturbances and Main Solutions
2.9.4. Use
2.10. Engineering Project
2.10.1. Index of the Project
2.10.2. Planning, Executing and Putting It Into Practice

Module 3. Control, Command and Signaling (CCS)

3.1. CCS and the Railroad
3.1.1. Evolution
3.1.2. Railroad Safety
3.1.3. The Importance of RAMS
3.1.4. Railroad Interoperability
3.1.5. Components of the CCS Subsystem
3.2. The Interlocking
3.2.1. Evolution
3.2.2. Principles of Use
3.2.3. Types
3.2.4. Other Elements
3.2.5. Program of Use
3.2.6. Future Developments
3.3. The Blockade
3.3.1. Evolution
3.3.2. Types
3.3.3. The Capacity of the Transport and the Blockade
3.3.4. Design Criteria
3.3.5. Communication of the Blockade
3.3.6. Specific Applications
3.4. Detection of the Train
3.4.1. Track Circuits
3.4.2. Axle Counters
3.4.3. Design Criteria
3.4.4. Other Technology
3.5. Elements of the Field
3.5.1. Track Apparatus
3.5.2. Signals
3.5.3. Level Crossing Protection Systems
3.5.4. Detectors to Support the Operation

3.6. Train Protection Systems
- 3.6.1. Evolution
- 3.6.2. Types
- 3.6.3. Onboard Systems
- 3.6.4. ATP
- 3.6.5. ATO
- 3.6.6. Design Criteria
- 3.6.7. Future Developments

3.7. The ERTMS System
- 3.7.1. Evolution
- 3.7.2. Regulations
- 3.7.3. Architecture and Components
- 3.7.4. Levels
- 3.7.5. Modes of Operation
- 3.7.6. Design Criteria

3.8. The CBTC System
- 3.8.1. Evolution
- 3.8.2. Regulations
- 3.8.3. Architecture and Components
- 3.8.4. Modes of Operation
- 3.8.5. Design Criteria

3.9. Relationship Between Rail Services and CCS
- 3.9.1. Urban Services
- 3.9.2. Interurban Services
- 3.9.3. High-Speed Services

3.10. Engineering Project
- 3.10.1. Index of the Project
- 3.10.2. Planning, Executing and Putting It Into Practice

Module 4. Telecommunications

4.1. Railroad Telecommunications
- 4.1.1. Safety and Availability of Telecommunication Systems
- 4.1.2. Classification of the Railroad Telecommunications Systems
- 4.1.3. Convergence to IP Networks

4.2. Transmission of medium
- 4.2.1. Copper Cables
- 4.2.2. Radio Links
- 4.2.3. Optical Fiber

4.3. Transport and Access Networks
- 4.3.1. Digital Transmission
- 4.3.2. PDH Systems
- 4.3.3. SDH Systems
- 4.3.4. Evolution of the Systems

4.4. Voice Communication Systems
- 4.4.1. Traditional Telephone Operation
- 4.4.2. Switched Telephony
- 4.4.3. Voice Over IP
- 4.4.4. Voice Network Architecture
- 4.4.5. Numbered Plan

4.5. Networks of IP Data
- 4.5.1. Fundamentals. OSI Model
- 4.5.2. Packet-Switched Networks
- 4.5.3. Local Ethernet Networks
- 4.5.4. IP/MPLS Networks

4.6. Mobile Communications
- 4.6.1. Fundamentals of Mobile Communications
- 4.6.2. Train-Ground Analog
- 4.6.3. Wifi Systems
- 4.6.4. TETRA Systems

4.7. GSM-R Mobile Communications
- 4.7.1. Specific GSM-R Features vs. GSM (2G)
- 4.7.2. Architecture
- 4.7.3. Call Management
- 4.7.4. High Availability Network Design
- 4.7.5. ERTMS L2: GSM-R + ETCS L2
- 4.7.6. GSM-R Evolution Towards 5G (FRMCS)

4.8. Operation and Supervision of Telecommunication Networks
- 4.8.1. ISO TMNS Model
- 4.8.2. Standard Protocols and Proprietary Managers
- 4.8.3. Centralized Management Systems
- 4.8.4. Provision of Services

