Masters in Telecommunications and Electronic Engineering (MET – MEE)

TelecomBCN

TELECOMBCN or ETSETB is the Telecommunications Engineer School of BARCELONATECH University

BARCELONATECH is:

• Public university in Spain
• Created in 1971
• Second largest producer of engineers in Spain
• Strong research activity
• Strong international dimension
• 23 schools in 8 Catalan cities
UPC BarcelonaTech

Barcelona
Vilanova i la Geltrú
Castelldefels
Sant Cugat
Terrassa
Manresa

Campus Nord UPC
Departments

• Professors are associated to departments
• Departments of our school involved in MET and MEE:
  • Main departments of ETSETB involved in MET and MEE
    • Department of Electronic Engineering (EEL)
    • Department of Network Engineering (ENTEL)
    • Department of Signal Theory and Communications (TSC)
  • Other departments that are involved in the bachelor degrees
    • Department of Applied Mathematics (MA)
    • Department of Applied Physics (FA)
    • Department of Computer Architecture (DAC)
    • Department of Management (OE)

Masters
Types of Spanish Masters

- Masters with regulated professional skills
  - Professional competences regulated by law to practice a profession:
    - Industrial engineer
  - Optionally, research competences

- Masters without regulated professional skills
  - Professional approach, but without a profession regulated by law:
    - Electronic Engineer
    - Software Engineer
  - Research approach: focussed to PhD

Doctorate Access

- Minimum: 300 ECTS of which 60 ECTS must be master level

PhD – Doctorate Program

- 1 year Master 60 ECTS
- 4 years Degree 240 ECTS
- Minimum

- 2 years Master 120 ECTS
- 4 years Degree 240 ECTS
Master Studies at TelecomBCN

- **Master in Telecommunications Engineering (MET): 120 ECTS**
  - Regulated professional competences
  - Two academic approaches: Professional profile - Research profile

- **Master in Electronic Engineering (MEE): 120 ECTS**
  - Two academic approaches: Professional profile - Research profile

- Master in Photonics: 60 ECTS
- Master in Computer Vision: 60 ECTS
- Master in Wireless Communications: 60 ECTS
- Erasmus Mundus Programmes:
  - EM-MERIT: European Master of Research on Information and Communication Technologies
  - EuroPhotonics: Erasmus Mundus Master in Photonics Engineering, Nano-photonics and Bio-photonics

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Master in Telecommunications Engineering (MET)
• Communication systems: wired and wireless, optical fibre.
• Computer networks, Internet, local area networks (Ethernet, Wi-Fi).
• Security in communication networks: encryption, user authentication, digital signatures.
• Radio navigation, global positioning systems (GPS).
• Radar.
• Information processing: encoding, compression, error correction, image recognition, video clip recognition, voice recognition, voice generation.
• Electronic components and circuits: microprocessor devices (routers, switches, …), sensors, actuators, transducers.
• Technology and electronics, analogue and digital electronic instrumentation, medical electronics, consumer electronics, control systems, robotics, automation.
• Micro and nanotechnologies.
• Bioengineering applications, telemedicine, e-commerce platforms, smart cities, smart metering, sensor networks, smart homes, green computing, cloud computing.
MET structure (120 ECTS)

NO SPECIALIZATION - MAXIMUM FLEXIBILITY
Choose 15 ECTS from one intensification and 30 elective ECTS
Double-Degree students must follow this path

INTENSIFICATIONS

- Communications 15 ECTS
- Electronics 15 ECTS
- Multimedia 15 ECTS
- Networks 15 ECTS

ELECTIVE CREDITS 30 ECTS

THESIS 30 ECTS

CORE COMPULSORY 45 ECTS

BRIDGE MAX: 30 ECTS
ASSIGNED BY MASTER ACADEMIC COMMISSION

MET structure (120 ECTS)

WITH SPECIALIZATION

Each specialization has 30 ECTS:
4 compulsory subjects + 2 specialization elective subjects

