

## SUBJECT TEACHING GUIDE

M1598 - Telecommunication Systems

Master's Degree in Telecommunication Engineering

Academic year 2021-2022

| 1. IDENTIFYING DATA              |                                                         |                  |                    |                  |                    |
|----------------------------------|---------------------------------------------------------|------------------|--------------------|------------------|--------------------|
| Degree                           | Master's Degree in Telecommunication Engineering        |                  |                    | Type and Year    | Compulsory. Year 2 |
| Faculty                          | School of Industrial Engineering and Telecommunications |                  |                    |                  |                    |
| Discipline                       |                                                         |                  |                    |                  |                    |
| Course unit title and code       | M1598 - Telecommunication Systems                       |                  |                    |                  |                    |
| Number of ECTS credits allocated | 5                                                       | Term             | Semester based (1) |                  |                    |
| Web                              |                                                         |                  |                    |                  |                    |
| Language of instruction          | Spanish                                                 | English Friendly | Yes                | Mode of delivery | Face-to-face       |

|                  |                                                                                               |  |  |  |  |
|------------------|-----------------------------------------------------------------------------------------------|--|--|--|--|
| Department       | DPTO. INGENIERIA DE COMUNICACIONES                                                            |  |  |  |  |
| Name of lecturer | AMPARO HERRERA GUARDADO                                                                       |  |  |  |  |
| E-mail           | amparo.herrera@unican.es                                                                      |  |  |  |  |
| Office           | Edificio Ing. de Telecomunicación Prof. José Luis García García. Planta: - 1. DESPACHO (S129) |  |  |  |  |
| Other lecturers  | ALMUDENA SUAREZ RODRIGUEZ<br>MARIA ISABEL PONTON LOBETE                                       |  |  |  |  |

| 3.1 LEARNING OUTCOMES                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------|
| - Knowledge of telecommunications systems, in particular satellite communications systems: Orbital calculations, link calculations. |
| - Capacity of design and definition of the communications system, and ability for the choice of components.                         |
| - Knowledge of the techniques of modeling and study of the characteristics of an RF system                                          |
| - Management of a simulation environment and its simulation techniques of mixed systems: RF and Baseband                            |
| - Management of the equipment of measurement and characterization of an RF and mixed system.                                        |

#### 4. OBJECTIVES

Design a Satellite Communication System based on the application.

To know the basic magnitudes of the communication systems in mixed environments: RF and Microwave with Base Band

Characterize communication systems in Mixed environments: RF and Microwave with Baseband

#### 6. COURSE ORGANIZATION

##### CONTENTS

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Introduction: Origin and history of satellite communications. Current status and prospects for satellite communications. Organizations. Satellite telecommunication services. Assigned frequency bands. Basic elements: spatial and ground segments. Services.                                                                                                                                                                 |
| 2 | Propagation. Losses. Attenuation. Polarization change due to rain. Rotation of Faraday in the ionosphere. Effects of rain, sun and moon. Link.- Transmission losses. Atmospheric losses Antenna temperature. System derating temperature. G / T ratio in earth stations. Balance of uplink and descending. Intersatellites links. Signal noise relationships.                                                                  |
| 3 | Orbital aspects.- Orbital mechanics. Description of the orbit. Position of the satellite in the orbit. Location of the satellite with respect to Earth. Orbital elements. Types of orbits                                                                                                                                                                                                                                      |
| 4 | Satellite Subsystems. Orbital and position control subsystem. Telemetry, Tracking and control subsystems. Power subsystem. Communications subsystem: Transparent repeater, Regenerative repeaters. Frequency bands. Characteristics of transponders. Antenna subsystem: aperture antennas, gain and coverage area. Earth stations. Antennas for earth stations. Recommendations. Figure of merit. Equipment of earth stations. |
| 5 | Examples of links.- Links Intelsat. Domestic satellites with small stations. Diffusion Direct TV, DBS. Design of low speed satellites. VSAT                                                                                                                                                                                                                                                                                    |
| 6 | Design and simulation of a communications Satellite link. Design and Define a QPSK modulator (2 weeks), Define and simulate the RF chain for the transmitter and receiver with commercial components (3 weeks). Integration of subsystems Baseline and RF (2 weeks) integrate the entire transmitting chain receiver (2 weeks)                                                                                                 |
| 7 | Measurement of the designed equipment, RF blocks and baseband (2 weeks), measures of the integration of the whole system (2 weeks)                                                                                                                                                                                                                                                                                             |

## 7. ASSESSMENT METHODS AND CRITERIA

| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Type         | Final Eval. | Reassessn | %      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|-----------|--------|
| Individual Projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Others       | No          | Yes       | 34,00  |
| Simulation Laboratory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Others       | Yes         | No        | 24,00  |
| Measurement laboratory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Others       | Yes         | No        | 12,00  |
| Final Exam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Written exam | Yes         | Yes       | 30,00  |
| TOTAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |             |           | 100,00 |
| <b>Observations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |             |           |        |
| <p>The subject is organized to be evaluated with the continuous evaluation method, the laboratory simulation and measurement are mandatory as well as the final written exam. Students who have not passed any of the partial evaluations carried out during the course may be submitted to the final exam with the weight of the mark being 60%, and 40% will be obtained from the evaluation of the laboratory work.</p> <p>The remaining students who follow the continuous evaluation will be able to obtain 70% by this method being 30% the weight of the final exam. In the continuous evaluation, two individual works, the class activities and the practice sessions will be carried out in the simulation laboratory and in the measurement laboratory. And finally in the June call for a written exam.</p> |              |             |           |        |
| <b>Observations for part-time students</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |           |        |
| <p>Students who have chosen the part-time option will be able to present themselves to the final exam with the weight of the grade being 60%, and the remaining 40% will be obtained from the evaluation of the laboratory work, both simulation and measurement, composite For 13 sessions of two hours that are mandatory and not recoverable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |             |           |        |

## 8. BIBLIOGRAPHY AND TEACHING MATERIALS

| BASIC                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| RF Circuit Design (Second edition) . Richard Chi-Hsi Li. ED Wiley ISBN 978- 118-30990-2 versión Adobe-PDF. ISBN 978-1-118-12849-7 (Version impresa) |
| RF System Design of Transceivers for Wireless Communications (Qizheng Gu) ED: Springer 2005 ISBN: 978-0387241616                                    |