

Academic Year: (2023 / 2024)

Review date: 27/04/2023 13:09:09

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: MORALES CESPEDES, MAXIMO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Digital Communications, Systems and Transmission Channels .

OBJECTIVES

Knowledge about the basic planning, deployment and optimization techniques applied for wireless communication networks. The student acquires the abilities to perform the planning, put in operation and optimization of wireless networks.

For planning wireless networks the knowledge of the following subjects is needed:

- Influence of the propagation and noise.
- Integration in the link of modulation and coding.
- Scaling the elements of the wireless network.
- Medium access control procedures.
- Wireless systems architecture.

The student achieves the following competences:

- Ability to calculate link budgets in wireless networks.
- Ability to scale the elements in the network.
- Ability to design wireless systems using the technical, economic and social constraints as input in the design.
- Ability to use software tools in order to design and scale wireless networks.

DESCRIPTION OF CONTENTS: PROGRAMME

Topic 1. Introduction to wireless communications.

- 1.1 Kind of services: bearer services, added value services.
- 1.2 Wireless networks: trunk networks, mobile systems, PAN, LAN, WAN, sensor networks.
- 1.3 The radio electric spectrum.

Topic 2. The radioelectric channel.

- 2.1 Elements of a radio link.
- 2.2 Friis's formula.
- 2.3 Diffraction.
- 2.4 Noise model.
- 2.5 Mobile propagation
- 2.6 The Okumura Hata model.
- 2.7 The Walfish-COST model
- 2.8 Indoor propagation models

Topic 3. Statistical channel models

- 3.1 Impulse channel response.
- 3.2 Slow fading.
- 3.3 Rayleigh and Rice channels.
- 3.4 Fading statistics.
- 3.5 Statistical channel models

- 3.6 Wide band channel models.
- 3.7 Delay and Doppler Spreads
- 3.8 Transverse filter channel model.
- 3.9 COST 207 channel model.

Topic 4. Capacity of wireless channels.

- 4.1 Flat fading channels
- 4.2 Channel state information at the receiver.
- 4.3 Ergodic and outage capacity.
- 4.4 Capacity of multiple access and broadcast channels.

Topic 5. Cellular systems.

- 5.1 Cellular geometry
- 5.2 Rhombus numbers.
- 5.3 Cochannel interference
- 5.4 Cellular sub-division.
- 5.5 Limits on the cell size.
- 5.5 Interference and traffic in CDMA systems

Topic 6. 2G Mobile networks planning.

- 6.1 GSM radio system.
- 6.2 GSM subsystems.
- 6.3 Traffic, control and signalling channels.
- 6.4 Base station and mobile equipment.
- 6.5 GSM standards and link balance.

Topic 7. 3G Mobile networks planning.

- 7.1 UMTS services and architecture.
- 7.2 UMTS channels.
- 7.3 UMTS codes.
- 7.4 UMTS equipment
- 7.5 UMTS specifications.
- 7.6 UMTS link budget.

Topic 8. 4G Mobile networks planning.

- 8.1 LTE architecture and services.
- 8.2 LTE channels.
- 8.3 LTE modulation and resources.
- 8.4 MIMO in LTE.
- 8.5 LTE equipment.
- 8.6 LTE specifications.
- 8.7 LTE link balance.

LEARNING ACTIVITIES AND METHODOLOGY

Three teaching activities are proposed: theoretical lectures in class, practical exercises and projects and lab practices. The ECTS credits include always the student's personal work.

THEORETICAL CLASSES (3ECTS)

The theoretical classes will be taught using the blackboard and multimedia means as projectors. At the same time the recommended readings, exercises, projects, homework, etc., will be proposed to the students.

PRACTICAL EXERCISES (2.2 ECTS)

Three kind of practical exercises are considered:

- Solving and evaluation of the proposed exercises.
- Evaluation of the proposed projects.

LABORATORY CLASSES (0.8 ECTS)

The practical sessions in lab allow the students to know the actual working of the systems.

- The practical work is performed with a professional wireless planning system that incorporates terrain and building data bases.

ASSESSMENT SYSTEM

% end-of-term-examination/test: 60

% of continuous assessment (assignments, laboratory, practicals...): 40

Continuous evaluation includes:

- Laboratory Exercises (20 %)
- End-of-topic exams (20%)
 - An exam is programmed at the end of topics 5 and 8 that covers the subjects studied previously.

Final exam (60 %)

- The final examination is a standard closed-book written exam. The exam will test the knowledge and understanding about the main aspects covered in the course.
- To pass the course the students will need to score at least 40% of the mark of the final exam.

BASIC BIBLIOGRAPHY

- Goldsmith, Andrea Wireless communications, Cambridge University Press, 2005, ISBN: 0521837163.
- Hernando Rábanos, José María Comunicaciones móviles, Centro de Estudios Ramón Areces, 2004, ISBN:848004635X.