SPECIALIZATIONS

- Antennas, microwave and geosensors for communications and Earth observation 30 ECTS
- Electronics 30 ECTS
- Fiber-Optic communications 30 ECTS
- Visual media 30 ECTS
- Networks and Internet technologies 30 ECTS
- Wireless communications 30 ECTS

ELECTIVE CREDITS 30 ECTS
MET: Bridge Courses

• Communication bridge courses:
  • Digital communications
  • Signal processing
  • Antennas and microwaves
  • Telecommunication systems fundamentals

• Networking bridge courses:
  • Data transmission protocols

• Electronics bridge courses:
  • Programmable electronics
  • Systems based on microprocessors

Core Courses

• Communications
  • Advanced communications for wireless systems (ACWS)
  • Wireless communications links and antennas (WLA)
  • Telecommunication systems (TSYS)

• Networking
  • Communication networks (CN)
  • Overlay networks (OVNET)

• Electronics
  • Electronic system design for communications (ESDC)
  • Electronic instrumentation and optoelectronics (EIO)

• Projects
  • Innovation based service management (IBSM)
  • Management of telecommunications projects (MTP)
MET Paths

• Intensification
  • Choose 3 from 6
  • http://infoteleco.upc.edu/genweb/llistats_assignatures/assignatures_master_met_intensification.html

• Specialization
  • 4 compulsory
  • 2 specialization electives
  • http://infoteleco.upc.edu/genweb/llistats_assignatures/assignatures_master_met_specialization.html

Distribution in semesters

• 1\textsuperscript{st} semester:
  • (Bridge subjects)
  • Core subjects:
    • All except MTP
    • 1 or 0 specialization subject
      • All except IT
      • If WAN, simultaneously with CN
      • If QSN simultaneously with CN and OVNET
      • If AFOC or AMC simultaneously with TSYS

• 2\textsuperscript{nd} and 3\textsuperscript{rd} semesters: no restrictions
  • MTP as late as possible

• 4\textsuperscript{th} semester: Master’s thesis (TFM)
• Bridge courses
• Other courses of other or the same specialization tracks
• Elective transversal courses
• Seminars (2.5 ECTS)
  • One seminar to recognize activities organized by ETSETB or students organizations (conferences, short courses, …)
• “Special subjects”
• Introduction to Research (up to 15 ECTS)
• Internship in technological companies or research laboratories (15 ECTS)
  • Also possibility of extra-curricular internships
  • Inici ➤ Empreses ➤ Convenis de cooperació educativa ➤ Informació per a estudiants
• Recognized credits for working experience (max 15 ECTS)
• Courses of other masters (under tutor supervision)

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**MET: Elective Credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Term</th>
<th>Semester</th>
<th>Students</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBI@CERN</td>
<td>Fall</td>
<td>2nd-4th</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Imagine-IoT</td>
<td>Fall</td>
<td>2nd-4th</td>
<td>4</td>
<td>10</td>
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<tr>
<td>Colibri</td>
<td>Spring</td>
<td>3rd-4th</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I2P</td>
<td>Spring</td>
<td>1st-3rd</td>
<td>12-20</td>
<td>5</td>
</tr>
</tbody>
</table>

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**Special subjects**

• Subjects on innovation and entrepreneurship for a reduced amount of students:

- Multidisciplinary
- International
- Innovation / entrepreneurship / disruptive design
- Address to professor Ramon Bragos for more information
Special subjects

- **CBI@CERN**: Fall term, 2nd-4th semester, 4 students, 10ECTS
  - UPC + ESADE + IED students
  - Three intensive weeks at Ideasquare@CERN

- **Imagine IoT**: Fall term, 2nd-4th semester, 4 students, 10 ECTS
  - UPC + EADA + Elisava students
  - Friday afternoon + Saturday morning + intensive periods
Special subjects

- **I2P**: Spring term, 1st-3rd semester, 12-20 students, 5 ECTS
- Mixed teams: ESADE MBA + Telecom MET-MEE + FIB

Internship Innovation Project (I2P) is a master level course where student teams tackle a challenge presented by an organization.

