Course guide
300525 - APT - Telecommunication Architectures and Protocols

Last modified: 07/07/2026

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: **Degree:** BACHELOR'S DEGREE IN SATELLITE ENGINEERING (Syllabus 2024). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Definit a la web de l'assignatura

Others:

PRIOR SKILLS

-digital signal processing, sampling and quantization;
-signal spectrum and bandwidth;

TEACHING METHODOLOGY

Weekly classes include theoretical classes (lecture sessions), problem sessions and laboratory classes. In the theoretical classes, the main concepts are explained; in the problem sessions, exercises related to the theoretical concepts and presentations are done; and in the laboratory, practicals are done where students use hardware and software tools to reinforce concepts.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge:
K1: Identify basic tools applied in the field of satellite engineering.
K3: Identify the elements of telecommunication systems.
K4: Identify standards associated with satellite engineering, as well as regulatory, social, ethical, environmental, commercial, operational, and technical and economic feasibility constraints.

Skills:
S1: Apply basic and advanced concepts to problems related to space engineering.
S6: Evaluate satellite systems, taking into account specifications, regulations, and mandatory standards.
S7: Design a terrestrial-to-satellite and inter-satellite telecommunications network.

Competences:
C1: Develop autonomous learning skills.
C2: Carry out tasks and projects individually or as part of a group, assuming responsibilities.

At the end of the course, the student should be able to:
-understand what a communication protocol is,
-understand the communication rules required in space, compare them with those on Earth, and the performance metrics used,
-identify standardization bodies and reference models for satellite communications,
-understand the functions of the main communication protocols, both internal to the satellite and between satellites and Earth-satellite systems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	33,0	26.40
Hours small group	22,0	17.60
Self study	70,0	56.00

Total learning time: 125 h

CONTENTS

Fundamentals and the Challenge of Space

Description:
The objective of this block is to understand why space requires different communication rules than those on Earth, the concept of protocol and the metrics used to evaluate its operation.

Full-or-part-time: 12h
Theory classes: 2h
Laboratory classes: 2h
Self study : 8h

Reference models

Description:
Students are explained how communications and protocols are structured, the most important standardization organizations, and the OSI and TCP/IP models.

Full-or-part-time: 7h
Theory classes: 3h
Self study : 4h

The Physical Layer and access

Description:
It studies how information is processed and transmitted in space, access control methods and the functions of the physical layer.

Full-or-part-time: 15h
Theory classes: 2h
Laboratory classes: 4h 30m
Self study : 8h 30m

Internal communications of the Satellite

Description:
It explains how the internal components of the satellite communicate, the concept and examples of buses and the functions of the link layer.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 2h
Self study : 7h

Space Mission Protocols

Description:
It covers the international rules used by agencies such as NASA or ESA, the CCSDS, and the functions of data link and layer three protocols.

Full-or-part-time: 11h
Theory classes: 3h
Self study : 8h

The Terrestrial Internet adapted to Space

Description:
The functions of the transport layer, the effects of latency, and basic data encodings are explained.

Full-or-part-time: 32h
Theory classes: 10h
Laboratory classes: 5h 30m
Self study : 16h 30m

Non-terrestrial networks (NTN)

Description:
It explains how to connect a mobile phone or a sensor directly to a satellite (DTS), the basic functions and parameters of a wireless network and the IoT, and its adaptation to satellite communications.

Full-or-part-time: 15h
Theory classes: 4h 30m
Laboratory classes: 2h
Self study : 8h 30m

Security

Description:
The concept of security in satellite communications, its importance and examples of solutions are explained.

Full-or-part-time: 7h
Theory classes: 2h 30m
Self study : 4h 30m

Megaconstellations and Dynamic Networks

Description:
Concepts such as DTN and space routing are covered.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 4h
Self study : 5h

Introduction to virtualization and the Cloud

Description:
It discusses the future of communications in space, the concepts of SDN and virtualization.

Full-or-part-time: 4h
Theory classes: 2h
Laboratory classes: 2h

GRADING SYSTEM

The evaluation criteria defined on the subject website will be applied.

BIBLIOGRAPHY

Basic:
- Hoyhtya, Marko. Satellite Communications and Networks [on line]. 1st ed. 2025. Cham: Springer Nature Switzerland, 2025 [Consultation: 26/06/2026]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-031-72927-0. ISBN 9783031729270.
- Maral, Gérard; Bousquet, Michel. Satellite communications systems. 2nd ed. Chichester [etc.]: John Wiley & Sons, 1993. ISBN 0471930326.