Communications technologies for a connected society

Academic Year: (2019 / 2020) **Review date: 03-05-2019**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: GONZALEZ SERRANO, FRANCISCO JAVIER

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

1. Access Networks and Shared Media.
2. Digital Communications.

OBJECTIVES

The main goal of this course is providing the student with a global view of the different communication technologies used in modern communications networks (from Broadband Access Networks, to Personal Area Networks and Internet of Things). More specifically, the course emphasizes those aspects more closely related to digital communications: the physical and data link (logical link and medium access control) layers.

In order to achieve this goal, the student must acquire the following set of ABET program outcomes: a, b, c, d, e, g, i, j, k.

Regarding the competences, the student must acquire the following competences:

1. General competences:
1.1. Analysis, synthesis and communication. (PO: a, b, e, g, k)
1.2. Organization, planning and design. (PO: a, b, c, e, g, k)
1.3. Information search and interpretation. (PO: a, b, i, j, k)
1.4. Problem solving. (PO: a, e, j, k)
1.5. Collaborative work. (PO: d, g)
1.6. Capacity to apply theoretical concepts. (PO: a, b, c, e, k)
2. Specific competences:
2.1. Cognitive (PO: a, b, c, e, j, k)
2.1.1. Global knowledge of broadband access networks and services.
2.1.2. Knowledge of the physical media and digital communications techniques used in communication networks.
2.1.3. Specific knowledge of the most important wired and wireless broadband access networks and technologies.
2.2. Instrumental (PO: a, b, c, d, e, i, j, k)
2.2.1. Comparison of broadband access networks according to several criteria.
2.2.2. Choice of appropriate access network technology to meet specific needs.
2.2.3. Analysis of known and new access network technologies.
2.2.4. Simulation of broadband access networks and technologies.
3. Attitude competences: (PO: d, e, g, i, j)
3.1. Creativity.
3.2. Responsibility.
3.3. Motivation.
3.4. Critical vision of broadband access networks and technologies.

DESCRIPTION OF CONTENTS: PROGRAMME

The programme is divided in 16 topics grouped together in 4 large blocks:

Block 1: Introduction.
1. Introduction to broadband networks and access technologies.
2. Broadband services and applications.

Block 2: Wired Broadband Access Technologies.
3. Digital subscriber loops (xDSL).
4. Hybrid optical fiber and cable networks (HFC).
5. Passive optical fiber networks (PON).

Block 3: Wireless Broadband Access Technologies.
6. Wireless Local Access Networks
7. Broadband Mobile Communication Networks

8. Satellite Communication
Block 4: Technologies for the Connected Society
9. Internet of Things
10. Short-range Access Networks:
¿ NFC, RFID, Bluetooth, Zig-bee, UWB, 802.15.6. Wearables.
11. Technologies for Remote Areas:
¿ HAPS, Balloons, Drones
12. Technologies for disaster and security critical areas:
¿ TETRA; Military Networks.
13. Technologies for Intelligent Transport Systems:
¿ Vehicular networks: V2V, V2I; 802.11p
14. Technologies for Smart Cities/Buildings/Homes:
¿ LPWAN, SigFox, LoRa, NB-IoT
¿ Sensor Networks
15. Technologies for eHealth
16. Emerging Technologies
¿ 5G, HetNEts, LIFI

LEARNING ACTIVITIES AND METHODOLOGY

1. Theory: lectures and exercises. 3.0 ECTS. (PO: a, d, e, g, j)
1.1. Exposition of the main theoretical and practical aspects related to broadband access networks and technologies.
1.2. Analysis and synthesis problems related to different broadband access networks and technologies with special emphasis on their critical comparison.
1.3. Collective resolution of general doubts in class and individual resolution of specific doubts in the office.
1.4. Group solution of proposed exercises with occasional collection and evaluation is used to enhance collaborative and communication skills.
1.5. After each major block a short theoretical exam will be performed.
2. Laboratory experiments. 1.5 ECTS. (PO: a, b, c, d, e, g, i, j, k)
2.1. Global simulation of a standardized broadband access technology specified at the beginning of the course. Several groups of students will be established and each group will be responsible for the simulation of a specific block of the technology. At the end all the blocks will be integrated in order to achieve a global simulator.
2.2. Learning to work in a multidisciplinary team is emphasized by assigning each member of the group a specific role and responsibility: team leader, test engineer, person in charge of integration, hardware engineer, etc.
2.3. Collaborative work inside each group (the whole group is responsible for the success or failure of their block) and with other groups (so that consecutive blocks can be integrated properly) is emphasized.
2.4. The experiments involve system design (standards only define the transmitter, not the receiver), as well as designing a test plan to guarantee that each block works properly, analyzing the results obtained and correcting possible errors.
2.5. Communication skills are emphasized by asking each group to write a short technical report about their design and experiments and perform a brief exposition.
3. Project. 1.5 ECTS. (PO: a, d, g, i, j, k)
3.1. Each group has to write a theoretical technical report about a different broadband access technology. Two options are possible:
3.1.1. Describing more in depth some aspect of one or more technologies already seen in the course.
3.1.2. Providing a general analysis of a new technology not seen in the course.
3.2. The ability of the students to look for information, analyze it and synthesize it is evaluated through a written technical report.

ASSESSMENT SYSTEM

The work of the students will be evaluated through a continuous evaluation system using several indicators: group exercises collected in class, short theoretical exams performed after each major block, group theoretical technical report, and technical report and presentation about the laboratory experiments.
The precise scoring used will be the following:

1. Exams: 30 %. (PO: a, d, e, g, j)
2. Laboratory experiments: 20 %. (PO: a, b, c, d, e, g, i, j, k)
3. Project on communication technologies: 30 %. (PO: a, d, g, i, j, k)
4. Presentation of the Project: 20 % (PO a, d)

% end-of-term-examination:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

- Devaki Chandramouli, Rainer Liebhart, Juho Pirskanen 5G for the Connected World, WILEY, 2019

- Rodolfo I. Meneguette, Robson E. De Grande, Antonio A. F. Loureiro Intelligent Transport System in Smart Cities: Aspects and Challenges of Vehicular Networks and Cloud (Urban Computing) , Springer, 2019

- Vlasios Tsiatsis, Stamatis Karnouskos, Jan Holler Internet of Things: Technologies and Applications for a New Age of Intelligence, Academic Press, 2018

ADDITIONAL BIBLIOGRAPHY

- Anna Maria Vegni, Dharma P. Agrawal Cognitive Vehicular Networks, CRC Press, 2016

- Burak Kantarci, Sema Oktug Wireless Sensor and Actuator Networks for Smart Cities, MDPI AG, 2018

- Mohamed Gado, Doaa Abd El-Moghith Li-FI Technology for Indoor Access: Li-Fi, LAP LAMBERT Academic Publishing, 2015

- Syed A. Ahson, Mohammad Ilyas Near Field Communications Handbook, Auerbach Publications, 2011