**Colibrí**: Spring term, 3rd-4th semester, 4 students, 5 ECTS
- Colibrí consortium
Double degrees and mobility

- Mobility: Erasmus+, SICUE, ....
- Current Double Degrees:
  - KTH (Kungliga Tekniska Högskolan) Stockholm, Sweden
  - IIT (Illinois Institute of Technology) Chicago, USA
  - SUPAERO (École nationale supérieure de l'aéronautique et de l'espace) Toulouse, France
  - Telecom Bretagne (ENST), Brest, France
  - IST (Instituto Superior Técnico) Lisboa, Portugal
  - Pontificia Universidad Católica del Perú (PUCP)
  - Politecnico de Milano, Italia

- [http://etsetb.upc.edu/ca/international/international-partners/double-degree-partners](http://etsetb.upc.edu/ca/international/international-partners/double-degree-partners)

Master in Electronic Engineering (MEE)
• Why a Master?
  • Labour market is becoming more and more competitive. Master degree allows you to increase your income and gives you additional opportunities to improve your position.

• Why MEE?
  • Students that have finished MEE have an easy access to industrial/research activities.
    • Employability rate of 97.4%.
    • The 88.6% has taken less than 3 months to find the first job.
    • 90.3% of the graduates during academic year 2009-2010 have a salary considered "More than 2000 € per month".
  • MEE comes from a 25 years of experience teaching electronics at master level.
  • Hewlett Packard has chosen MEE as the master to train its electronic engineers under program HP Academy.

• Master in Electronic Engineering
  • 120 ECTS

• Two academic approaches:
  • Professional profile
  • Research profile
Suggested profiles of access

- Degree in Engineering of Electronic Systems
- Degree in Engineering of industrial electronics and automatic
- Degree in Science and Technologies of Telecommunications (generalist approach)
- Degree in Engineering of Audio-visual Systems
- Degree in Engineering of Telecommunications Systems
- Degree in Telematics Engineering
- Electronics or Telecommunications Engineers
  - Recognition of 60 ECTS
- Electronics or Telecommunications Technical Engineers
- Degree in Biomedical Engineering

MEE structure

Level B2 of English required

- Compulsory subject area (45 ECTS):
  - Power Control and Processing
  - Advanced Analog Circuits
  - Instrumentation and Sensors
  - Advanced Digital Systems
  - Micro and Nano electronic Design
  - Micro and Nanotechnologies
  - Signal Processing
  - Innovation Based Service Man.
  - Management of Telecomm. Projects

- Elective subject area (max. 45 ECTS)

- Master’s thesis (30 ECTS)
  - 1 semester

120 ECTS

Level B2 of English required
### MEE Structure

#### Example:

<table>
<thead>
<tr>
<th>2B</th>
<th>Master thesis (30 ECTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>Management in telecom projects</td>
</tr>
<tr>
<td>1B</td>
<td>Elective subjects (45 ECTS)</td>
</tr>
<tr>
<td>1A</td>
<td>Innovation based service management</td>
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<tr>
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<td>Advanced analog circuit techniques</td>
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<td>Micro and nano technologies</td>
</tr>
<tr>
<td></td>
<td>Micro and nano electronic design</td>
</tr>
</tbody>
</table>

#### Elective subjects (Bridge + electives 45 ECTS)

- Management in telecom projects
- Innovation based service management
- Advanced analog circuit techniques
- Instrumental and sensors
- Advanced digital systems
- Micro and nano technologies
- Micro and nano electronic design

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Master thesis (30 ECTS)
MEE: Bridge Courses

Degree in Engineering of Electronic Systems: no necessity of bridge courses.
Any other degrees need some bridge courses, unless the equivalent subject has been taken as an elective one.

