



UNIVERSITÀ
DEGLI STUDI
DI BRESCIA

Università degli Studi di Brescia

Study Programme	05812 - COMMUNICATION TECHNOLOGIES AND MULTIMEDIA
Course unit	A000346 - DIGITAL MODULATION AND CHANNEL CODING
Academic year	2022/2023
Course leader:	MIGLIORATI PIERANGELO
Period	Primo Semestre
Teaching Methods	Convenzionale
Teaching Language	eng

MAIN COURSE

Study Programme	05812 - COMMUNICATION TECHNOLOGIES AND MULTIMEDIA
Course unit	A000346 - DIGITAL MODULATION AND CHANNEL CODING
Tenured Professor	MIGLIORATI PIERANGELO

SYLLABUS

LINGUA INSEGNAMENTO

English

CONTENUTI

Introduction. Course structure. Modulation and demodulation for the AWGN channel
Characterization of signals and noise waveforms. Modulation and demodulation for the

Additive White Gaussian Noise channel (AWGN). The optimal receiver for the AWGN channel. Performance estimation. The Union bound. Examples. Digital Modulation Systems (OFDM, CPM, DSSS) Orthogonal Frequency Division Multiplexing (OFDM). Transmitter and receiver. Channel equalization in the frequency domain. Effects of non-linearities. Examples of applications of OFDM. Continuous Phase Modulation techniques (CPM). Full and partial response CPM. Optimal and simplified receivers. Power spectrum estimation. Practical examples (GMSK, TFM, ...). Direct Sequence Spread Spectrum (DSSS) Modulation and Code Division Multiple Access (CDMA) techniques. Block and Convolutional Linear Codes Linear block codes. The generation matrix and the parity check matrix. Cyclic codes. Hard and soft decision decoding. Performance evaluation. Burst error correction. Examples. Convolutional codes. Definition. Optimum decoding. The Viterbi algorithm. Performance evaluation. Classic concatenated codes. Examples. Recent trends in channel coding Turbo codes. Low Density Parity Check codes. Examples. Examples of modern communications systems GSM, UMTS, LTE, xDSL, DPL, DAB, DVB, WiMax, WiFi, Software Radio, Cognitive Radio, MIMO Systems, UWB, RFID, Domotic Applications, Wireless communications in the Smart Cities, etc.

LIBRI DI TESTO/LIBRI CONSIGLIATI

Simon Haykin, Communication Systems, 4th ed., Wiley, 2001 J. G. Proakis, Digital Communications, McGraw-Hill. S. Benedetto, E. Biglieri, Principles of Digital Transmission, Kluwer Academic-Plenum Publishers. S. Bellini, Trasmissione numerica, CUSL, 1996. S. Bellini, Teoria dell'informazione e codici, free available in web.

OBIETTIVI FORMATIVI

The aim of this course is the analysis of the principal error control coding techniques and digital modulation techniques used in the modern communication systems (5G, WiFi, WiMax, Digital Power Lines, Terrestrial Digital Video Broadcasting, etc.).

PREREQUISITI

Fourier transform. Basic Concepts of Probability and Random Variables. Basic concepts of linear algebra.

METODI DIDATTICI

Lessons and examples.

ALTRE INFORMAZIONI

No.

MODALITÀ DI VERIFICA DELL'APPRENDIMENTO

Written and Oral examination.

PROGRAMMA ESTESO

Introduction. Course structure. Modulation and demodulation for the AWGN channel. Characterization of signals and noise waveforms. Modulation and demodulation for the Additive White Gaussian Noise channel (AWGN). The optimal receiver for the AWGN channel. Performance estimation. The Union bound. Examples. Digital Modulation Systems (OFDM, CPM, DSSS) Orthogonal Frequency Division Multiplexing (OFDM). Transmitter and receiver. Channel equalization in the frequency domain. Effects of non-linearities. Examples of applications of OFDM. Continuous Phase Modulation techniques (CPM). Full and partial response CPM. Optimal and simplified receivers. Power spectrum estimation. Practical examples (GMSK, TFM, ...). Direct Sequence Spread Spectrum (DSSS) Modulation and Code Division Multiple Access (CDMA) techniques. Block and Convolutional Linear Codes Linear block codes. The generation matrix and the parity check matrix. Cyclic codes. Hard and soft decision decoding. Performance evaluation. Burst error correction. Examples. Convolutional codes. Definition. Optimum decoding. The Viterbi algorithm. Performance evaluation. Classic concatenated codes. Examples. Recent trends in channel coding Turbo codes. Low Density Parity Check codes. Examples. Examples of modern communications systems GSM, UMTS, LTE, xDSL, DPL, DAB, DVB, WiMax, WiFi, Software Radio, Cognitive Radio, MIMO Systems, UWB, RFID, Domestic Applications, Wireless communications in the Smart Cities, etc.