Course guides
230997 - SCFOB - Secure Communications in Fiber-Optic Networks

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.
Degree: MASTER’S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER’S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER’S DEGREE IN CYBERSECURITY (Syllabus 2020). (Optional subject).
Academic year: 2021
ECTS Credits: 5.0
Languages: English

LECTURER

Coordinating lecturer: Comellas Colome, Jaume
Others: Gene Bernaus, Joan Manuel
Lazaro Villa, Jose Antonio
Spadaro, Salvatore

PRIOR SKILLS

Programing skills
Fundamentals of communication networks

TEACHING METHODOLOGY

Lectures
Laboratory practical work
Individual and group assignments

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this course is to train students in methods of understanding, evaluating and designing mechanisms for implementing security protocols in fiber optic based networks. The main concepts and specificities of optical networks regarding security issues are introduced and practical solutions are studied.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>33,0</td>
<td>26.40</td>
</tr>
<tr>
<td>Hours small group</td>
<td>6,0</td>
<td>4.80</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
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</tbody>
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Total learning time: 125 h
## CONTENTS

### 1. Introduction

**Description:**
- Fiber Optic networks fundamentals
- Multi-layer, multi-domain, network management and control
- Need for physical layer security strategies

**Full-or-part-time:** 9h 30m  
- Theory classes: 2h  
- Guided activities: 1h  
- Self study: 6h 30m

### 2. Security issues in IP over optical networks

**Description:**
- Nodes and fibers tapping and jamming  
- Crosstalk attacks  
- Quality of service (QoS) degrading/disruptive attacks  
- Disturbances on network control  
- FTTH networks attacks

**Full-or-part-time:** 19h  
- Theory classes: 4h  
- Guided activities: 2h  
- Self study: 13h

### 3. Limitations of Physical Layer-Agnostic Security Technologies

**Description:**
- Types of security  
  - Unconditional security  
  - Computational security  
  - Information-based security  
- The thread of quantum computing  
  - Shor’s algorithm  
  - Post-quantum cryptography  
- High-speed secure communications  
  - The speed-security trade-off  
  - State-of-the art

**Related activities:**  
- Real time encryption algorithms analysis, simulation and comparison

**Full-or-part-time:** 29h  
- Theory classes: 4h  
- Laboratory classes: 3h  
- Guided activities: 2h  
- Self study: 20h
4. Security technologies for the optical layer

Description:
Physical layer security
- The wiretap channel
- Secrecy capacity
Confidentiality/authenticity: optical encryption
- Optical code division multiplexing (OCDM)
- Optical key distribution
- Spatial division multiplexing (SDM)
Privacy: optical steganography
- Chromatic dispersion
- Amplified spontaneous emission (ASE)
Integrity/availability: optical jamming
- Waveband conversion
- Optical chaos-based communications

Full-or-part-time: 29h
Theory classes: 6h
Guided activities: 3h
Self study : 20h

5. Quantum security technologies

Description:
Quantum tools for classic cryptography
- Quantum random number generators (QRNG)
- Quantum noise-randomized ciphers (QNRC)
Quantum cryptography
- Quantum key distribution (QKD)
- Quantum ciphers

Related activities:
Lab Practice: QKD algorithms analysis, simulation and comparison

Full-or-part-time: 38h 30m
Theory classes: 6h
Laboratory classes: 3h
Guided activities: 3h
Self study : 26h 30m

GRADING SYSTEM

Personal assignments (40%), Group assignments (20%), Final exam (40%)
**BIBLIOGRAPHY**

**Basic:**