- Control Theory and Applications
- Electronics for communications systems
- Introduction to Microelectronic technologies
- Programmable Electronics
- Sensors, Instruments and Measurement Systems
- Systems based on microprocessors
- Introduction to Power Electronics (seminar in February)
- Fundamentals of Discrete-time Signal Processing (seminar in February)

MEE Compulsory Courses

- Advanced analog circuit techniques (AACT)
  - Amplification
  - Continuous time and switched capacitor filtering
  - Analog – Digital conversion
MEE Compulsory Courses

- Advanced digital systems (ADS)
  - Memory design
  - Communication architectures
    - Scratchpads and cache memory
    - SOC memory systems
    - Board-based memory systems
  - Real-time operating systems (RTOS)
  - Physical communication mechanisms

- Power control and processing (PCP)
  - Switching converters modelling
  - State-space linear control techniques in switching power converters
  - Control applications in power electronics
• Instrumentation and sensors (IS)
  • Instrumentation systems
    • Advanced instrumentation systems architectures
    • Virtual instrumentation
    • Error analysis and specification
    • Estimation theory
    • Instrumentation systems calibration techniques
  • Sensor systems
    • Sensor principles, implementation and characteristics review
    • Advanced sensor conditioning techniques
    • Coherent detection methods for AC sensors
    • Self-correction and self-calibration techniques
    • Smart-sensor structure and standards
    • Sensor networks
    • Energy harvesting techniques for sensor systems

• Micro and nanotechnologies (MNT)
  • Field effect transistors and advanced devices
  • Power devices
  • Fabrication technology
  • Sensors
  • Electrokinetics
  • Advanced materials
• Micro and nano electronic design (MND)
  • Basic digital blocks and their characterization
  • Basic analog blocks and their characterization
  • Practical aspects of VLSI design
  • Basic concepts of testing
  • Laboratory of VLSI design

• Signal Processing for Electronic Engineers
  • Fundamentals of signal processing
  • Basic estimation theory
  • Nonparametric spectrum estimation
  • Signal modelling and parametric spectral estimation
  • Wiener filtering
Management Compulsory Courses

• Innovation based service management (IBSM)
  • Service economy
  • Strategy and innovation management
  • Innovative business models for a new economy
  • Collaborative consumption and open source
  • Service marketing
  • Service quality
  • Design services: the QFD methodology
  • The importance of organizational behaviour to managers
  • Group behaviour

Management Compulsory Courses

• Management of telecommunication projects (MTP)
  • CDIO subject
  • Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
  • Ability to develop, direct, coordinate, and technical and financial management of projects mainly in the field of telecommunication systems
• Elective credits (45 ECTS):
  
  • Bridging courses
  
  • Internship in technological companies (15 ECTS)
  
  • Recognized credits for working experience
  
  • Seminars (2.5 ECTS, 20 h, February and July)
  
  • Elective courses
    • Professional oriented
    • Research oriented
Apart from the elective subjects, even further specialization can be done through:

- Introduction to Research (15 ECTS): small project developed in a research group in order to specialize in a particular topic.

If the student has followed a minimum of 20 ECTS in one of the intensification topics (IR could be included in any of them depending on the developed work), the school will certify it once the student award the master title.

Elective Courses

- Elective subjects from other masters could be chosen under tutor supervisor.

- This includes mobility to international universities which is possible and encouraged!
  - Typically for doing elective courses and/or Master Thesis

Contact International Mobility Office at ETSETB!!

- A double degree with Politecnico de Milano
Sources of information


- Academic Secretary: administration, payments, etc.
  Ground floor at B3 building, masters@etsetb.upc.edu

- Academic Supervisor: he/she will guide you in the election of subjects

- MEE coordinator: credit recognition, mobility and internships in companies and universities, etc.
  Isidro Martín, isidro.martin@upc.edu

- Students’ delegate: his mission is to gather information about the day-to-day running of MEE and transmit to MEE coordinator suggestions to improve the Master development.
  Eduard Pérez, eduard2566@gmail.com

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Master thesis in the ETSETB
Development of the Universal Gateway for the Barcelona Municipality:

- Wireless Network Group
- Ajuntament de Barcelona
- First smart city pilot build in 2007 in Sant Vicenç dels Horts
- Mobile nodes on board of public transportation buses to measure data (parking available places) and collect information from sensors.
- One single equipment on the street to collect information from different sensor manufacturers

Train on Board Monitoring:

