HybridProfessional Master's Degree
Telecommunications Engineering

tech global university

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Hybrid Professional Master's Degree

Telecommunications Engineering

Modality: **Hybrid (Online + Internship)**
Duration: **12 months**
Certificate: **TECH Global University**
Credits: **60 + 4 ECTS**
Website:www.techtitute.com/us/informatica/hybrid-professional-masters-degree/hybrid-professional-masters-degree-telecommunications-engineering

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01

Introduction

Telecommunications Engineering plays a crucial role in today's society, marked by the rise of emerging technologies such as 5G, the Internet of Things (IoT) and Artificial Intelligence. In fact, the expansion of 5G networks and the preparation for the deployment of 6G are transforming communications, improving the speed and capacity of networks and enabling a more efficient integration of devices and systems. In this context, TECH has developed this comprehensive program, which combines the online format for the theory, based on the innovative learning methodology known as Relearning, with a practical stay in a renowned company.

Thanks to this Hybrid Professional Master's Degree, you will gain access to advanced and specialized knowledge in key areas such as networks, communication systems, cybersecurity and new technologies such as 5G and IoT."

Telecommunications Engineering is one of the most dynamic and fundamental fields in the digital era, driving the development of key technologies. In fact, this discipline plays a crucial role in the expansion of advanced communications infrastructures, essential for the digitization of industries such as health, transportation and education.

This is how this Hybrid Professional Master's Degree was created, which will offer professionals a comprehensive training that will cover from fundamental concepts to advanced applications in telecommunications. In this sense, they will acquire skills in the handling of basic electronic instruments, including the evaluation of electrical signals and the use of passive components and amplifiers. In this way, they will be able to design and implement circuits that can be applied in the construction of electronic and telecommunication systems.

Likewise, they will delve into analog and digital electronics, applying their knowledge to combinational and sequential digital circuits, differentiating between synchronous and asynchronous configurations. In addition, renewable energy sources and power electronics will be explored, expanding towards efficient and sustainable energy systems.

Finally, emphasis will be placed on computer networks and telecommunication systems. In this way, computer scientists will cover everything from LAN architecture and IP addressing operation to the design and management of wireless and 5G networks, applying their skills in programming and systems analysis to the configuration, security and optimization of networks.

In this way, TECH has implemented a comprehensive program, which will be divided into two distinct sections. First, the graduate will be able to study the theory completely online, only needing an electronic device with an Internet connection, with the support of the revolutionary Relearning learning methodology, consisting of the reiteration of key concepts for an optimal assimilation of the contents. Ultimately, the degree includes a 3-week practical internship in a prestigious company in the sector.

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

- Development of more than 100 case studies presented by IT professionals, experts in telecommunications, as well as university professors with extensive experience in engineering
- Its graphic, schematic and eminently practical contents, with which they are conceived, gather essential information on those technologies that are indispensable for professional practice
- All of this will be complemented by 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
- Furthermore, you will be able to carry out a internship in one of the best companies

This program will facilitate greater integration between software development and the underlying hardware, optimizing both system performance and design. What are you waiting for to enroll"

Bet on TECH! You will be able to handle basic electronic instruments and components, which are fundamental to understand the technologies that support the telecommunication infrastructure"

In this Professional Master's Degree proposal, of a professionalizing nature and blended learning modality, the program is aimed at updating IT professionals who develop their functions in telecommunications, and who require a high level of qualification. The contents are based on the latest scientific evidence, and oriented in a didactic way to integrate theoretical knowledge into IT practice, and the theoretical-practical elements will facilitate the updating of knowledge and allow for more effective decision making.

Thanks to its multimedia content elaborated with the latest educational technology, they will allow the education professional a situated and contextual learning, that is to say, a simulated environment that will provide an immersive learning programmed to specialize in real situations. This program is designed around Problem-Based Learning, whereby the physician must try to solve the different professional practice situations that arise during the course. For this purpose, students will be assisted by an innovative interactive video system created by renowned experts in the field of educational coaching with extensive experience.

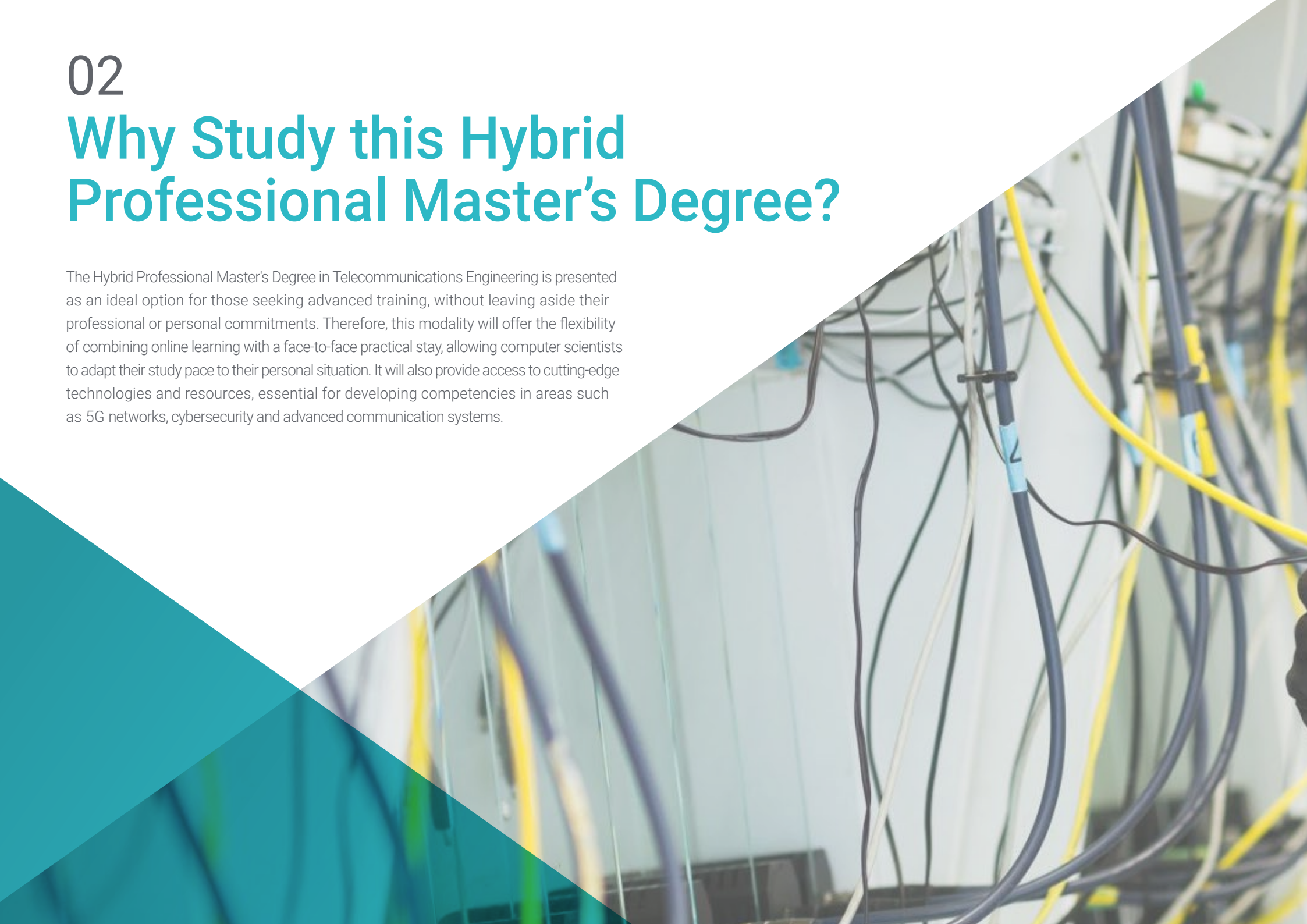
You will analyze advanced topics of digital and analog electronics, essential for the design and analysis of combinational and sequential circuits. With all TECH's quality guarantees.

You will be able to familiarize yourself with emerging technologies such as 5G, switching network design and distributed network interconnection, thanks to an extensive library of innovative multimedia resources.

02

Why Study this Hybrid Professional Master's Degree?

The Hybrid Professional Master's Degree in Telecommunications Engineering is presented as an ideal option for those seeking advanced training, without leaving aside their professional or personal commitments. Therefore, this modality will offer the flexibility of combining online learning with a face-to-face practical stay, allowing computer scientists to adapt their study pace to their personal situation. It will also provide access to cutting-edge technologies and resources, essential for developing competencies in areas such as 5G networks, cybersecurity and advanced communication systems.



Combining theory and practice in an adaptable format will expand professional growth and job opportunities, all from the world's best digital university, according to Forbes: TECH"

1. Updating from the latest technology available

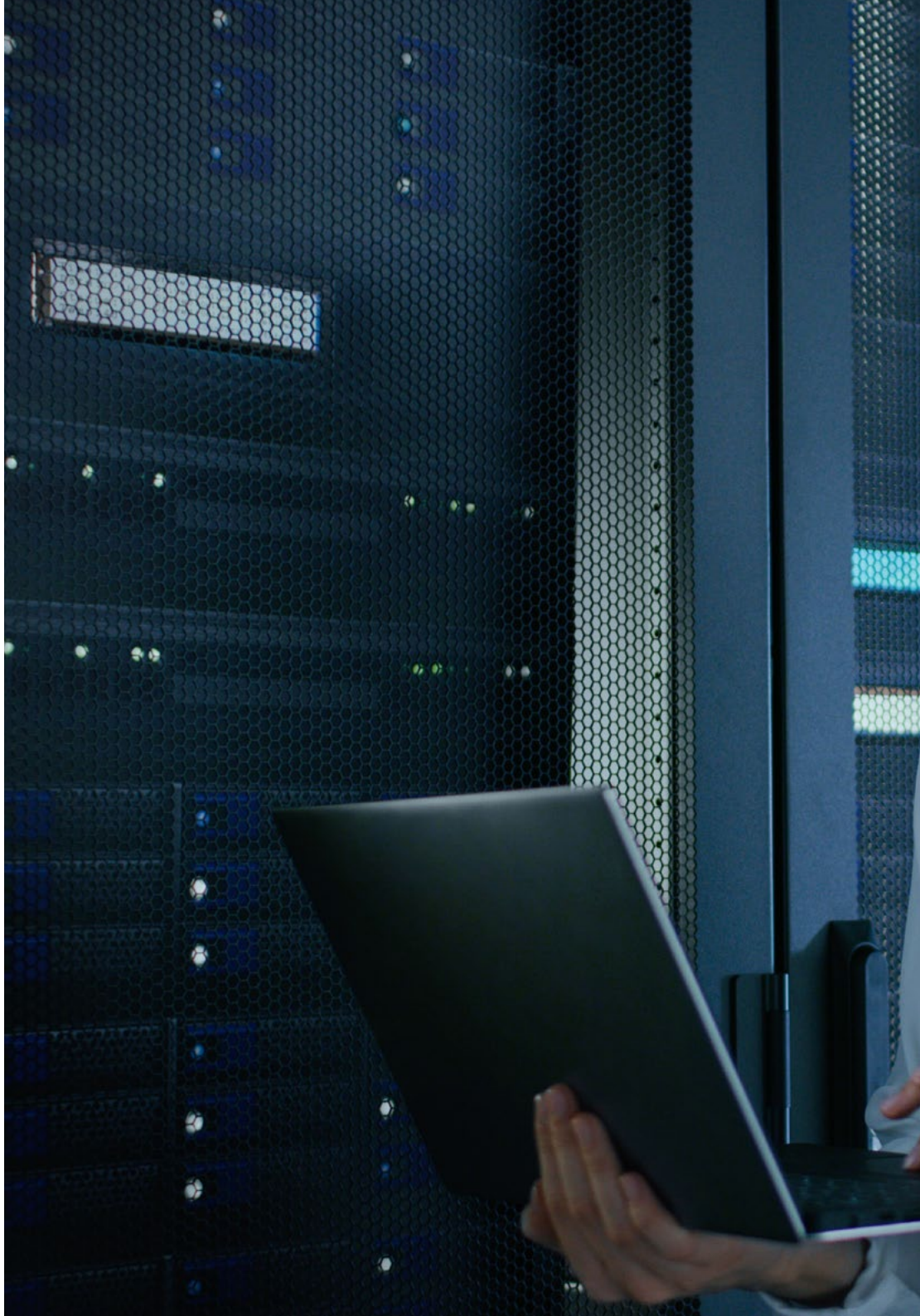
The deployment of 5G networks is one of the most relevant developments, as it offers ultra-fast transmission speeds and minimal latency, facilitating the integration of large-scale IoT devices, industrial automation and real-time artificial intelligence applications. In addition, the use of Software Defined Networking (SDN) and Network Functions Virtualization (NFV) allow telecommunications infrastructures to be managed and optimized in a more flexible and efficient way, facilitating the implementation of cloud-based services.