4.9. Telecommunications Services and Clients in the Railroad Environment
- 4.9.1. Railroad Services and Clients
- 4.9.2. Fixed Telecommunications
- 4.9.3. Mobile Telecommunications
- 4.9.4. Engineering Project
- 4.9.5. Index of the Project
- 4.9.6. Planning, Executing and Putting It Into Practice

Module 5. Civil Infrastructure

5.1. Approximation of the Characteristics of the Railroad Civil Infrastructure
- 5.1.1. Interaction of the Infrastructure With a Vehicle
- 5.1.2. General Dynamic of the Railroad
- 5.1.3. Parameters of the Design of the Infrastructure

5.2. Railroad Platform
- 5.2.1. Constitution of the Platform
- 5.2.2. Typology
- 5.2.3. Railroad Bedding Layers

5.3. Bridges
- 5.3.1. Typology
- 5.3.2. Characteristics and Techniques
- 5.3.3. Interaction With the Vehicle

5.4. Tunnels
- 5.4.1. Typology
- 5.4.2. Characteristics and Techniques
- 5.4.3. Interaction With the Vehicle
- 5.4.4. Particularities in the Aerodynamic Field
- 5.4.5. Particularities in the Field of the Civil Protection and Safety

5.5. The Ballasted Track
- 5.5.1. Typology
- 5.5.2. The Running Rail
- 5.5.3. Other Components
- 5.5.4. The Flying-Ballast Phenomenon

5.6. The Ballastless Track
- 5.6.1. Typology
- 5.6.2. Components
- 5.6.3. Transition of Ballastless Track to a Ballasted Track

5.7. Track Apparatus
- 5.7.1. Typology
- 5.7.2. Diversions and Crossings
- 5.7.3. Expansion Equipment

5.8. Other Auxiliary Elements
- 5.8.1. Stops and Braking Zones
- 5.8.2. Multifunctional Barriers
- 5.8.3. Width Changers
- 5.8.4. Scales

5.9. Relationship Between Rail Services and Civil Infrastructure
- 5.9.1. Urban Services
- 5.9.2. Interurban Services
- 5.9.3. High-Speed Services

5.10. Resilience of Infrastructure Against Extreme Events
- 5.10.1. Meteorological Events
- 5.10.2. Sliding
- 5.10.3. Landslides

Module 6. Rolling Stock

6.1. Railroad Vehicles
- 6.1.1. Evolution
- 6.1.2. Classification
- 6.1.3. Functional Parts

6.2. Wheel-Track Interaction
- 6.2.1. Mounted Wheels and Axles
- 6.2.2. Bogies and Stands
- 6.2.3. Wheel Guidance
- 6.2.4. Tilting
- 6.2.5. Variable Width Systems

6.3. Dynamic Railroad
- 6.3.1. Movement Equations
- 6.3.2. Traction Curves
- 6.3.3. Adherence
- 6.3.4. Suspension
- 6.3.5. Aerodynamics in High Speed Trains

6.4. Body, Cabin, Doors, WC and Interior Design
- 6.4.1. Body
- 6.4.2. Driver's Cab
- 6.4.3. Doors, WC and Interior Design

6.5. HV and LV electrical circuits
- 6.5.1. Pantograph
- 6.5.2. HV Switchgear and Transformer
- 6.5.3. HV Circuits Architecture
- 6.5.4. Auxiliary Services Converter and Batteries
- 6.5.5. LV Circuits Architecture

6.6. Electrical Traction
- 6.6.1. Traction Chain
- 6.6.2. Electric Traction Motors
- 6.6.3. Static Converters
- 6.6.4. HV Filter

6.7. Diesel Traction, Diesel-Electric Traction and Hybrid Traction
- 6.7.1. Diesel Traction
- 6.7.2. Diesel-Electric Traction
- 6.7.3. Hybrid Traction

6.8. Braking System
- 6.8.1. Automatic Braking Service
- 6.8.2. Electric Brake
- 6.8.3. Parking Brake
- 6.8.4. Auxiliary Brake

