Communication channels and systems

Academic Year: (2022 / 2023) **Review date: 31-05-2022**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: BOUSOÑO CALZON, CARLOS

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Systems, Communication Theory, Electromagnetic Fields

OBJECTIVES

The objectives of the course are
1) To address several key issues such as noise, bandwidth limitation, interference; and to investigate their effects on the performance of communication systems, through error probability analysis.
2) To analyze the different types of transmission media and their impairments.
3) To explore fundamental limits of communication systems, such as channel capacity.
4) To plan and analyze simple communication systems in terms of coverage and capacity.

Related to the following:
)
Specific objectives
1.- cognitive
- Transmission concepts
- Channel characterization and modelling.
- Quality measurement in communication channels
- Limits in Performance of physical channels.
- Design and planning of communication systmes
2.- Instrumental
- Programming with channel simulation software

DESCRIPTION OF CONTENTS: PROGRAMME

UNIT 1. Link Budget:
- Power and Attenuation
  Logarithmic Units: dB, dBW, dBm.
- Noise and other impairments.
- Probability of error: an introduction to communication quality.

UNIT 2. Propagation models
- Large scale and Log-normal models
- Small-scale radio propagation models: multipath.

UNIT 3. Signal models
- Multipath models
  - Power profile
  - Coherence bandwidth

- Doppler Effect.
  - Frequency shift
  - Coherence Time
- Channel Classification
- Statistical behavior of fading
  - Rayleigh and Rice models
  - Signal-to-Noise ratio: exponential

UNIT 4. Discrete Channel Models.
- Memoryless models: Binary Symmetric Channel (BSC)

- Channels with memory.
  - Markov models
  - Example of parameter estimation in the Gilbert's Model.

- Computation of the Bit Error Probability
  - Matrix Probabilities
  - Error patterns
  - Applications to system design.

LEARNING ACTIVITIES AND METHODOLOGY

The course consists of the following elements: lectures, exercises, and computer exercises.
LECTURES (2,5 ECTS)
The ON LINE lectures provide the students with explanation of the core material in the course.
EXERCISES (2.5 ECTS)
In these sessions at the classroom, students will discuss problems which merge the different concepts together.

LABORATORIES (1 ECTS)
Some selected concepts will be discussed using the computer. Students may form small working groups.

ASSESSMENT SYSTEM

Assessment includes:
- A selected set of problems (30%)
- Final exam (60%)
- Lab-Programming (10%)

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Bernard Sklar Digital Communications: Fundamentals and Applications, Prentice Hall.

- John C. Bellamy Digital Telephony, Wiley-Interscience; 3 edition (2000).

ADDITIONAL BIBLIOGRAPHY

- Carlos Bousoño, Francisco J. González Notas de la Asignatura, http://www.tsc.uc3m.es/docencia/SyCT.

- S. Benedetto and E. Biglieri Principles of Digital Transmission with wireless applications, Kluwer Academic, 1999

- William Turin Digital Transmission Systems: Performance Analysis and Modeling, Mcgraw-Hill (Tx); 2 Sub edition (November 3, 1998).