2. Gaining in-depth knowledge from the experience of top specialists

The large team of professionals that will accompany the specialist throughout the practical period is a first-class and an unprecedented guarantee of updating. With a specifically appointed tutor, students will be able to develop real projects in a state-of-the-art environment, which will allow them to incorporate the most effective procedures and approaches in Telecommunication Engineering into their daily practice.

3. Entering first-class professional environments

TECH carefully selects all available centers for Internship Programs. Thanks to this, the specialist will have guaranteed access to a prestigious environment in the area of Telecommunication Engineering. In this way, you will be able to see the day-to-day work of a demanding, rigorous and exhaustive work area, always applying the latest technology available in its work methodology.



4. Combining the best theory with state-of-the-art practice

The academic market is plagued by teaching programs that are poorly adapted to the daily work of the specialist and that require long teaching hours, often not very compatible with personal and professional life. TECH offers a new learning model, 100% practical, that allows you to get in front of state-of-the-art procedures in the field of Telecommunication Engineering and, best of all, to put it into professional practice in just 3 weeks.

5. Opening the door to new opportunities

The convergence of telecommunications with emerging technologies such as Artificial Intelligence, data analytics and cloud computing is creating a dynamic environment full of possibilities. By exploring areas such as network optimization, the implementation of 5G solutions and the development of advanced communication systems, computer scientists can leverage their skills to innovate in creating more efficient and secure infrastructures. This intersection of technologies opens up opportunities to lead complex projects, develop new applications and services, and contribute to the evolution of a sector crucial to the digital future.

You will have full practical immersion at the center of your choice”

03

Objectives

This university program has been designed to train professionals in the design, implementation and management of networks and communication systems, integrating cutting-edge concepts such as 5G networks, IoT and cybersecurity. In addition, the degree's comprehensive approach will not only strengthen computer scientists' skills in addressing complex technical challenges, but also expand their opportunities to lead and contribute to key innovations in the telecommunications sector.

You will be trained in the design, development and management of telecommunications systems and networks, covering everything from fundamental theory to practical application in the workplace"

General Objective

- The overall objective of the Hybrid Professional Master's Degree in Telecommunications Engineering will be to provide computer scientists with a comprehensive preparation to project, calculate, design, implement and manage networks, equipment, facilities and systems in Telecommunications Engineering. In this way, they will develop advanced competencies in the technical domain and the management of technological projects, successfully facing current and future challenges in the field of telecommunications, understanding emerging technologies and best practices in the sector

You will develop advanced technical competencies, project management skills and a solid understanding of emerging technological innovations"

Specific Objectives

Module 1. Basic Electronics and Instrumentation

- Learn about the operation and limitations of the instruments of a basic electronic workstation
- Know and implement the basic techniques for measuring electrical parameters of signals, and evaluate the associated errors and their possible correction techniques
- Master the basic characteristics and behavior of the most common passive components and be able to select them for a given application
- Understand the basic characteristics of linear amplifiers
- Know, design and implement the basic circuits using operational amplifiers considered ideal.
- Understand the operation of capacitively coupled multi-stage feedback-free amplifiers and be able to design them
- Analyze and know how to apply the basic techniques and configurations in analog integrated circuits

Module 2. Analog and Digital Electronics

- Know the basic concepts of digital and analog electronics
- Master the different logic gates and their characteristics
- Analyze and design digital circuits, both combinational and sequential
- Distinguish and evaluate the advantages and disadvantages between sequential synchronous and asynchronous circuits, and of using a clock signal
- Know integrated circuits and logic families
- Understand the different sources of energy, especially solar photovoltaic and solar thermal energy
- Obtain basic knowledge of electrical engineering, electrical distribution and power electronics

Module 3. Random Signals and Lineal Systems

- Understand the fundamentals of probability calculus
- Know the basic theory of variables and vectors
- Know in depth the random processes and their temporal and spectral characteristics
- Apply the concepts of deterministic and random signals to the characterization of disturbances and noise
- Know the fundamental properties of the systems
- Master linear systems and the related functions and transforms
- Apply concepts of Linear Time Invariant Systems (LTI Systems) to model, analyze and predict processes

Module 4. Computer Networks

- Acquire the essential knowledge of computer networks on the Internet
- Understand the functioning of the different layers that define a network system, such as the application, transport, network and link
- Understand the composition of LANs, their topology and their network elements and interconnection
- Learn how IP addressing and subnetting work
- Understand the structure of wireless and mobile networks, including the new 5G network
- Know the different network security mechanisms, as well as the different Internet security protocols

Module 5. Digital Systems

- Understand the structure and operation of microprocessors
- Know how to use the instruction set and machine language
- Be able to use hardware description languages
- Know the basic characteristics of microcontrollers
- Analyze the differences between microprocessors and microcontrollers
- Master the basic features of advanced digital systems

Module 6. Communication Theory

- Know the fundamental characteristics of the different types of signals
- Analyze the different disturbances that can occur in signal transmission
- Master the signal modulation and demodulation techniques
- Understand the Analog Communication Theory and its modulations
- Understand the Digital Communication Theory and its transmission models
- Be able to apply this knowledge to specify, deploy and maintain communication systems and services

Module 7. Switch Networks and Telecommunication Infrastructures

- Differentiate between the concepts of access and transport networks, circuit-switched and packet-switched networks, fixed and mobile networks, as well as distributed network systems and applications, voice, data, audio and video services
- Know the methods of network interconnection and routing, as well as the basics of network planning and dimensioning based on traffic parameters
- Master the basic fundamentals of service quality
- Analyze the performance (delay, loss probability, blocking probability, etc.) of telecommunication networks
- Understand and apply the standards and regulations of protocols and networks of international standardization organizations
- Know the Common Telecommunication Infrastructure planning in residential contexts

Module 8. Mobile Communication Networks

- Analyze the fundamental concepts of mobile communications networks
- Know the principles of mobile communications
- Master architecture and protocols of mobile communications networks
- Understand the basic technologies used in GSM, UMTS and LTE networks
- Understand the signaling systems and the different network protocols of GSM, UMTS and LTE
- Understand the functional entities of GSM, UMTS and LTE and their interconnection with other networks

Module 9. Radio Networks and Services

- Understand the access, link control and radio resource control mechanisms of an LTE system
- Understand the fundamental concepts of radio spectrum
- Know the specific services for radio networks
- Know the IP multicast techniques best suited to the connectivity provided by radio networks. Understand the impact of radio networks on end-to-end quality of service and know the existing mechanisms to mitigate them
- Master WLAN, WPAN, WMAN wireless networks
- Analyze the different architectures of satellite networks and know the different services supported by a satellite network

Module 10. System Engineering and Network Services

- Master the fundamental concepts of service engineering
- Know the basic principles of configuration management of evolving software systems
- Know the technologies and tools for the provision of telematic services
- Know different architectural styles of a software system, understand their differences and know how to choose the most appropriate one according Cone the system requirements
- Understand validation and verification processes and their relationships with other phases of the life cycle
- Be able to integrate systems for the capture, representation, processing, storage, management and presentation of multimedia information for the construction of telecommunication services and telematic applications
- Know common elements for the detailed design of a software system
- Acquire the ability to program, simulate and validate telematic, networked and distributed services and applications
- Understand the process and activities of transition, configuration, deployment and operation
- Understand network management, automation and optimization processes

04

Skills

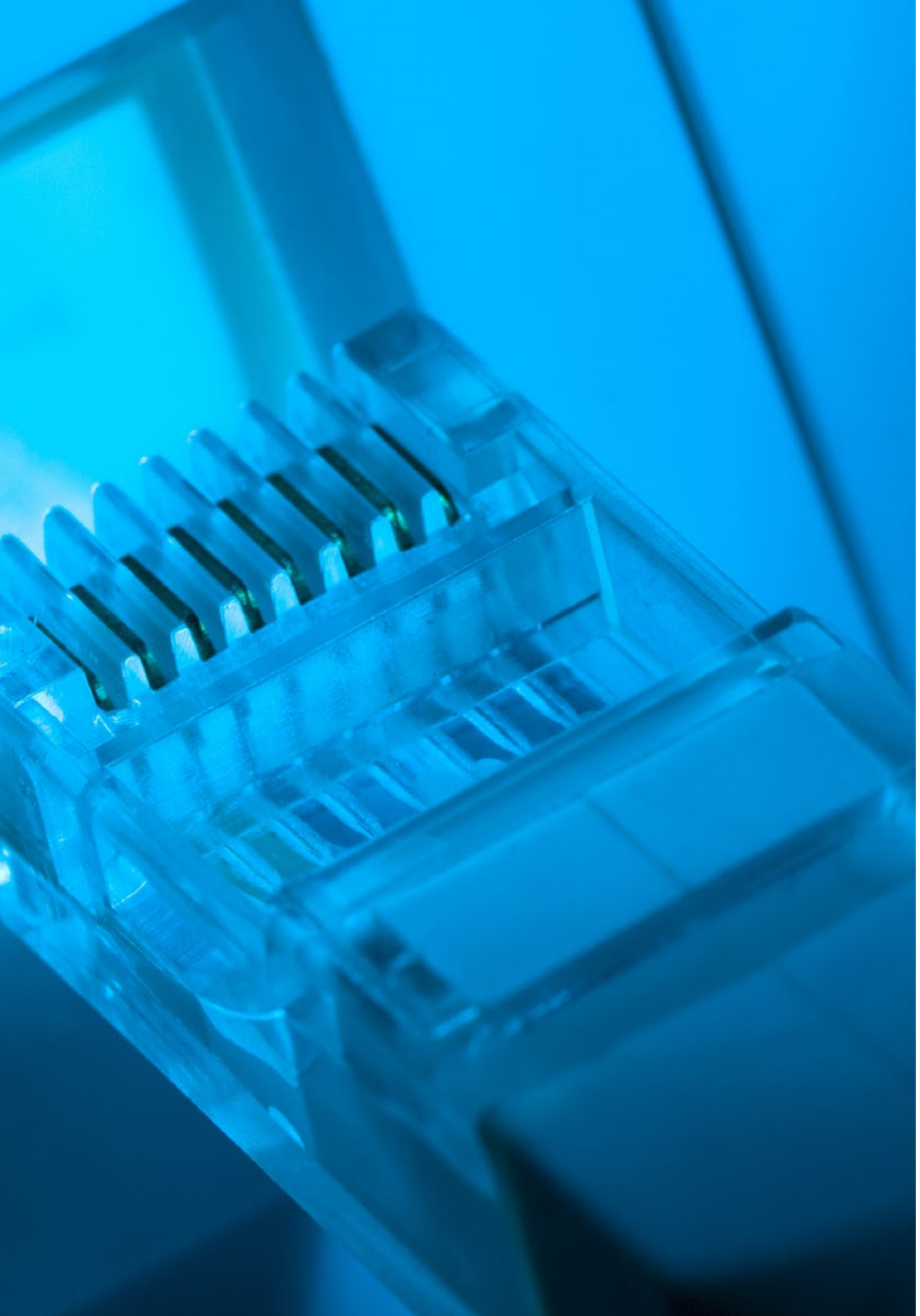
This Hybrid Professional Master's Degree in Telecommunication Engineering will provide computer scientists with essential skills in advanced and specialized telecommunications. These include the design and implementation of next-generation communication networks, and the management of complex infrastructures and the application of emerging technologies, such as 5G and the Internet of Things (IoT). In addition, professionals will acquire in-depth knowledge in cybersecurity, network optimization and data analytics, critical skills to protect and improve the efficiency of communication systems.