6.9. Signaling Systems, Communications Systems and Command and Diagnostics Systems
- 6.9.1. ATP- ERTMS/ ETCS System
- 6.9.2. Train-Ground Communication Systems - GSM-R
- 6.9.3. Command And Diagnosis Systems - TCN Network

6.10. Maintenance of Railroad Vehicles
- 6.10.1. Installations for the Maintenance of Railroad Vehicles
- 6.10.2. Maintenance Interventions
- 6.10.3. Entities in Charge of Maintenance

Module 7. Risks and Safety

7.1. Life Cycle of Railroad Projects
- 7.1.1. Phases of the Life Cycle
- 7.1.2. Safety Activities
- 7.1.3. RAM Operations - Reliability, Availability and Maintainability

7.2. Safety Management - RAMS
- 7.2.1. Safety Management
- 7.2.2. Functional Safety
- 7.2.3. Quality Management

7.3. Threat Management
- 7.3.1. Threat Identification and Analysis
- 7.3.2. Classification of Threat and Level of Risk
- 7.3.3. Risk Acceptance Criteria

7.4. Functional Safety
- 7.4.1. Safety Functions
- 7.4.2. Security Requirements
- 7.4.3. Security Integrity Level - SIL

7.5. RAM Indicators
- 7.5.1. Reliability
- 7.5.2. Availability
- 7.5.3. Maintainability

7.6. Process of Verification and Validation
- 7.6.1. Methodology V&V
- 7.6.2. Design Verification
- 7.6.3. Inspection and Proof

7.7. Safety Case
- 7.7.1. Structure of the Safety Case
- 7.7.2. Evidence of Safety
- 7.7.3. Related Safety Case and Conditions of Application

7.8. RAMS Management - Operation and Maintenance
- 7.8.1. RAMS Operational Indicators
- 7.8.2. Modifications Management
- 7.8.3. Modification File

7.9. Process of Certification and Independent Assessment
- 7.9.1. Independent Safety Assessment - ISA & AsBO
- 7.9.2. Conformity Assessment - NoBO & DeBO
- 7.9.3. Authorization to Put Into Practice

Module 8. Operation

8.1. Railroad Operation
- 8.1.1. Functions Considered in the Field of Railroad Operation
- 8.1.2. Demand for Passenger Transport
- 8.1.3. Demand for Freight Transport

8.2. Traffic Regulation
- 8.2.1. Principles of Railroad Traffic Regulation
- 8.2.2. Circulation Regulations
- 8.2.3. Gear Calculation
- 8.2.4. The Traffic Control Center

8.3. Capacity
- 8.3.1. Analysis of Line Capacity
- 8.3.2. Capacity Assigning
- 8.3.3. The Network Statement

8.4. Passenger Services
- 8.4.1. Planning Services
- 8.4.2. Identification of Restrictions and Limitations in the Operation
- 8.4.3. Passenger Stations

8.5. Freight Services
- 8.5.1. Planning Services
- 8.5.2. Identification of Restrictions and Limitations in the Operation
- 8.5.3. Freight Terminal
- 8.5.4. Particularity of Freight Operations in High Speed Lines

8.6. Economy of Railroad Systems
- 8.6.1. The Economy of Railroads in the Current Context
- 8.6.2. Economy of Infrastructure Management
- 8.6.3. Economy of Services Operation

8.7. Railroad Operations From the Point of View of Energy Consumption
- 8.7.1. Energy Consumption and Emissions Associated With Railroad Travel
- 8.7.2. Energy Management in Railroad Companies
- 8.7.3. Energy Consumption in High Speed Lines

8.8. Energetic Efficiency
- 8.8.1. Strategies to Reduce the Consumption of Electric Traction Energy
- 8.8.2. Efficient Infrastructure Design
- 8.8.3. Making the Most of the Electrical Energy Regenerated in the Traction
- 8.8.4. Efficient Driving

8.9. Incident Management
- 8.9.1. Contingency Plan
- 8.9.2. The Incident Control Center
- 8.9.3. Specific Analysis of Meteorological Phemomena

