AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

Teaching SYSTEMS AND DEVICES FOR SATELLITES

GenCod A005672

Owner professor Caterina CIMINELLI

Teaching in italian SYSTEMS AND DEVICES FOR SATELLITES

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SSD code ING-INF/01

Reference course AEROSPACE ENGINEERING

Course type Laurea Magistrale

Credits 9.0

Teaching hours Front activity hours: 81.0

For enrolled in 2019/2020

Taught in 2020/2021

Course year 2

Language ENGLISH

Curriculum SYSTEMS

Location Brindisi

Semester First Semester

Exam type Oral

Assessment Final grade

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course aims at presenting the basic concepts and the recent advances in the field of electronic devices and systems for satellites. After a brief introduction on the space missions, the fundamentals of modern VLSI devices and RF microelectronics are discussed, together with the description to the main characteristics and challenges of the space environment. The basic solution for electronic circuits and systems in space applications and the related technogical options are described.The strategies to be followed in the design and testing are also discussed. A classification of the modern spacecrafts and a full overview of the satellites subsystems are also given, together with a number of examples of spacecrafts and missions. The electronic and optoelectronic systems for the satellite platform and for for telecom and EO payloads are the main topics of the course.

REQUIREMENTS

Fundamentals of Chemistry, Physics, and Computer Science

COURSE AIMS

The training objectives of the course are as follows.
1) KNOWLEDGE AND UNDERSTANDING of the fundamentals of the electronic devices/systems for space at the state-of-the-art.
2) APPLYING KNOWLEDGE AND UNDERSTANDING, by designing innovative electronic systems for space.
3) MAKING JUDGEMENT, by choosing independently the most appropriate approach to implement a specific functionality.
4) COMMUNICATION, by writing proper technical reports on different topic relevant to electronic devices/systems for space, and by discussing their contents.
5) LIFELONG LEARNING SKILLS, as ability of studying and understanding autonomously new electronic devices/systems for space.

TEACHING METHODOLOGY

Classroom lectures, numerical exercises, lab exercises.

ASSESSMENT TYPE

Oral exam or written test

FULL SYLLABUS

Chapter 1 - Introduction **(0.5 CFU)**

Space Missions: Space System Segments; Design of System Segments for Space Flight Missions; Space Flight Mission Classification.

Chapter 2 – Fundamentals of modern VLSI devices and RF Microelectronics **(1.5 CFU)**

Transistors: Semiconductor devices, Applications, Loss and gain, The *pn*Junction, The BJT, The MOSFET, HBT, HFET.

From Transistors to Circuits to Systems: Building Circuits and Systems from Transistors.

Microwave Electronics: Basics of Microwave Electronics, Microelectronic devices based on GaAs, Monolithic microwave integrated circuits.

Chapter 3 - The Space Environment **(0.5 CFU)**

Spacecraft and the Space Environment: Introduction; Influence of the Sun and the Space Background; Influence of the Earth.

Chapter 4 - Electronic circuits and systems in Space applications**(0.5 CFU)**

Introduction: General view of the extreme environment electronics.

Extreme environments: High-pressure and high-temperature environments; Cold-temperature environments; Severe radiation environments.

Technology options**.**

Chapter 5 - Electronic Design and Test for Space Systems **(1 CFU)**

Space Electronics, Technology, materials and devices, Fault Tolerance and Mitigation Techniques, Space COTS.

Qualification, Standards and Tests.

Chapter 6 – Modern spacecrafts **(1.5 CFU)**

Satellite Classification: Classification by mass; Classification by mission; Classification by orbit.

Overview of Satellite Subsystems: Structure and Mechanisms; Electrical Power Supply; Thermal Control; Satellite Propulsion; Attitude Control; Data Management; Communication; Payload.

Examples of spacecrafts and missions.

Chapter 7 – Electronic and optical systems for the satellite platform **(2 CFU)**

Electronic and optoelectronic devices and systems for electrical power supply: Solar cells and solar array; Power semiconductor devices and power electronic converters.

Optoelectronic and microelectromechanical sensors for satellite attitude control: Star tracker; Microelectromechanical inertial sensors for Space; Optoelectronic gyroscopes.

Optical fiber sensors for structural health monitoring and temperature sensing: Fundamentals of optical fiber sensors; Fiber sensors for structural health monitoring; Fiber sensors for temperature sensing.

On-board computers: Spaceborne processors; Memories for Space; Technologies for spacecraft data buses.

Examples of systems.

Chapter 8 – Electronic systems for telecom and EO payloads **(1.5 CFU)**

Electronic hardware for telecom payloads: transparent and regenerative telecom payloads; Communication receiver: block diagram. Linearizer/channel amplifiers.

Electronic and optoelectronic hardware for EO payloads: Image sensors for Space; Infrared sensors, Passive Microwave Sensors, Radar systems, LIDAR.

Examples of systems

REFERENCE TEXT BOOKS	Handbook of Space Technology, Edited by Wilfried Ley, Klaus Wittmann and Willi Hallmann © 2009 John Wiley & Sons, Ltd., ISBN: 978-0-470-69739-9 Space Microsystems and Micro/Nano Satellites, Edited by Zheng You © 2015 Elsevier, ISBN: 978-0-12-812672-1 Photonics in space: advanced photonic devices and systems,Caterina Ciminelli, Francesco Dell'Olio, and Mario N. Armenise,© 2016 by World Scientific Publishing Co. Pte. Ltd. ISBN: 9789814725101