You will face technical and management challenges with a holistic perspective, preparing you to lead innovative projects and adapt to rapid technological evolutions in the industry"

General Skill

- Design and implement telecommunication networks, installations and systems

You will develop competencies to lead complex and global projects, increasing the potential to take on managerial and leadership roles in an increasingly competitive and digitized market"



Specific Skills

- Know about the operation and basic instrumentation of electronic devices
- Master all aspects of analog and digital electronics
- Develop knowledge of linear systems and random signals
- Use hardware description languages and know the characteristics of digital systems
- Know about the history and advances in communication theory
- Gain knowledge of computer systems and telecommunication infrastructures in order to be able to work with them
- Work with mobile communication networks and radio services
- Create telecommunications services and telematic applications

05

Course Management

This academic program includes the most specialized teaching staff in the current educational market. They are specialists selected by TECH to develop the whole syllabus. In this way, starting from their own existence and the latest evidence, they have designed the most up-to-date content that provides a guarantee of quality in such a relevant subject.

TECH offers the most specialized teaching staff in the field of study. Enroll now and enjoy the quality you deserve"

International Guest Director

Sinan Akkaya is an outstanding technology leader with extensive international engineering, management and leadership experience, specializing in access networks and enterprise infrastructure construction and operations. In this regard, he has demonstrated a strong ability to lead large-scale teams and projects, focusing on advanced technology implementation, innovation and product development. His experience ranges from strategic planning to operational execution of complex wireless network solutions and communication systems.

As such, in his role as Director of Radio Access Network Engineering, at AT&T, he has led the Radio Frequency and Network Engineering activities for the Northern California and Nevada region , where he has overseen the implementation of 4G and 5G networks, as well as network expansion to over 900 sites. Under his leadership, the region has achieved the highest EBITDA in the company, highlighted by his ability to manage large budgets, optimize operating costs and ensure network performance. In addition, he has played a key role in the implementation of emerging technologies, such as Massive MIMO and 5G mm-wave, as well as in the management of services such as FirstNet, focused on public safety.

He has also worked in consulting for large telecom operators, OEMs and global companies, providingtechnical and strategic advice to optimize networks and improve the quality of services. He has also supervised multidisciplinary teams, managed network investments in excess of $500 million annually and made significant contributions to the expansion and optimization of telecommunications networks. He has been a frequent speaker at international conferences, where he has shared his knowledge and perspective on technology trends and strategies for the evolution of wireless networks.

Mr. Akkaya, Sinan

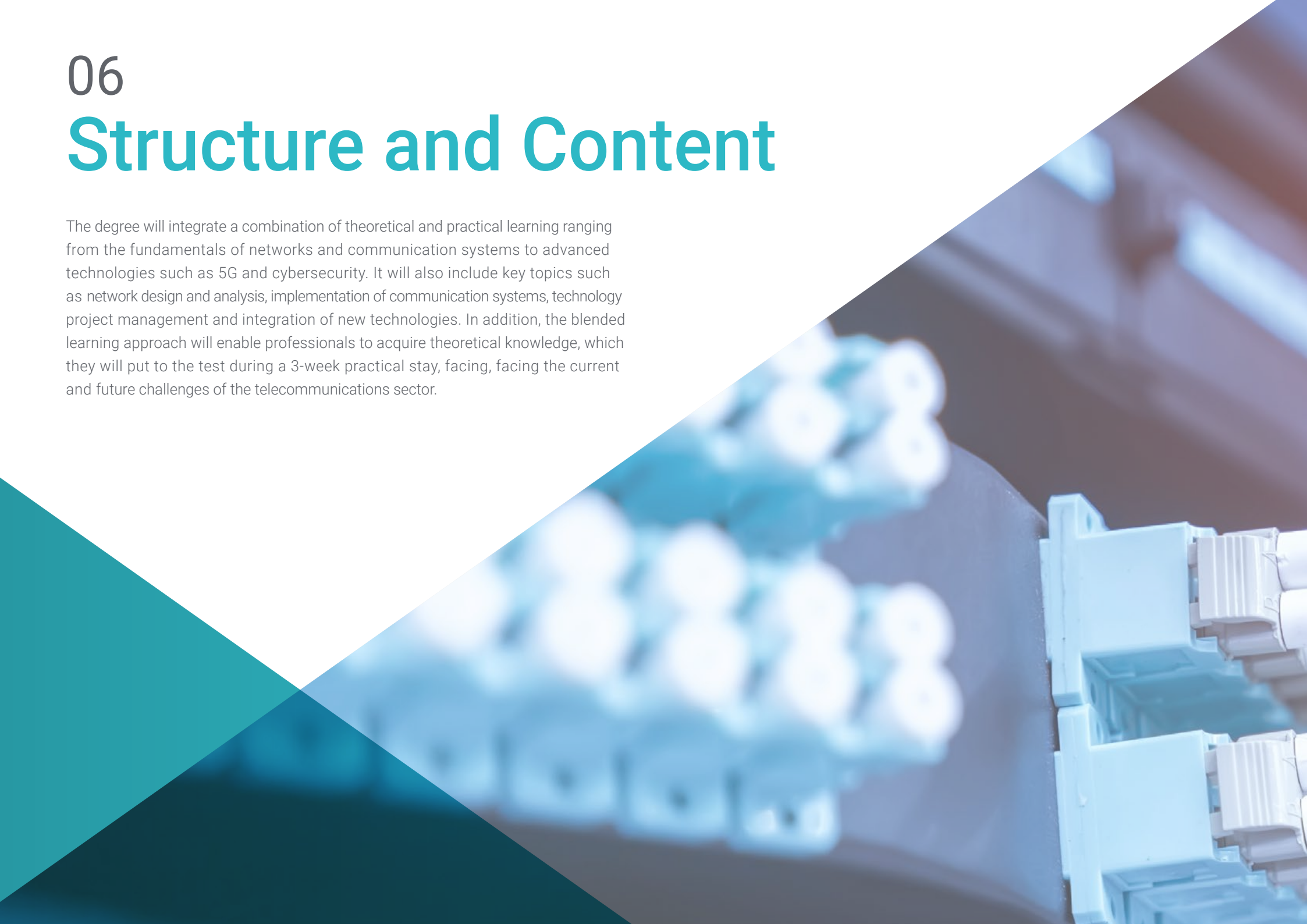
- Director of Radio Access Network Engineering at AT&T, San Ramon, California, United States
- Manager of Radio Frequency Engineering at AT&T
- Senior RF Engineer at Wireless Facilities International
- Radio Frequency Engineer at Lightbridge Communications Corporation RF Design Engineer at Turkcell
- Product Manager at General Electric
- Master of Science in Electrical and Electronic Engineering at Newcastle University
- Bachelor of Science in Electrical and Electronic Engineering from Orta Doğu Technical University
- Member of: American Heart Association

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

06

Structure and Content

The degree will integrate a combination of theoretical and practical learning ranging from the fundamentals of networks and communication systems to advanced technologies such as 5G and cybersecurity. It will also include key topics such as network design and analysis, implementation of communication systems, technology project management and integration of new technologies. In addition, the blended learning approach will enable professionals to acquire theoretical knowledge, which they will put to the test during a 3-week practical stay, facing, facing the current and future challenges of the telecommunications sector.



You will be prepared to lead and execute complex projects, adapting to the changing needs of the sector and contributing to the advancement of telecommunications in different environments"

Module 1. Basic Electronics and Instrumentation

1.1. Basic Instrumentation
- 1.1.1. Introduction. Signals and Their Parameters
- 1.1.2. Basic Electrical Quantities and their Measurement
- 1.1.3. Oscilloscopes
- 1.1.4. Digital Multimeter
- 1.1.5. Function Generator
- 1.1.6. Laboratory Power Supply

1.2. Electronic Components in the Laboratory
- 1.2.1. Main Types and Concepts of Tolerance and Series
- 1.2.2. Thermal Behavior and Power Dissipation. Maximum Voltage and Current
- 1.2.3. Concepts of Coefficients of Variation, Drift and Non-Linearity
- 1.2.4. Most Common Specific Parameters of the Main Types. Catalog Selection and Limitations

1.3. The Junction Diode, Circuits with Diodes, Diodes for Special Applications
- 1.3.1. Introduction and Operation
- 1.3.2. Circuits with Diodes
- 1.3.3. Diodes for Special Applications
- 1.3.4. Zener Diode

1.4. The Bipolar Junction Transistor (BJT) and FET/MOSFET
- 1.4.1. Transistor Fundamentals
- 1.4.2. Polarization and Transistor Stabilization
- 1.4.3. Transistor Circuits and Applications.
- 1.4.4. Single-Stage Amplifiers
- 1.4.5. Amplifier Types, Voltage, Current
- 1.4.6. Alternating Models

1.5. Basic Concepts of Amplifiers. Circuits with Ideal Operational Amplifiers
- 1.5.1. Types of Amplifiers. Voltage, Current, Transimpedance and Transconductance
- 1.5.2. Characteristic Parameters: Input and Output Impedances, Direct and Inverse Transfer Functions
- 1.5.3. Vision as Quadripoles and Parameters
- 1.5.4. Amplifier Association: Cascade, Series-Series, Series-Parallel, Series-Parallel, Parallel-Series and Parallel, Parallel
- 1.5.5. Concept of Operational Amplifier. General Characteristics. Use as a Comparator and as an Amplifier
- 1.5.6. Inverting and Non-Inverting Amplifier Circuits. Precision Trackers and Rectifiers. Voltage Current Control
- 1.5.7. Elements for Instrumentation and Operational Calculation: Adders, Subtractors, Differential Amplifiers, Integrators and Differentiators
- 1.5.8. Stability and Feedback: Astables and Triggers

1.6. Single-Stage Amplifiers and Multistage Amplifiers
- 1.6.1. General Concepts of Device Polarization
- 1.6.2. Basic Biasing Circuits and Techniques. Implementation for Bipolar and Field Effect Transistors. Stability, Drift and Sensitivity
- 1.6.3. Basic Small Signal Amplification Configurations: Common Emitter-Source, Base-Gate, Collector-Drainer. Properties and Variants
- 1.6.4. Performance Against Large Signal Excursions and Dynamic Range
- 1.6.5. Basic Analog Switches and their Properties
- 1.6.6. Frequency Effects in Single-Stage Configurations: Case of Medium Frequencies and their Limits
- 1.6.7. Multistage Amplification with R-C and Direct Coupling. Amplification, Frequency Range, Polarization and Dynamic Range Considerations

1.7. Basic Configurations in Analog Integrated Circuits
- 1.7.1. Differential Input Configurations. Bartlett's Theory. Polarization, Parameters and Measurements
- 1.7.2. Polarization Functional Blocks: Current Mirrors and their Modifications. Active Loads and Level Changers
- 1.7.3. Standard Input Configurations and their Properties: Single Transistor, Darlington Pairs and their Modifications, Helmode
- 1.7.4. Output Configurations

1.8. Active Filters
- 1.8.1. Overview
- 1.8.2. Operational Filter Design
- 1.8.3. Low Pass Filters
- 1.8.4. High Pass Filters
- 1.8.5. Band Pass and Band Filters
- 1.8.6. Other Types of Active Filters

1.9. Analog-to-Digital (A/D) Converters
- 1.9.1. Introduction and Functionalities
- 1.9.2. Instrumental Systems
- 1.9.3. Types of Converters
- 1.9.4. Converter Characteristics
- 1.9.5. Data Processing

1.10. Sensors
- 1.10.1. Primary Sensors
- 1.10.2. Resistive Sensors
- 1.10.3. Capacitive Sensors
- 1.10.4. Inductive and Electromagnetic Sensors
- 1.10.5. Digital Sensors
- 1.10.6. Signal-Generating Sensors
- 1.10.7. Other Types of Sensors

Module 2. Analog and Digital Electronics

2.1. Introduction: Digital Concepts and Parameters
- 2.1.1. Analog and Digital Quantities
- 2.1.2. Binary Digits, Logic Levels and Digital Waveforms
- 2.1.3. Basic Logic Operations
- 2.1.4. Integrated Circuits
- 2.1.5. Introduction of Programmable Logic
- 2.1.6. Measuring Tools
- 2.1.7. Decimal, Binary, Octal, Hexadecimal, BCD Numbers.
- 2.1.8. Arithmetic Operations with Numbers
- 2.1.9. Error Detection and Correction Codes
- 2.1.10 Alphanumeric Codes