8.10. Civil Protection and Safety
- 8.10.1. Self-Protection Plans
- 8.10.2. Specific Installations in this Field
- 8.10.3. The Safety Control Center

Module 9. Research, Development and Innovation (R&D&I)

9.1. Current Context of R&D&I in Railroad Systems
- 9.1.1. European Impulse
- 9.1.2. Shift2Rail and ERJU European Research Programs
- 9.1.3. Situation and Perspectives in Other Countries and Regions of the World

9.2. The Phases of the R&D&I Process
- 9.2.1. Innovation Models
- 9.2.2. The R&D&I Project
- 9.2.3. Technological Intelligence
- 9.2.4. The R&D&I Strategy
- 9.2.5. Trial Installations

9.3. Technological Challenges of the Railroad Systems
- 9.3.1. Traditional and Future Challenges
- 9.3.2. Railroad Interoperability in Terms of R&D&I
- 9.3.3. The Digital Revolution in Railroad Sector

9.4. R&D&I in the Field of Electric Traction Energy
- 9.4.1. Current and Predicted Lines of R&D&I
- 9.4.2. Technological Initiatives to Highlight
- 9.4.3. Main Research Groups in this Subject

9.5. R&D&I in the Field of CCS
- 9.5.1. Current and Predicted Lines of R&D&I
- 9.5.2. Technological Initiatives to Highlight
- 9.5.3. Main Reserach Groups in this Subject

9.6. R&D&I in the Field of Telecommunications
- 9.6.1. Current and Predicted Lines of R&D&I
- 9.6.2. Technological Initiatives to Highlight
- 9.6.3. Main Research Groups in this Subject

9.7. R&D&I in the Field of Infrastructure
- 9.7.1. Current and Predicted Lines of R&D&I
- 9.7.2. Technological Initiatives to Highlight
- 9.7.3. Main Research Groups in this Subject

9.8. R&D&I in the Field of Rolling Stock
- 9.8.1. Current and Predicted Lines of R&D&I
- 9.8.2. Technological Initiatives to Highlight
- 9.8.3. Main Research Groups in this Subject

9.9. Results of the R&D&I Process
- 9.9.1. Results Protection
- 9.9.2. Transfer of Technology
- 9.9.3. Implementation in the Service

9.10. New Railroad Systems
- 9.10.1. Situation and Outlook
- 9.10.2. Magnetic Levitation Technology
- 9.10.3. The New Concept of Hyperloop

Module 10. The New Digital Revolution in Railroads

10.1. The Fourth Railroad Revolution
- 10.1.1. Technological Evolution
- 10.1.2. Digital Technologies Applied to Railroads
- 10.1.3. Fields of Application in the Current Context

10.2. Key Technology Analysis
- 10.2.1. Big Data
- 10.2.2. Cloud Computing
- 10.2.3. Artificial Intelligence
- 10.2.4. IoT and New Sensorization
- 10.2.5. DAS

10.3. Application of Electric Railroad Network
- 10.3.1. Objective
- 10.3.2. Functionality
- 10.3.3. Implementation

10.4. Application in Maintenance
- 10.4.1. Objective
- 10.4.2. Functionality
- 10.4.3. Implementation

10.5. Application in Passenger Stations
- 10.5.1. Objective
- 10.5.2. Functionality
- 10.5.3. Implementation

10.6. Application in Railroad Logistics Management
- 10.6.1. Objective
- 10.6.2. Functionality
- 10.6.3. Implementation

10.7. Application in Railroad Traffic Management
- 10.7.1. Objective
- 10.7.2. Functionality
- 10.7.3. Implementation

10.8. Cybersecurity in the Railroad
- 10.8.1. Objective
- 10.8.2. Functionality
- 10.8.3. Implementation

10.9. User Experience
- 10.9.1. Objective
- 10.9.2. Functionality
- 10.9.3. Implementation

10.10. Digitalization Strategies in Various Railroads
- 10.10.1. German Railroads
- 10.10.2. French Railroads
- 10.10.3. Japanese Railroads
- 10.10.4. Other Railroads