- Wireless Network Group
- Funded by ALSTOM
- Development of a system to perform train on board monitoring
  - Preventive maintenance
  - Sensing mechanic parts (Temperature, Vibration)
  - Transport information inside the train
  - Process, transfer and generate alarms
  - Solution implemented: 802.15.4 + Gateway
  - Energy harvesting by vibration
Develop Advanced Driver Assistant Systems for Buses:

- Image Processing Group
- Advanced Hardware Architecture Group
- Funded by Arcol S.A.
- 360º vision system
- Blind Spot Detection and Line departure

**Topics in Master:**
- 230620: Digital Image and Video Processing
- 230621: Introduction to Computer Vision
- 230660: Programmable Electronics
- 230659: Sensors, Instruments and Measurement Systems

Drivers Drowsiness Detection:

- Drowsiness detection through the analysis of driver’s biological data.
- FICOSA
- Portable biomedical sensor that sends variations of the thoracic effort through Bluetooth.
- Application in the Smartphone to analyse and store data and used as interface

**Topics in Master:**
- 230643: Instrumentation and Sensors
- 230674: Biomedical Instrumentation Design
- 230659: Sensors, Instruments and Measurement Systems
High Efficiency Solar Cells:

- Micro and Nanotechnologies Research Group
- Funded by European Union
- PERC: Passivated Emitter and Rear Cell
- IBC: Interdigitated Back-Contacted solar cells: Efficiency > 22% (Spanish record!)

Topics in Master:
- 230361: Solar Cell for Dummies

Non-intrusive monitoring of coronary stent:

- RF & Microwave Systems, Devices and Materials
- Hospital Universitari Germans Trias i Pujol
- Micro-wave based monitoring of coronary stents.
- Commonly, stent monitoring requires invasive procedures (catheterization) or exposition to X-rays.

Topics in Master:
- 230608: Microwave, Terahertz and Photonic Technologies (MET)
- 29407: Design and Analysis of RF and Microwave Systems for Communications
**RESCUECELL:** Potable kit for detecting trapped and buried people in ruins and avalanches:

- Signal Processing and Communications Group
- Funded by the European Union
- RESCUECELL project aims at developing a cost-effective, robust and lightweight technology, that can easily be transported to the affected zone (avalanche or earthquake), and by spreading several nodes covering the entire zone, the technology will lead to the location of possible injured people swiftly within some minutes.

**ICT for High Throughput Low Latency infrastructures based on dynamic all optical networks:**

- Optical Communications Group
- Funded by the European Union
- COCONUT: “Cost-effective COhereNt Ultra-dense-WDM-PON for lambda-To-the-user access”: 

![COCONUT Diagram](image)
Design of superconductive filters with fractal geometry:

- RF & Microwave Systems, Devices and Materials
- Funded by the European Union
- Collaboration with Fractus S.A.

UPC Cube-Sat:

- Passive Microwave Remote Sensing Group
- Companies or consortium
- Some testing facilities @ UPC NanoSat-lab
  - Shake table, Thermal Vacuum Chamber and Sun Simulator, Amateur Ground Station, Helmholtz Coils and Air Bearing
- More than 90 students have been involved in the Cat-1 Cube-Sat development.
Display technology:

• Electrowetting: Geometric changes to liquid by applying electric fields
• Amazon will develop ebooks or tablets with pixels based on this technology
• Technology also applicable to liquid lenses

• Topics in Master:
  • 230669: MEMS. Microelectromechanical Systems

Graphene-enabled Wireless Communications:

• Graphene nanoantennas for nano-range communication
• Samsung Advanced Institute of Technology
• Intel Research
• Mid-term: Graphene-based Wireless Network-on-Chip for Multi-Core processors
• Long-term: Wireless Nano-Sensor Networks

• Topics in Master:
  • 230675 - EDIS - Edison: Energy Management for Distributed and Integrated Systems
Nanofabrication:

- Polystyrene nanospheres
- Diameter: 200nm (1/50 human hair)
- Deposited by electrospraying

- Used as sacrificial element in nanofabrication, also by unique optical properties
- Patented technology

Topics in Master:
- 230645 - MNT - Micro and Nanotechnologies