2.2. Logic Gates
- 2.2.1. Introduction
- 2.2.2. The Investor
- 2.2.3. The AND Gate
- 2.2.4. The OR Gate
- 2.2.5. The NAND Gate
- 2.2.6. The NOR Gate
- 2.2.7. Exclusive OR and NOR Gates
- 2.2.8. Programmable Logic
- 2.2.9. Fixed Function Logic

2.3. Boolean Algebra
- 2.3.1. Boolean Operations and Expressions
- 2.3.2. Laws and Rules of Boolean Algebra
- 2.3.3. DeMorgan's Theorems
- 2.3.4. Boolean Analysis of Logic Circuits
- 2.3.5. Simplification Using Boolean Algebra
- 2.3.6. Standard Forms of Boolean Expressions
- 2.3.7. Boolean Expressions and Truth Tables
- 2.3.8. Karnaugh Maps
- 2.3.9. Minimization of a Sum of Products and Minimization of a Product of Sums

2.4. Basic Combinational Circuits
- 2.4.1. Basic Circuits
- 2.4.2. Combinational Logic Implementation
- 2.4.3. Universal Properties of NAND and NOR Gates
- 2.4.4. Combinational Logic with NAND and NOR Gates
- 2.4.5. Logic Circuit Operation with Pulse Trains
- 2.4.6. Adders
  - 2.4.6.1. Basic Adders
  - 2.4.6.2. Parallel Binary Adders
  - 2.4.6.3. Carrying Adders
- 2.4.7. Comparators
- 2.4.8. Decoders
- 2.4.9. Encoder
- 2.4.10 Code Converters
- 2.4.11 Multiplexers
- 2.4.12 Demultiplexers
- 2.4.13. Applications

2.5. Latches, Flip-Flops and Timers
- 2.5.1. Basic Concepts
- 2.5.2. *Latches*
- 2.5.3. Edge-Triggered Flip-Flops
- 2.5.4. Operating Characteristics of Flip-Flops
  - 2.5.4.1. Type D
  - 2.5.4.2. Type J-K
- 2.5.5. Monostable
- 2.5.6. Unstable
- 2.5.7. The 555 Timer
- 2.5.8. Applications

2.6. Counters and Shift Registers
- 2.6.1. Asynchronous Meter Operation
- 2.6.2. Synchronous Meter Operation
  - 2.6.2.1. Ascendant
  - 2.6.2.2. Descendant
- 2.6.3. Synchronous Meter Design
- 2.6.4. Cascade Meters
- 2.6.5. Meter Decoding
- 2.6.6. Application of Counters
- 2.6.7. Basic Functions of Shift Registers
  - 2.6.7.1. Displacement Registers with Serial Input and Parallel Output
  - 2.6.7.2. Shift Registers with Parallel Input and Serial Output
  - 2.6.7.3. Displacement Registers with Input and Parallel Output
  - 2.6.7.4. Bi-Directional Shift Registers
- 2.6.8. Counters Based on Shift Registers
- 2.6.9. Counter Register Applications

2.7. Memories, Introduction to SW and Programmable Logic
- 2.7.1. Semiconductor Memory Principles
- 2.7.2. RAM Memories
- 2.7.3. ROM Memories
  - 2.7.3.1. Read-Only
  - 2.7.3.2. PROM
  - 2.7.3.3. EPROM
- 2.7.4. Flash Memory
- 2.7.5. Memory Expansion
- 2.7.6. Special Types of Memory
  - 2.7.6.1. FIFO
  - 2.7.6.2. LIFO
- 2.7.7. Optical and Magnetic Memories
- 2.7.8. Programmable Logic: SPLD and CPLD
- 2.7.9. Macrocells
- 2.7.10 Programmable Logic: FPGA
- 2.7.11 Programmable Logic Software
- 2.7.12. Applications

2.8. Analog Electronics: Oscillators
- 2.8.1. Theory of Oscillators
- 2.8.2. Wien Bridge Oscillator
- 2.8.3. Other RC Oscillators
- 2.8.4. Colpitts Oscillator
- 2.8.5. Other LC Oscillators.
- 2.8.6. Crystal Oscillator
- 2.8.7. Quartz Crystals
- 2.8.8. 555 Timer
  - 2.8.8.1. Operation as Stable
  - 2.8.8.2. Monostable Operation
  - 2.8.8.3. Circuits
- 2.8.9. BODE Diagrams
  - 2.8.9.1. Amplitude
  - 2.8.9.2. Phase
  - 2.8.9.3. Transfer Functions

2.9. Power Electronics: Thyristors, Converters, Inverters
- 2.9.1. Introduction
- 2.9.2. Concept of Converter
- 2.9.3. Types of Converters
- 2.9.4. Parameters to Characterize Converters
  - 2.9.4.1. Periodic Signal
  - 2.9.4.2. Time Domain Representation
  - 2.9.4.3. Frequency Domain Representation
- 2.9.5. Power Semiconductors
  - 2.9.5.1. Ideal Element
  - 2.9.5.2. Diode
  - 2.9.5.3. Thyristor
  - 2.9.5.4. GTO (Gate Turn-off Thyristor)
  - 2.9.5.5. BJT (Bipolar Junction Transistor)
  - 2.9.5.6. MOSFET
  - 2.9.5.7. IGBT (Insulated Gate Bipolar Transistor)
- 2.9.6. AC/DC Converters. Rectifiers
  - 2.9.6.1. Quadrant Concept
  - 2.9.6.2. Uncontrolled Rectifiers
    - 2.9.6.2.1. Simple Half-Wave Bridge
    - 2.9.6.2.2. Full Wave Bridge
  - 2.9.6.3. Controlled Rectifiers
    - 2.9.6.3.1. Simple Half-Wave Bridge
    - 2.9.6.3.2. Full-wave Controlled Bridge
  - 2.9.6.4. DC/DC Converters
    - 2.9.6.4.1. Step-Down Dc/Dc Converter
    - 2.9.6.4.2. Step-Up Dc/Dc Converter
  - 2.9.6.5. DC/DC Converters. Inverters
    - 2.9.6.5.1. Square Wave Inverter
    - 2.9.6.5.2. PWM Inverter
  - 2.9.6.6. AC/AC Converters. Cycloconverters
    - 2.9.6.6.1. All/Nothing Control
    - 2.9.6.6.2. Phase Control

2.10. Electric Power Generation, Photovoltaic Installation. Legislation
- 2.10.1. Components of Solar Photovoltaic Systems
- 2.10.2. Introduction to Solar Energy
- 2.10.3. Classification of Solar Photovoltaic Installations
  - 2.10.3.1. Stand-Alone Applications
  - 2.10.3.2. Grid-Connected Applications
- 2.10.4. Elements of an ISF
  - 2.10.4.1. Solar Cell: Basic Characteristics
  - 2.10.4.2. The Solar Panel
  - 2.10.4.3. Controller
  - 2.10.4.4. Accumulators. Types of Cells
  - 2.10.4.5. The Investor
- 2.10.5. Grid-Connected Applications
  - 2.10.5.1. Introduction
  - 2.10.5.2. Elements of a Grid-Connected Solar Photovoltaic Installation
  - 2.10.5.3. Design and Calculation of Grid-Connected Photovoltaic Installations
  - 2.10.5.4. Design of a Solar Farm
  - 2.10.5.5. Design of Building-Integrated Installations
  - 2.10.5.6. Interaction of the Installation with the Electrical Grid
  - 2.10.5.7. Analysis of Possible Disturbances and Quality of Supply
  - 2.10.5.8. Measurement of Power Consumption
  - 2.10.5.9. Safety and Protections in the Installation
  - 2.10.5.10. Current Regulations
- 2.10.6. Renewable Energy Legislation

Module 3. Random Signals and Lineal Systems

3.1. Probability Theory
- 3.1.1. Concept of Probability Probability Space
- 3.1.2. Conditional Probability and Independent Events
- 3.1.3. Total Probability Theorem. Bayes' Theorem
- 3.1.4. Composite Experiments. Bernoulli Tests

3.2. Random Variables
- 3.2.1. Random Variable Definition
- 3.2.2. Probability Distributions
- 3.2.3. Main Distributions
- 3.2.4. Functions of Random Variables
- 3.2.5. Moments of Random Variable
- 3.2.6. Generator Functions

3.3. Random Vectors
- 3.3.1. Random Vector Definition
- 3.3.2. Joint Distribution
- 3.3.3. Marginal Distributions
- 3.3.4. Conditional Distributions
- 3.3.5. Linear Correlation Between Two Variables
- 3.3.6. Normal Multivariant Distribution

3.4. Random Processes
- 3.4.1. Definition and Description of Random Processes
- 3.4.2. Random Processes in Discrete Time
- 3.4.3. Random Processes in Continuous Time
- 3.4.4. Stationary Processes
- 3.4.5. Gaussian Processes
- 3.4.6. Markovian Processes

3.5. Queuing Theory in Telecommunications
- 3.5.1. Introduction
- 3.5.2. Basic Concepts
- 3.5.3. Model Description
- 3.5.4. Example of the Application of Queuing Theory in Telecommunications

3.6. Random Processes. Temporal Characteristics
- 3.6.1. Concept of Random Process
- 3.6.2. Processes Qualification
- 3.6.3. Main Statistics
- 3.6.4. Stationarity and Independence
- 3.6.5. Temporary Averages
- 3.6.6. Ergodicity

3.7. Random Processes. Spectral Characteristic
- 3.7.1. Introduction
- 3.7.2. Power Density Spectrum
- 3.7.3. Power Density Spectral Properties.
- 3.7.4. Relationship between the Power Spectrum and Autocorrelation

3.8. Signals and Systems. Properties
- 3.8.1. Introduction to Signals
- 3.8.2. Introduction to Systems
- 3.8.3. Basic Properties of Systems
  - 3.8.3.1. Linearity
  - 3.8.3.2. Time Invariance
  - 3.8.3.3. Causality
  - 3.8.3.4. Stability.
  - 3.8.3.5. Memory
  - 3.8.3.6. Invertibility

3.9. Lineal Systems with Random Inputs
- 3.9.1. Fundamentals of Linear Systems
- 3.9.2. Response to Linear Systems and Random Signals
- 3.9.3. Systems with Random Noise
- 3.9.4. Spectral Characteristics of the System Response
- 3.9.5. Equivalent Noise Bandwidth and Temperature
- 3.9.6. Noise Source Modeling

3.10. LTI Systems
- 3.10.1. Introduction
- 3.10.2. Discrete-Time LTI Systems
- 3.10.3. Continuous-Time LTI Systems
- 3.10.4. Properties of LTI Systems
- 3.10.5. Systems Described by Differential Equations

Module 4. Computer Networks

4.1. Computer Networks on the Internet
- 4.1.1. Networks and Internet
- 4.1.2. Protocol Architecture

4.2. The Application Layer
- 4.2.1. Model and Protocols
- 4.2.2. FTP and SMTP Services
- 4.2.3. DNS Service
- 4.2.4. HTTP Operation Model
- 4.2.5. HTTP Message Formats
- 4.2.6. Interaction with Advanced Methods

4.3. The Transport Layer
- 4.3.1. Communication Between Processes
- 4.3.2. Connection-oriented Transportation: TCP and SCTP

4.4. The Network Layer
- 4.4.1. Circuit and Packet Switching
- 4.4.2. IP Protocol (v4 and v6)
- 4.4.3. Routing Algorithms

4.5. The Link Layer
- 4.5.1. Link Layer and Error Detection and Correction Techniques
- 4.5.2. Multiple Access Links and Protocols
- 4.5.3. Link Level Addressing

4.6. LAN Networks
- 4.6.1. Network Topologies
- 4.6.2. Network and Interconnection Elements

4.7. IP Addressing
- 4.7.1. IP Addressing and *Subnetting*
- 4.7.2. Overview: An HTTP Request

4.8. Wireless and Mobile Networks
- 4.8.1. 2G, 3G and 4G Mobile Networks and Services
- 4.8.2. 5G Networks

4.9. Network Security
- 4.9.1. Fundamentals of Communications Security
- 4.9.2. Access Control
- 4.9.3. System Security
- 4.9.4. Fundamentals of Cryptography
- 4.9.5. Digital Signature

