UNIVERSITÀ DI PISA

DIGITAL COMMUNICATIONS

LUCA SANGUINETTI

Academic year	2022/23
Course	INFORMATICA E NETWORKING
Code	919II
Credits	12

Modules	Area	Type	Hours	Teacher(s)
FUNDAMENTAL OF SIGNALS AND SYSTEMS	ING-INF/03	LEZIONI	48	LUCA SANGUINETTI
FUNDAMENTALS OF DIGITAL COMMUNICATIONS	ING-INF/03	LEZIONI	48	MARCO LUISE

Obiettivi di apprendimento

Conoscenze

MODULE 1: **FUNDAMENTALS OF SIGNALS AND SYSTEM**
Fourier Analysis of Signals and Systems: The Fourier Transform, Transmission of Signals through Linear Time-Invariant System, Canonical Representation of Band-Pass Signals, Linear Modulation Theory, Numerical Computation of the Fourier Transfom
Probability Theory and Bayesian Inference: Probability Theory, Random Variables, The Gaussian Distribution, The Central Limit Theorem, Bayesian Inference. Application to communication systems.
Stocastic Processes: Definition, Strictly Stationary and Weakly Stationary Processes, Ergodic Processes, Transmission of a Weakly Stationary Process through a Linear Time-invariant Filter, Power Spectral Density of a Weakly Stationary Process, The Gaussian Process, Noise
Basics of Information Theory: Entropy, Lossless Data Compression Algorithms, Channel Capacity
MODULE 2: **FUNDAMENTALS OF DIGITAL COMMUNICATIONS**

1. Basics of Signals, Spectra, Digital Communications, and Information Theory (4 hours)
2. Digital Data Signals for wired and wireless media – Wireless Communications (6 hours)
3. Generation of cellular networks (2G to 5G), multiplexing and multiple access, including CDMA and OFDM(A) (12 hours)
4. Fiber-Optic communications for Internet backbones (12 hours)
5. Technologies for the access network: the families of xDSL and FTTx (8 hours)
6. Physical-secure communications: Spread spectrum signaling and anti-jamming/spoofing (6 hours)

Modalità di verifica delle conoscenze

Oral exam with the teachers

Capacità

MODULE 1: **FUNDAMENTALS OF SIGNALS AND SYSTEMS**
The student who successfully passes the exam will have acquired the knowledge necessary for the analysis of signals and systems and the basic technologies for data transfer in communications systems.
MODULE 2: **FUNDAMENTALS OF DIGITAL COMMUNICATIONS**
The student who successfully completes the course will have the ability to understand the main communication standards for the delivery of digital information in the Future Internet. She/He will master digital signalling and formatting for wireless and wired communications in optical backbones, 4G and 5G cellular networks and in xDSL, and will have a fundamental knowledge about the issues of digital encoding of information and exploitation of communication resources like energy and bandwidth. moded.

Modalità di verifica delle capacità

Oral exam with the teachers, and development of howeworks during the course.

Comportamenti

The student will acquire also a vision of the market and of the industrial needs in the field of communication networks

Modalità di verifica dei comportamenti

Through some questions during the oral exam and classes.

UNIVERSITÀ DI PISA

Prerequisiti (conoscenze iniziali)

MODULE 1: **FUNDAMENTALS OF SIGNALS AND SYSTEM**
Basic knowledge of mathematical analysis and probability theory. Basic knowledge of the MATLAB programming language.
MODULE 2: **FUNDAMENTALS OF DIGITAL COMMUNICATIONS**
Basic knowledge of signals, systems, and digital formats.

Indicazioni metodologiche

Delivery: face to face/Online
Attendance: Not mandatory
Learning activities:

- Attending lectures
- Individual study
- Bibliography search

Programma (contenuti dell'insegnamento)

MODULE 1: **FUNDAMENTALS OF SIGNALS AND SYSTEM**
Fourier Analysis of Signals and Systems: The Fourier Transform, Transmission of Signals through Linear Time-Invariant System, Canonical Representation of Band-Pass Signals, Linear Modulation Theory, Numerical Computation of the Fourier Transfom
Probability Theory and Bayesian Inference: Probability Theory, Random Variables, The Gaussian Distribution, The Central Limit Theorem, Bayesian Inference. Application to communication systems.
Stocastic Processes: Definition, Strictly Stationary and Weakly Stationary Processes, Ergodic Processes, Transmission of a Weakly Stationary Process through a Linear Time-invariant Filter, Power Spectral Density of a Weakly Stationary Process, The Gaussian Process, Noise
Basics of Information Theory: Entropy, Lossless Data Compression Algorithms, Channel Capacity
MODULE 2: **FUNDAMENTALS OF DIGITAL COMMUNICATIONS**

1. Basics of Signals, Spectra, Digital Communications, and Information Theory (4 hours)
2. Digital Data Signals for wired and wireless media – Wireless Communications (6 hours)
3. Generation of cellular networks (2G to 5G), multiplexing and multiple access, including CDMA and OFDM(A) (12 hours)
4. Fiber-Optic communications for Internet backbones (12 hours)
5. Technologies for the access network: the families of xDSL and FTTx (8 hours)
6. Physical-secure communications: Spread spectrum signaling and anti-jamming/spoofing (6 hours)

Bibliografia e materiale didattico

MODULE 1: **FUNDAMENTALS OF SIGNALS AND SYSTEM**
Slides presented during the lectures and other reference material that will be indicated during the course, including the folling book:

- Simon Haykin *Digital Communication Systems*, Wiley.

Modalità d'esame

Mandatory oral exam: for each module (IT & WC) 30 min. Discussion about two main topics suggested by the examiner, and that the student must be capable to master in detail.

Ultimo aggiornamento 19/09/2022 17:52