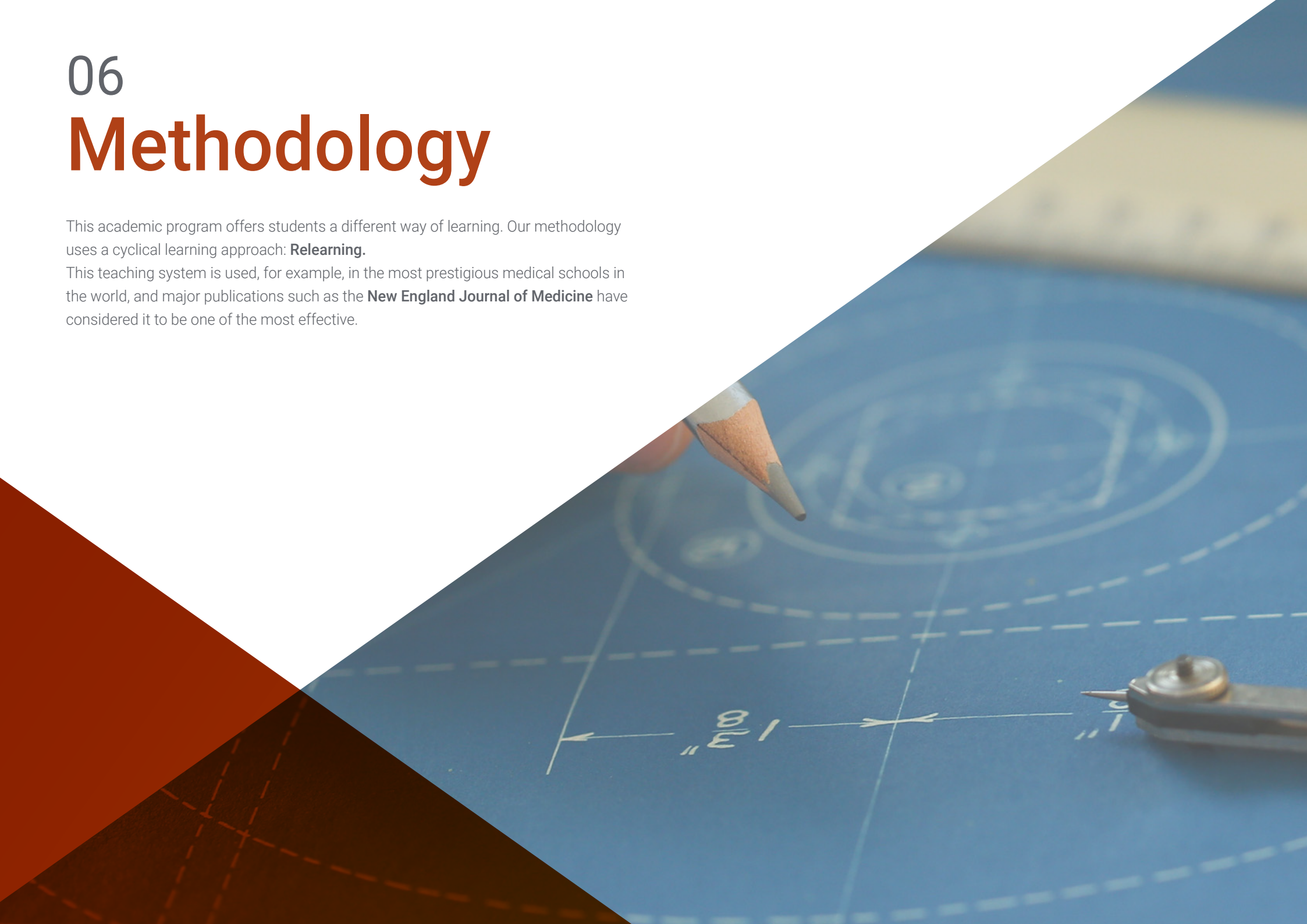
A program designed by experts with extensive experience will help you achieve your career goals in the Railroad Systems sector"