4.10. Internet Security Protocols
- 4.10.1. IP Security and Virtual Private Networks (VPN)
- 4.10.2. Web Security with SSL/TLS

Module 5. Digital Systems

5.1. Basic Concepts and Functional Organization of the Computer
- 5.1.1. Basic Concepts
- 5.1.2. Functional Structure of Computers
- 5.1.3. Concept of Machine Language
- 5.1.4. Basic Parameters for the Characterization of Computer Performance
- 5.1.5. Conceptual Levels of Computer Description
- 5.1.6. Conclusions

5.2. Representation of Information at the Machine Level
- 5.2.1. Introduction
- 5.2.2. Text Representation
  - 5.2.2.1. ASCII (American Standard Code for Information Interchange) Code
  - 5.2.2.2. Unicode Code
- 5.2.3. Sound Representation
- 5.2.4. Image Representation
  - 5.2.4.1. Bitmaps
  - 5.2.4.2. Vector Maps
- 5.2.5. Video Representation
- 5.2.6. Representation of Numerical Data
  - 5.2.6.1. Integer Representation
  - 5.2.6.2. Representation of Real Numbers
    - 5.2.6.2.1. Rounding
    - 5.2.6.2.2. Special Situations
- 5.2.7. Conclusions

5.3. Diagram of Computer Operation
- 5.3.1. Introduction
- 5.3.2. Processor Internals
- 5.3.3. Sequencing of the Internal Workings of a Computer
- 5.3.4. Management of Control Instructions
  - 5.3.4.1. Management of Jump Instructions
  - 5.3.4.2. Management of Subroutine Call and Return Instructions.
- 5.3.5. Interrupts
- 5.3.6. Conclusions

5.4. Description of a Computer at the Machine and Assembly Language Levels
- 5.4.1. Introduction: RISC vs CISC Processors
- 5.4.2. A RISC Processor: CODE-2
  - 5.4.2.1. Characteristics of CODE-2
  - 5.4.2.2. Description of the CODE-2 Machine Language
  - 5.4.2.3. Methodology for the Realization of Programs in CODE-2 Machine Language.
  - 5.4.2.4. Description of the CODE-2 Assembly Language.
- 5.4.3. A CISC Family: Intel 32-Bit Processors (IA-32)
  - 5.4.3.1. Evolution of the Intel Family of Processors
  - 5.4.3.2. Basic Structure of the 80×86 Processor Family
  - 5.4.3.3. Syntax, Instruction Format and Types of Operands
  - 5.4.3.4. Basic Instruction Repertoire of the 80×86 Processor Family
  - 5.4.3.5. Assembler Directives and Memory Location Reservation
- 5.4.4. Conclusions

5.5. Processor Organization and Design
- 5.5.1. Introduction to the CODE-2 Processor Design.
- 5.5.2. CODE-2 Processor Control Signals
- 5.5.3. Design of the Data Processing Unit
- 5.5.4. Design of the Control Unit
  - 5.5.4.1. Wired and Microprogrammed Control Units
  - 5.5.4.2. CODE-2 Control Unit Cycling
  - 5.5.4.3. Design of the CODE-2 Microprogrammed Control Unit.
- 5.5.5. Conclusions

5.6. Inputs and Outputs: Buses
- 5.6.1. Input/Output Organization
  - 5.6.1.1. Input/output Drivers
  - 5.6.1.2. Input/output Port Addressing
  - 5.6.1.3. I/O Transfer Techniques
- 5.6.2. Basic Interconnection Structures
- 5.6.3. Buses
- 5.6.4. Internal Structure of a PC

5.7. Microcontrollers and PICs
- 5.7.1. Introduction
- 5.7.2. Basic Characteristics of Microcontrollers
- 5.7.3. Basic Characteristics of the PICs
- 5.7.4. Differences Between Microcontrollers, PICs and Microprocessors

5.8. A/D Converters and Sensors
- 5.8.1. Signal Sampling and Reconstruction
- 5.8.2. A/D Converters
- 5.8.3. Sensors and Transducers
- 5.8.4. Basic Digital Signal Processing
- 5.8.5. Basic Circuits and Systems for A/D Conversion

5.9. Programming a Microcontroller System
- 5.9.1. System Design and Electronic Configuration
- 5.9.2. Configuration of a Micro-Controlled Digital Systems Development Environment using Free Tools
- 5.9.3. Description of the Language Used by the Microcontroller
- 5.9.4. Programming of the Microcontroller Functions.
- 5.9.5. Final Assembly of the System

5.10. Advanced Digital Systems: FPGAs and DSPs
- 5.10.1. Description of Other Advanced Digital Systems
- 5.10.2. Basic Characteristics of FPGAs
- 5.10.3. Basic Characteristics of DSPs
- 5.10.4. Hardware Description Languages

Module 6. Communication Theory

6.1. Introduction: Telecommunication Systems and Transmission Systems
- 6.1.1. Introduction
- 6.1.2. Basic Concepts and History
- 6.1.3. Telecommunication Systems
- 6.1.4. Transmission Systems

6.2. Signal Characterization
- 6.2.1. Deterministic vs. Random Signals
- 6.2.2. Periodic and Non-Periodic Signal
- 6.2.3. Energy and Power Signal
- 6.2.4. Baseband and Bandpass Signal
- 6.2.5. Basic Parameters of a Signal
  - 6.2.5.1. Mean Value
  - 6.2.5.2. Average Energy and Power
  - 6.2.5.3. Maximum Value and RMS Value
  - 6.2.5.4. Energy and Power Spectral Density
  - 6.2.5.5. Power Calculation in Logarithmic Units

6.3. Disturbances in Transmission Systems
- 6.3.1. Ideal Channel Transmission
- 6.3.2. Classification of Disturbances
- 6.3.3. Linear Distortion
- 6.3.4. Non-Linear Distortion
- 6.3.5. Crosstalk and Interference
- 6.3.6. Noise
  - 6.3.6.1. Types of Noise
  - 6.3.6.2. Characterization
- 6.3.7. Narrow Band Passing Signals

6.4. Analog Communications. BORRAR
- 6.4.1. Introduction
- 6.4.2. General Concepts
- 6.4.3. Baseband Transmission
  - 6.4.3.1. Modulation and Demodulation
  - 6.4.3.2. Characterization
  - 6.4.3.3. Multiplexing
- 6.4.4. Mixers
- 6.4.5. Characterization
- 6.4.6. Type of Mixers

6.5. Analog Communications. Lineal Modulations
- 6.5.1. Basic Concepts
- 6.5.2. Amplitude Modulation (AM)
  - 6.5.2.1. Characterization
  - 6.5.2.2. Parameters
  - 6.5.2.3. Modulation/Demodulation
- 6.5.3. Double Side Band (DBL) Modulation.
  - 6.5.3.1. Characterization
  - 6.5.3.2. Parameters
  - 6.5.3.3. Modulation/Demodulation
- 6.5.4. Single Side Band (SSB) Modulation
  - 6.5.4.1. Characterization
  - 6.5.4.2. Parameters
  - 6.5.4.3. Modulation/Demodulation
- 6.5.5. Vestigial Side Band (VSB) Modulation
  - 6.5.5.1. Characterization
  - 6.5.5.2. Parameters
  - 6.5.5.3. Modulation/Demodulation
- 6.5.6. Quadrature Amplitude Modulation (QAM).
  - 6.5.6.1. Characterization
  - 6.5.6.2. Parameters
  - 6.5.6.3. Modulation/Demodulation
- 6.5.7. Noise in Analog Modulations
  - 6.5.7.1. Approach
  - 6.5.7.2. Noise in DBL
  - 6.5.7.3. Noise in BLU
  - 6.5.7.4. Noise in AM

6.6. Analog Communications. Angular Modulations
- 6.6.1. Phase and Frequency Modulation
- 6.6.2. Narrow Band Angular Modulation
- 6.6.3. Spectrum Calculation
- 6.6.4. Generation and Demodulation
- 6.6.5. Angular Demodulation with Noise
- 6.6.6. Noise in PM
- 6.6.7. Noise in FM
- 6.6.8. Comparison between Analog Modulations

6.7. Digital Communication Introduction. Transmission Models
- 6.7.1. Introduction
- 6.7.2. Fundamental Parameters
- 6.7.3. Advantages of Digital Systems
- 6.7.4. Limitations of Digital Systems
- 6.7.5. PCM Systems
- 6.7.6. Modulations in Digital Systems
- 6.7.7. Demodulations in Digital Systems

6.8. Digital Communication Digital Base Band Transmission
- 6.8.1. PAM Binary Systems
  - 6.8.1.1. Characterization
  - 6.8.1.2. Signal Parameters
  - 6.8.1.3. Spectral Model
- 6.8.2. Basic Binary Sampling Receiver.
  - 6.8.2.1. Bipolar NRZ
  - 6.8.2.2. Bipolar RZ
  - 6.8.2.3. Error Probability
- 6.8.3. Optimal Binary Receptor
  - 6.8.3.1. Context
  - 6.8.3.2. Error Probability Calculation
  - 6.8.3.3. Optimal Receptor Filter Design
  - 6.8.3.4. SNR Calculation
  - 6.8.3.5. Loans
  - 6.8.3.6. Characterization
- 6.8.4. M-PAM Systems
  - 6.8.4.1. Parameters
  - 6.8.4.2. Constellations
  - 6.8.4.3. Optimal Receiver
  - 6.8.4.4. Bit Error Probability (BER)
- 6.8.5. Signal Vectorial Space
- 6.8.6. Constellation of a Digital Modulation
- 6.8.7. M-Signal Receivers

6.9. Digital Communication Digital Bandpass Transmission. Digital Modulations
- 6.9.1. Introduction
- 6.9.2. ASK Modulation
  - 6.9.2.1. Characterization
  - 6.9.2.2. Parameters
  - 6.9.2.3. Modulation/Demodulation
- 6.9.3. QAM Modulation
  - 6.9.3.1. Characterization
  - 6.9.3.2. Parameters
  - 6.9.3.3. Modulation/Demodulation
- 6.9.4. PSK Modulation
  - 6.9.4.1. Characterization
  - 6.9.4.2. Parameters
  - 6.9.4.3. Modulation/Demodulation
- 6.9.5. FSK Modulation
  - 6.9.5.1. Characterization
  - 6.9.5.2. Parameters
  - 6.9.5.3. Modulation/Demodulation
- 6.9.6. Other Digital Modulations
- 6.9.7. Comparison between Digital Modulations

6.10. Digital Communication: Comparison, IES and Eye Diagram
- 6.10.1. Comparison between Digital Modulations
  - 6.10.1.1. Energy and Power of the Modulations.
  - 6.10.1.2. Envelope
  - 6.10.1.3. Noise Protection
  - 6.10.1.4. Spectral Model
  - 6.10.1.5. Channel Coding Techniques
  - 6.10.1.6. Synchronization Signals
  - 6.10.1.7. SER Symbol Error Rate
- 6.10.2. Bandwidth-Limited Channels
- 6.10.3. Inter Symbol Interference (IES)
  - 6.10.3.1. Characterization
  - 6.10.3.2. Limitations
- 6.10.4. Optimal Receiver in PAM Without IES.
- 6.10.5. Eye Diagrams

Module 7. Switch Networks and Telecommunication Infrastructures

7.1. Introduction to Switch Networks
- 7.1.1. Switching Techniques
- 7.1.2. Local LAN Networks
- 7.1.3. Topology and Transmission Media Review
- 7.1.4. Basic Transfer Concepts
- 7.1.5. Methods of Accessing the Media
- 7.1.6. Network Interconnection Equipment

7.2. Switching Techniques and Switch Structure. ISDN and FR Networks
- 7.2.1. Switch Networks
- 7.2.2. Circuit-Switch Networks
- 7.2.3. ISDN
- 7.2.4. Packet-Switched Networks
- 7.2.5. FR

7.3. Traffic Parameters and Network Dimensioning
- 7.3.1. Fundamental Traffic Concepts
- 7.3.2. Loss Systems
- 7.3.3. Standby Systems
- 7.3.4. Traffic Modeling System Examples

7.4. Quality of Service and Traffic Management Algorithms
- 7.4.1. Quality of Service
- 7.4.2. Congestion Effects
- 7.4.3. Congestion Control
- 7.4.4. Traffic Control
- 7.4.5. Traffic Management Algorithms

7.5. Access Networks: WAN Access Technologies
- 7.5.1. Wide Area Networks
- 7.5.2. WAN Network Access Technologies
- 7.5.3. xDSL Access
- 7.5.4. FTTH Access

7.6. ATM: Asynchronous Transfer Mode
- 7.6.1. ATM Service
- 7.6.2. Protocol Architecture
- 7.6.3. Logical ATM Connections
- 7.6.4. ATM Cells
- 7.6.5. ATM Cell Transmission
- 7.6.6. Types of ATM Services

7.7. MPLS: Multiprotocol Label Switching
- 7.7.1. Introduction MPLS
- 7.7.2. MPLS Operations
- 7.7.3. Labels
- 7.7.4. VPNs.

7.8. Project for the Implementation of a Telematic Network
- 7.8.1. Obtaining the information
- 7.8.2. Planning
  - 7.8.2.1. System Dimensioning
  - 7.8.2.2. Installation Site Drawings and Schematics
- 7.8.3. Specifications: Design Techniques
- 7.8.4. Network Implementation and Deployment

7.9. Structured Cabling. Case Study
- 7.9.1. Introduction
- 7.9.2. Structured Cabling Organizations and Standards
- 7.9.3. Transmission of medium
- 7.9.4. Structured Cabling
- 7.9.5. Physical Interface
- 7.9.6. Parts of a Structured Cabling (Horizontal and Vertical)
- 7.9.7. Identification System
- 7.9.8. Case Study

7.10. Common Telecommunication Infrastructure Planning
- 7.10.1. Introduction ICT
  - 7.10.1.1. ICT Standards
- 7.10.2. Enclosures and Piping
  - 7.10.2.1. Exterior Area
  - 7.10.2.2. Common Area
  - 7.10.2.3. Private Zone
- 7.10.3. ICT Distribution Networks
- 7.10.4. Technical Projects

Module 8. Mobile Communication Networks

8.1. Introduction Mobile Communication Networks
- 8.1.1. Communication Networks
- 8.1.2. Communication Network Classification
- 8.1.3. Radioelectric Spectrum
- 8.1.4. Radio Telephone Systems
- 8.1.5. Cellular Technology
- 8.1.6. Evolution of Mobile Telephone Systems

8.2. Protocols and Architecture
- 8.2.1. Protocol Concept Review
- 8.2.2. Communication Architecture Concept Review
- 8.2.3. OSI Model Review
- 8.2.4. TCP/IP Protocol Architecture Review
- 8.2.5. Structure of a Mobile Telephony Network

8.3. Mobile Communication Principles
- 8.3.1. Radiation and Antenna Types
- 8.3.2. Frequency Reuse
- 8.3.3. Signal Propagation
- 8.3.4. Itinerancy and Transfer
- 8.3.5. Multiple Access Techniques
- 8.3.6. Analog and Digital Systems
- 8.3.7. Portability

8.4. Review of GSM Networks: Technical Characteristics, Architecture and Interfaces
- 8.4.1. GSM Systems
- 8.4.2. GSM Technical Characteristics
- 8.4.3. GSM Network Architecture
- 8.4.4. GSM Channel Structure
- 8.4.5. GSM Interfaces

8.5. GSM and GPRS Protocol Review
- 8.5.1. Introduction
- 8.5.2. GSM Protocols
- 8.5.3. GSM Evolution
- 8.5.4. GPRS

8.6. UMTS System. Technical Characteristics, Architecture and HSPA
- 8.6.1. Introduction
- 8.6.2. UMTS Systems
- 8.6.3. UMTS Technical Characteristics
- 8.6.4. UMTS Network Architecture
- 8.6.5. HSPA

8.7. UMTS System. Protocols, Interfaces and VoIP
- 8.7.1. Introduction
- 8.7.2. UMTS Channel Structure
- 8.7.3. UMTS Protocols
- 8.7.4. UMTS Interfaces
- 8.7.5. VoIP and IMS

8.8. VoIP: Traffic Models for IP Telephony
- 8.8.1. VoIP Introduction
- 8.8.2. Protocols
- 8.8.3. VoIP Elements
- 8.8.4. Real-Time VoIP Transport
- 8.8.5. Packaged Voice Traffic Models

8.9. LTE System. Technical Characteristics and Architecture. CS Fallback
- 8.9.1. LTE Systems
- 8.9.2. LTE Technical Characteristics
- 8.9.3. LTE Network Architecture
- 8.9.4. LTE Channel Structure
- 8.9.5. LTE Calls: VoLGA, CS FB and VoLTE

8.10. LTE Systems: Interfaces, Protocols and Services
- 8.10.1. Introduction
- 8.10.2. LTE Interfaces
- 8.10.3. LTE Protocols
- 8.10.4. LTE Services

Module 9. Radio Networks and Services

9.1. Basic Techniques in Radio Networks
- 9.1.1. Introduction to Radio Networks
- 9.1.2. Basic Fundamentals
- 9.1.3. Multiple Access Techniques (MAC): Random Access (RA). MF-TDMA, CDMA, OFDMA
- 9.1.4. Radio Link Optimization: Fundamentals of Link Control Techniques (LLC). HARQ. MIMO

9.2. Radioelectric Spectrum
- 9.2.1. Definition
- 9.2.2. Nomenclature of Frequency Bands According to ITU-R.
- 9.2.3. Other Frequency Band Nomenclature
- 9.2.4. Radio Spectrum Division
- 9.2.5. Types of Electromagnetic Radiation

9.3. Radio Communication Systems and Services
- 9.3.1. Signal Conversion and Processing: Analog and Digital Modulations
- 9.3.2. Digital Signal Transmission
- 9.3.3. Digital Radio System DAB, IBOC, DRM and DRM+.
- 9.3.4. Radiofrequency Communication Networks
- 9.3.5. Configuration of Fixed Installations and Mobile Units
- 9.3.6. Structure of a Fixed and Mobile Radiofrequency Transmitting Center
- 9.3.7. Installation of Radio and Television Signal Transmission Systems
- 9.3.8. Verification of the Operation of Broadcasting and Transmission Systems.
- 9.3.9. Maintenance of Transmission Systems

9.4. Multicast and End-to-End QoS
- 9.4.1. Introduction
- 9.4.2. IP Multicast in Radio Networks
- 9.4.3. Delay/Disruption Tolerant Networking (DTN)
- 9.4.4. E-to-E Service Quality
  - 9.4.4.1. Impact of Radio Networks on E-to-E QoS
  - 9.4.4.2. TCP in Radio Networks

9.5. Local WLAN Wireless Networks
- 9.5.1. Introduction to WLANs
  - 9.5.1.1. Principles of WLANs
    - 9.5.1.1.1. How They Work
    - 9.5.1.1.2. Frequency Bands
    - 9.5.1.1.3. Security
  - 9.5.1.2. Applications
  - 9.5.1.3. Comparison between WLAN and Cabled LAN
  - 9.5.1.4. Health Effects of Radiation
  - 9.5.1.5. Standardization and Normalization of WLAN Technology
  - 9.5.1.6. Topology and Configurations
    - 9.5.1.6.1. Peer-to-Peer (Ad-Hoc) Configuration
    - 9.5.1.6.2. Configuration in Access Point mode
    - 9.5.1.6.3. Other Configurations: Network Interconnection
- 9.5.2. IEEE 802.11 Standard - WI-FI
  - 9.5.2.1. Architecture
  - 9.5.2.2. IEEE 802.11 Layers
    - 9.5.2.2.1. The Physical Layer
    - 9.5.2.2.2. The Link (MAC) Layer
  - 9.5.2.3. Basic WLAN Operation
  - 9.5.2.4. Radio Spectrum Allocation
  - 9.5.2.5. IEEE 802.11 Variants
- 9.5.3. The HiperLAN Standard
  - 9.5.3.1. Reference Model
  - 9.5.3.2. *HiperLAN/1*
  - 9.5.3.3. *HiperLAN/2*
  - 9.5.3.4. Comparison of HiperLAN with 802.11a

9.6. Wireless Metropolitan Area Networks (WMAN) and Wireless Wide Area Networks (WWAN)
- 9.6.1. Introduction to WMAN. Features
- 9.6.2. WiMAX. Characteristics and Diagram
- 9.6.3. Wireless Wide Area Networks (WWAN). Introduction
- 9.6.4. Satellite and Mobile Telephony Network

9.7. Personal (WPAN Wireless Networks)
- 9.3.1. Technology and Evolution
- 9.3.2. *Bluetooth*
- 9.3.3. Personal and Sensor Networks
- 9.3.4. Profiles and Applications

9.8. Terrestrial Radio Access Networks
- 9.8.1. Evolution of Terrestrial Radio Access: WiMAX, 3GPP
- 9.8.2. 4th Generation Accesses. Introduction
- 9.8.3. Radio Resources and Capacity
- 9.8.4. LTE Radio Carriers. MAC, RLC and RRC

9.9. Satellite Communications
- 9.9.1. Introduction
- 9.9.2. History of Satellite Communications
- 9.9.3. Structure of a Satellite Communication System
  - 9.9.3.1. The Special Segment
  - 9.9.3.2. The Control Center
  - 9.9.3.3. The Ground Segment
- 9.9.4. Types of Satellite
  - 9.9.4.1. By Purpose
  - 9.9.4.2. By Orbit
- 9.9.5. Frequency Bands

9.10. Planning and Regulations of Radio Systems and Services
- 9.10.1. Terminology and Technical Characteristics
- 9.10.2. Frequencies
- 9.10.3. Coordination, Notification and Registration of Frequency Assignments and Plan Modifications
- 9.10.4. Interference
- 9.10.5. Administrative Provisions
- 9.10.6. Provisions Relating to Services and Stations

Module 10. System Engineering and Network Services

10.1. Introduction to the System Engineering and Network Services
- 10.1.1. Concept of Computer System and Computer Engineering.
- 10.1.2. Software and its Characteristics
  - 10.1.2.1. Software Features
- 10.1.3. Software Evolution
  - 10.1.3.1. The Dawn of Software Development
  - 10.1.3.2. The Software Crisis
  - 10.1.3.3. Software Engineering
  - 10.1.3.4. The Software Tragedy
  - 10.1.3.5. The Actuality of Software
- 10.1.4. The Myths of Software
- 10.1.5. The new Software Challenges
- 10.1.6. Software Engineering Professional Ethics
- 10.1.7. SWEBOK. Software Engineering: Body of Knowledge

10.2. Development Process
- 10.2.1. Problem Solving Process.
- 10.2.2. The Software Development Process
- 10.2.3. Software Process vs. Life Cycle
- 10.2.4. Life cycles. Process Models (Traditional)
  - 10.2.4.1. Waterfall Model
  - 10.2.4.2. Prototype-Based Models
  - 10.2.4.3. Incremental Development Model
  - 10.2.4.4. Rapid Application Development (RAD)
  - 10.2.4.5. Spiral Model
  - 10.2.4.6. Unified Development Process or Rational Unified Process (RUP)
  - 10.2.4.7. Component-Based Software Development
- 10.2.5. The Agile Manifesto. Agile Methods
  - 10.2.5.1. Extreme Programming (XP)
  - 10.2.5.2. *Scrum*
  - 10.2.5.3. Feature Driven Development (FDD)
- 10.2.6. Software Process Standards
- 10.2.7. Definition of a Software Process
- 10.2.8. Software Process Maturity

10.3. Agile Project Planning and Management
- 10.3.1. What is Agile
  - 10.3.1.1. History of Agile
  - 10.3.1.2. Agile Manifesto
- 10.3.2. Fundamentals of Agile
  - 10.3.2.1. The Agile Mindset
  - 10.3.2.2. The Agile Fit
  - 10.3.2.3. Product Development Life Cycle