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

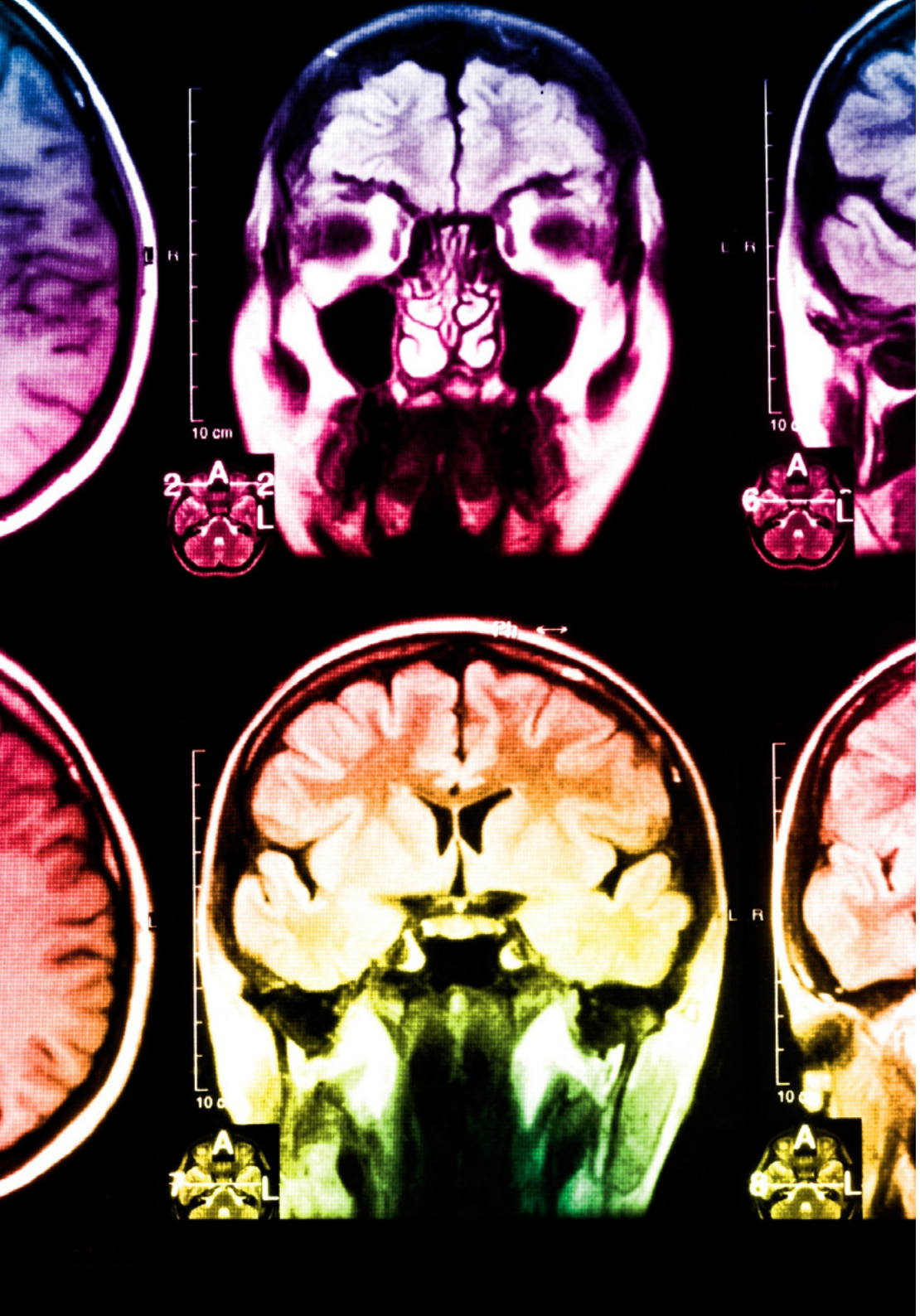
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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 relearn). 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 elearning, 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.