10.3.2.4. The "Iron Triangle"
10.3.2.5. Working with Uncertainty and Volatility
10.3.2.6. Defined Processes and Empirical Processes
10.3.2.7. The Myths of Agile
10.3.3. The Agile Environment
10.3.3.1. Operating Model
10.3.3.2. Agile Roles
10.3.3.3. Agile Techniques
10.3.3.4. Agile Practices
10.3.4. Agile Frameworks
10.3.4.1. eXtreme Programming (XP)
10.3.4.2. *Scrum*
10.3.4.3. Dynamic Systems Development Method (DSDM)
10.3.4.4. *Agile Project Management*
10.3.4.5. Kanban
10.3.4.6. *Lean Software Development*
10.3.4.7. *Lean Start-up*
10.3.4.8. Scaled Agile Framework (SAFe)
10.4. Configuration Management and Collaborative Repositories
10.4.1. Basic Concepts of Software Configuration Management
10.4.1.1. What is Software Configuration Management?
10.4.1.2. Software Configuration and Software Configuration Elements
10.4.1.3. Baselines
10.4.1.4. Versions, Revisions, Variants and Releases
10.4.2. Configuration Management Activities
10.4.2.1. Configuration Identification
10.4.2.2. Configuration Change Control
10.4.2.3. Generation of Status Reports
10.4.2.4. Configuration Audit
10.4.3. The Configuration Management Plan
10.4.4. Configuration Management Tools
10.4.5. Configuration Management in the Metric v.3 Methodology
10.4.6. Configuration Management in SWEBOK
10.5. System and Service Testing
10.5.1. General Testing Concepts
10.5.1.1. Verify and Validate
10.5.1.2. Definition of Test
10.5.1.3. Principles of Testing
10.5.2. Approaches to Testing
10.5.2.1. White box Testing
10.5.2.2. Black Box Testing
10.5.3. Static Testing or Revisions
10.5.3.1. Formal Technical Reviews
10.5.3.2. *Walkthroughs*
10.5.3.3. Code Inspections
10.5.4. Dynamic Testing
10.5.4.1. Unit Testing
10.5.4.2. Integration Tests
10.5.4.3. System Testing
10.5.4.4. Acceptance Testing
10.5.4.5. Regression Testing
10.5.5. Alpha Testing and Beta Testing
10.5.6. The Testing Process
10.5.7. Error, Defect and Failure
10.5.8. Automatic Testing Tools
10.5.8.1. Junit
10.5.8.2. LoadRunner
10.6. Modeling and Design of Network Architectures
10.6.1. Introduction
10.6.2. System Characteristics
10.6.2.1. Description of the Systems
10.6.2.2. Description and Features of Services
10.6.2.3. Performance Requirements
10.6.2.4. Operability Requirements

10.6.3. Requirements Analysis
10.6.3.1. User Requirements
10.6.3.2. Application Requirements
10.6.3.3. Network Requirements
10.6.4. Design of Network Architectures
10.6.4.1. Reference Architecture and Components
10.6.4.2. Architecture Models
10.6.4.3. System and Network Architectures
10.7. Non-Linear System Modeling and Design
10.7.1. Introduction
10.7.2. Addressing and Routing Architecture
10.7.2.1. Routing Strategy
10.7.2.2. Routing Strategy
10.7.2.3. Design Considerations
10.7.3. Network Design Concepts
10.7.4. Design Process
10.8. Platforms and Deployment Environments
10.8.1. Introduction
10.8.2. Distributed Computer Systems
10.8.2.1. Basic Concepts
10.8.2.2. Models of Computation
10.8.2.3. Advantages, Disadvantages and Challenges
10.8.2.4. Operating Systems Basics
10.8.3. Virtualized Network Deployments
10.8.3.1. Need for Change
10.8.3.2. Transformation of Networks: from "All-IP" to the Cloud
10.8.3.3. Network Deployment in the Cloud
10.8.4. Example: Network Architecture in Azure
10.9. E2E Performance: Delay and Bandwidth. QoS.
10.9.1. Introduction
10.9.2. Performance Analysis
10.9.3. QoS.
10.9.4. Traffic Prioritization and Management
10.9.5. Service Level Agreements
10.9.6. Design Considerations
10.9.6.1. Performance Assessment
10.9.6.2. Relationships and Interactions
10.10. Network Automation and Optimization
10.10.1. Introduction
10.10.2. Network Management
10.10.2.1. Management and Configuration Protocols
10.10.2.2. Network Management Architectures
10.10.3. Orchestration and Automation
10.10.3.1. ONAP Architecture
10.10.3.2. Controllers and Functions
10.10.3.3. Politics
10.10.3.4. Network Inventory
10.10.4. Optimization

You will acquire technical and management skills highly demanded in industries such as telecommunications, technology, automotive and healthcare, through the best teaching materials in the academic market"

07

Internship

After passing the online theoretical period, the program includes a period of practical training in a leading company. In this way, students will have at their disposal the support of a tutor who will accompany them throughout the process, both in the preparation and in the development of the internship.

Through these internships, you will be able to apply the theoretical knowledge acquired in the program to real projects and challenges, working in close collaboration with professionals in the sector"

The Internship Program of this Telecommunication Engineering program consists of a practical training period of 3 weeks, from Monday to Friday, with 8 consecutive hours of practical training, always with an assistant specialist. This internship will allow the graduate to work on real telecommunication projects, alongside a team of reference professionals in the field of Telecommunication Engineering, applying the most innovative procedures and mastering the latest technology available.

In this totally practical training proposal, the activities are aimed at developing and perfecting the necessary skills to develop telecommunication projects, in areas and conditions that require a high level of qualification, and oriented to the specific training to perform the activity. This is undoubtedly an opportunity to learn by working.

The practical part will be carried out with the participation of the student performing the activities and procedures of each competence area (learning to learn and learning to do) the activities and procedures of each area of competence (learning to learn and learning to do), with the accompaniment and guidance of teachers and other training partners that facilitate teamwork and multidisciplinary integration as transversal competences for the praxis of computer science (learning to be and learning to relate).

The procedures described below will form the basis of the practical part of the training, and their implementation will be subject to the center's own availability and workload, the proposed activities being the following:

Module	Practical Activity
Design and Development of Telecommunication Systems	Analyze technical requirements for the design of telecommunication networks
	Develop software and hardware solutions for telecommunication systems
	Implement wireless and wired communication technologies
	Integrate telecommunication systems into existing infrastructures
Telecommunications Project Management	Plan telecommunication network installation projects
	Oversee compliance with deadlines and budgets in technology projects
	Coordinate multidisciplinary teams in telecommunication projects
	Evaluate performance and efficiency of implemented systems
Telecommunications Security	Develop security policies for telecommunications networks and systems
	Implement communications encryption and authentication systems
	Perform security audits in telecommunications infrastructures
	Manage the response to security incidents in communication networks
Innovation and New Technologies	Research and evaluate new and emerging telecommunications technologies
	Prototype solutions based on next-generation technologies
	Participate in the creation of patents and related intellectual property
	Collaborate in telecommunications research and development projects
Consulting and Technical Advisory Services	Advise companies on the implementation of telecommunications solutions
	Conduct technical feasibility studies for telecommunications projects
	Prepare technical reports for strategic decision making
	Train and coach internal teams in the use of telecommunication technologies

Civil Liability Insurance

This institution's main concern is to guarantee the safety of the trainees and other collaborating agents involved in the internship process at the company. Among the measures dedicated to achieve this is the response to any incident that may occur during the entire teaching-learning process.

To this end, this entity commits to purchasing a civil liability insurance policy to cover any eventuality that may arise during the course of the internship at the center.

This liability policy for interns will have broad coverage and will be taken out prior to the start of the practical training period. That way professionals will not have to worry in case of having to face an unexpected situation and will be covered until the end of the internship program at the center.

General Conditions of the Internship Program

The general terms and conditions of the internship agreement for the program are as follows:

1. TUTOR: During the Hybrid Professional Master's Degree, students will be assigned two tutors who will accompany them throughout the process, answering any doubts and questions that may arise. On the one hand, there will be a professional tutor belonging to the internship center who will have the purpose of guiding and supporting the student at all times. On the other hand, they will also be assigned an academic tutor whose mission will be to coordinate and help the students during the whole process, solving doubts and facilitating everything they may need. In this way, the student will be accompanied and will be able to discuss any doubts that may arise, both practical and academic.

2. DURATION: The internship program will have a duration of three continuous weeks, in 8-hour days, 5 days a week. The days of attendance and the schedule will be the responsibility of the center and the professional will be informed well in advance so that they can make the appropriate arrangements.

3. ABSENCE: If the students does not show up on the start date of the Hybrid Professional Master's Degree, they will lose the right to it, without the possibility of reimbursement or change of dates. Absence for more than two days from the internship, without justification or a medical reason, will result in the professional's withdrawal from the internship, therefore, automatic termination of the internship. Any problems that may arise during the course of the internship must be urgently reported to the academic tutor.

4. CERTIFICATION: Professionals who pass the Hybrid Professional Master's Degree will receive a certificate accrediting their stay at the center.

5. EMPLOYMENT RELATIONSHIP: the Hybrid Professional Master's Degree shall not constitute an employment relationship of any kind.

6. PRIOR EDUCATION: Some centers may require a certificate of prior education for the Hybrid Professional Master's Degree. In these cases, it will be necessary to submit it to the TECH internship department so that the assignment of the chosen center can be confirmed.

7. DOES NOT INCLUDE: The Hybrid Professional Master's Degree will not include any element not described in the present conditions. Therefore, it does not include accommodation, transportation to the city where the internship takes place, visas or any other items not listed

However, students may consult with their academic tutor for any questions or recommendations in this regard. The academic tutor will provide the student with all the necessary information to facilitate the procedures in any case.

08

Where Can I Do the Internship?

This Hybrid Professional Master's Degree program includes in its itinerary a practical stay in a prestigious IT company, where students will put into practice everything they have learned in Telecommunication Engineering. In this sense, and to bring this degree to more professionals, TECH will offer the opportunity to take it in different organizations around the country. In this way, this institution strengthens its commitment to quality and affordable education for all.

The internship will enrich your academic training, giving you a competitive advantage in the labor market to assume strategic and technical roles in telecommunications."

The student will be able to complete the practical part of this Hybrid Professional Master's Degree at the following centers:

IT specialist

Colegio Territorial de Arquitectos de Alicante

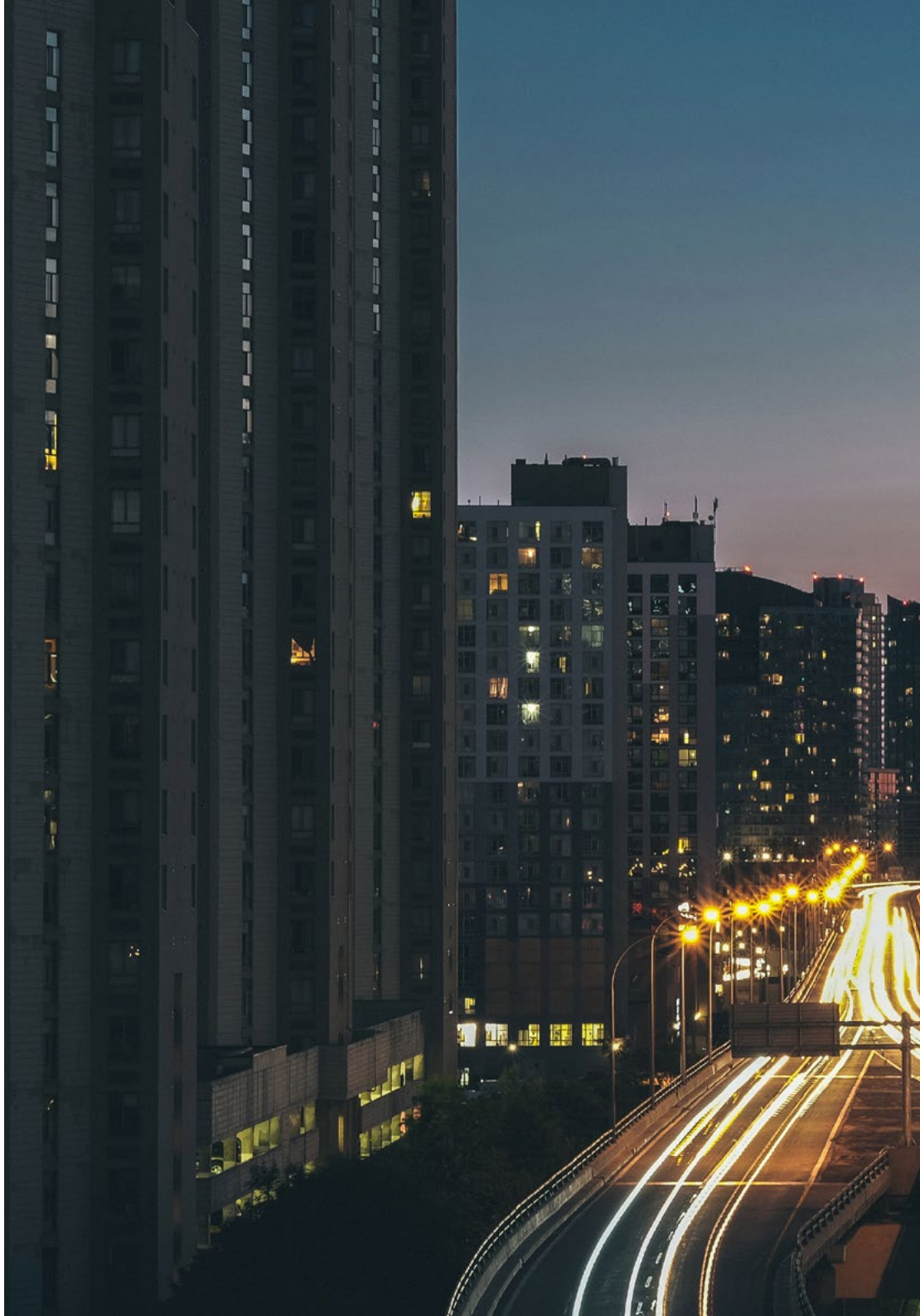
Country
Spain

City
Alicante

Address: Plaza Gabriel Miró, nº 2, 03001 Alicante

Represents and supports professionals in Alicante, ensuring that they have the necessary resources.

Related internship programs:
-Event Organization
- Digital Product Design (UX/UI)



Delve into the most relevant theory in this field, subsequently applying it in a real work environment"

09

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

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

Case Study to contextualize all content

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

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

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

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

A learning method that is different and innovative

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

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

The case method has been the most widely used learning system among the world's leading Information Technology schools for as long as they have existed. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

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

Relearning Methodology

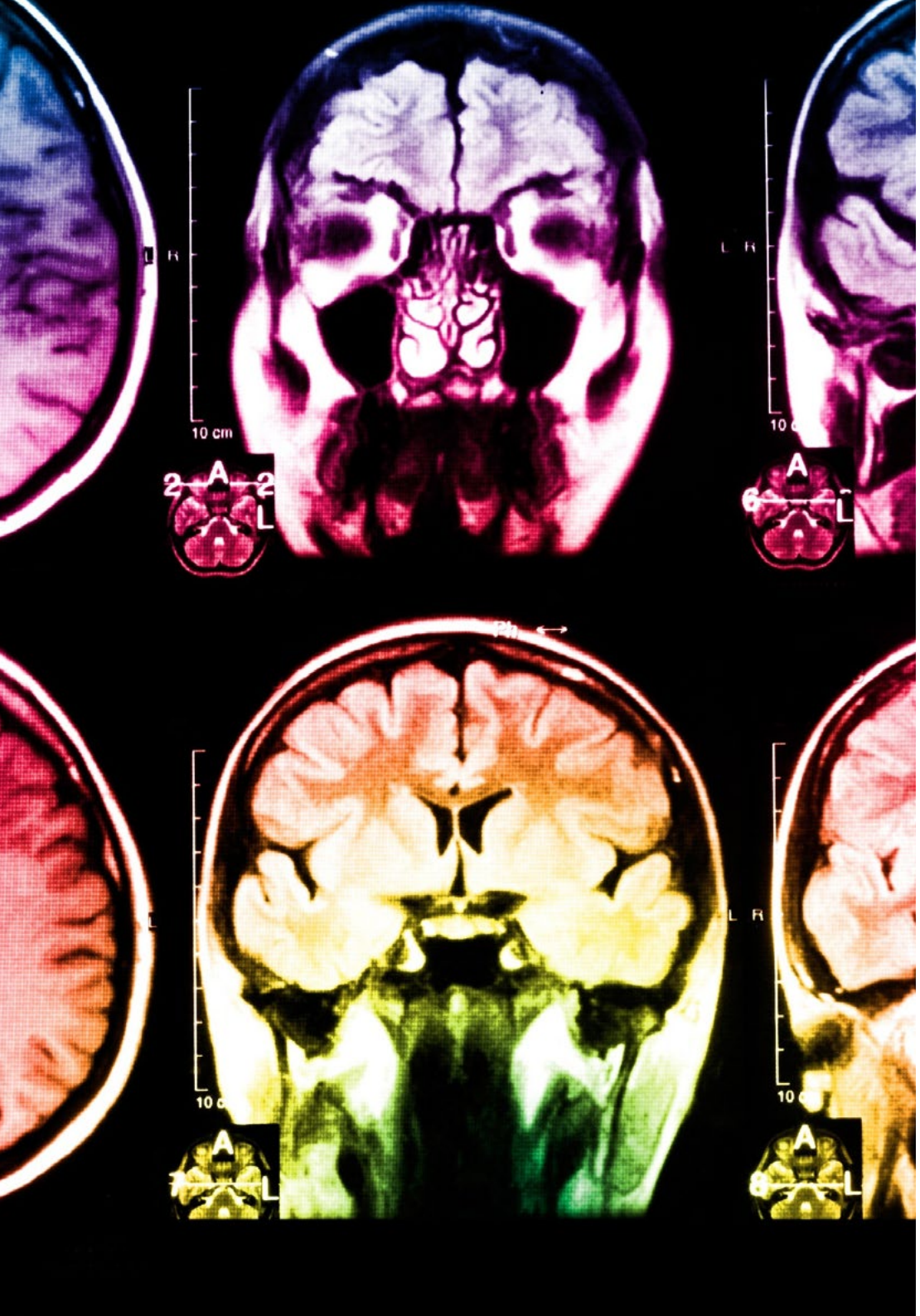
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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

vresults 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.

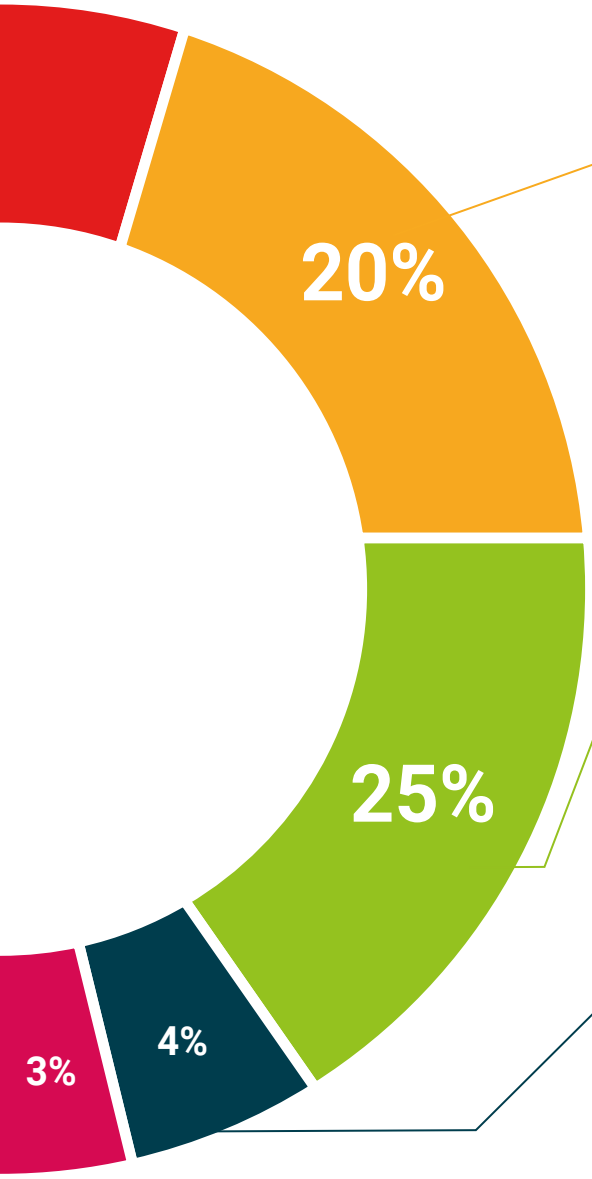
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

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.

10

Certificate

The Hybrid Professional Master's Degree in Telecommunications Engineering guarantees, in addition to the most rigorous and updated knowledge, access to a Hybrid Professional Master's Degree issued by TECH Global University.

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

This private qualification will allow you to obtain a **Hybrid Professional Master's Degree in Telecommunications Engineering** 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** private qualification 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: **Hybrid Professional Master's Degree in Telecommunications Engineering**

Modality: **online**

Duration: **12 months**

Accreditation: **60 + 4 ECTS**

tech global university

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

Hybrid Professional Master's Degree in Telecommunications Engineering

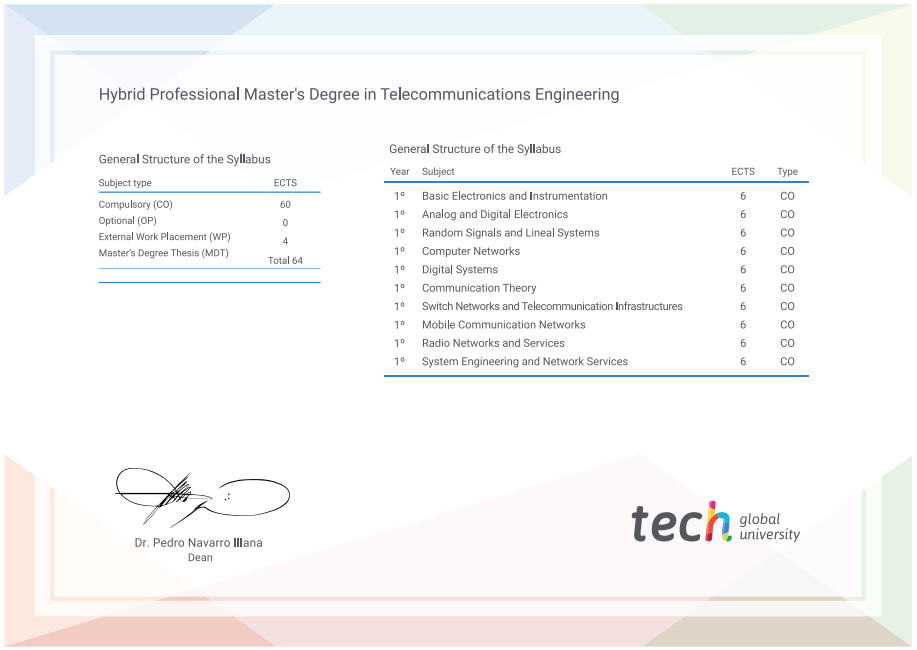
This is a private qualification of 1,620 hours of duration equivalent to 64 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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
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


Hybrid Professional Master's Degree in Telecommunications Engineering

General Structure of the Syllabus

Subject type	ECTS
Compulsory (CO)	60
Optional (OP)	0
External Work Placement (WP)	4
Master's Degree Thesis (MDT)	
	Total 64

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Basic Electronics and Instrumentation	6	CO
1º	Analog and Digital Electronics	6	CO
1º	Random Signals and Lineal Systems	6	CO
1º	Computer Networks	6	CO
1º	Digital Systems	6	CO
1º	Communication Theory	6	CO
1º	Switch Networks and Telecommunication Infrastructures	6	CO
1º	Mobile Communication Networks	6	CO
1º	Radio Networks and Services	6	CO
1º	System Engineering and Network Services	6	CO

Dr. Pedro Navarro Illana
Dean

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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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Hybrid Professional Master's Degree

Telecommunications Engineering

Modality: **Hybrid (Online + Internship)**

Duration: **12 months**

Certificate: **TECH Global University**

Credits: **60 + 4 ECTS**

HybridProfessional Master's Degree
Telecommunications Engineering

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