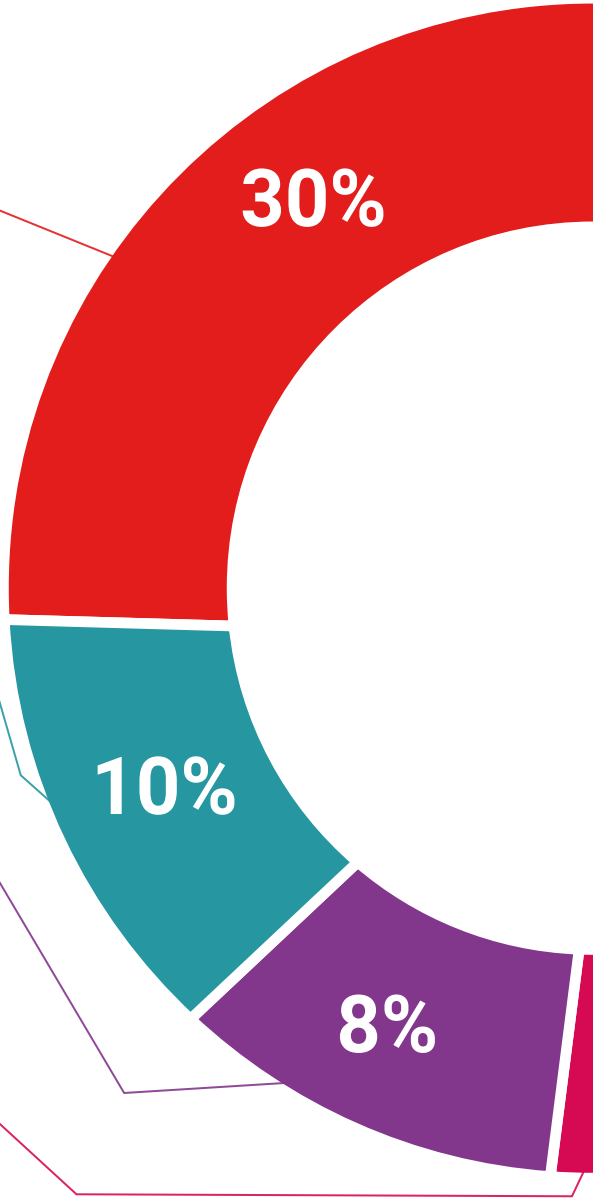
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

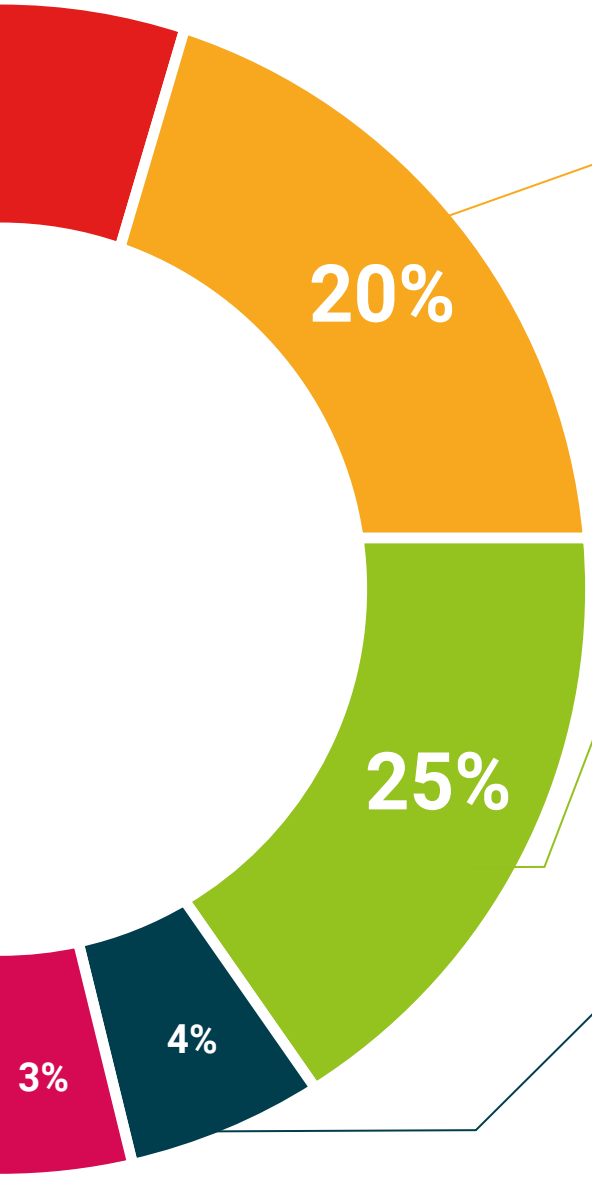
Practising Skills and Abilities

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 Railroad Systems guarantees you, in addition to the most rigorous and updated training, access to a Professional Master's Degree issued by TECH Global University.

Successfully complete this program and receive your university degree without travel or laborious paperwork”

This program will allow you to obtain your **Professional Master's Degree diploma in Railroad Systems** 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: **Professional Master's Degree in Railroad Systems**

Modality: **online**

Duration: **12 months**

Accreditation: **60 ECTS**


tech global university

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

Professional Master's Degree in Railroad Systems

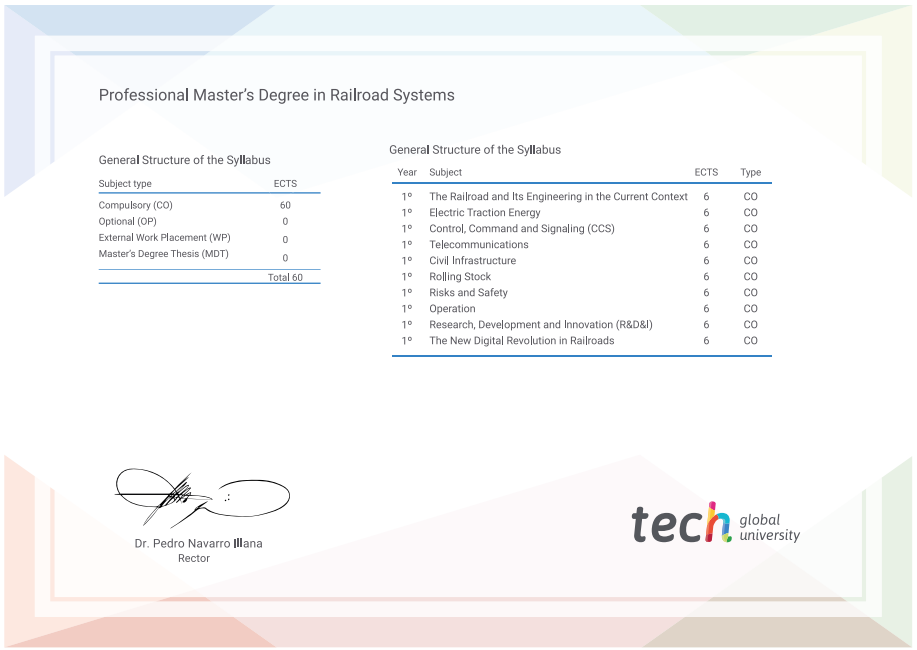
This is a program of 1,500 hours of duration equivalent to 60 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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

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 Railroad Systems

General Structure of the Syllabus

Subject type	ECTS
Compulsory (CO)	60
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
	Total 60

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	The Railroad and Its Engineering in the Current Context	6	CO
1º	Electric Traction Energy	6	CO
1º	Control, Command and Signaling (CCS)	6	CO
1º	Telecommunications	6	CO
1º	Civil Infrastructure	6	CO
1º	Rolling Stock	6	CO
1º	Risks and Safety	6	CO
1º	Operation	6	CO
1º	Research, Development and Innovation (R&D&I)	6	CO
1º	The New Digital Revolution in Railroads	6	CO

Dr. Pedro Navarro Illana
Rector

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*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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Professional Master's Degree
Railroad Systems

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Professional Master's Degree
Railroad Systems

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