ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000609 - Wireless Sensor Networks

DEGREE PROGRAMME

59AI - Master Universitario En Comunicaciones Inalámbricas

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	593000609 - Wireless Sensor Networks
No of credits	4.5 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	59AI - Master Universitario en Comunicaciones Inalámbricas
Centre	59 - Escuela Tecnica Superior De Ingenieria Y Sistemas De Telecomunicacion
Academic year	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
David Luengo Garcia (Subject coordinator)	A7011, D8201A	david.luengo@upm.es	Sin horario. Meetings with prior appointment.
Alejandro Garcia Lamperez	A7010	alejandro.garcia.lamperez@upm.es	Sin horario. Meetings with prior appointment.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB8 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CGI02 - Comprender el procedimiento, valor y límites del método científico, siendo capaz de identificar, localizar y obtener datos requeridos en un trabajo de investigación, de diseñar y guiar investigaciones analíticas, de modelado y experimentales, así como de evaluar datos de una manera crítica y extraer conclusiones.

CGI03 - Valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación.

CGI04 - Leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico.

UPM1 - Uso de la lengua inglesa

UPM4 - OrganizaciÃ³n y planificaciÃ³n /

3.2. Learning outcomes

RA40 - RA01 - Distinguish between WSN technologies, topologies, and architectures: WPAN and LPWAN

RA18 - RA03.- Choose the mathematical methods and tools necessary to tackle a problem and finds the solution.

RA41 - RA02 - Program WSNs nodes and design their deployment and supervision

RA42 - RA05 - Design a WSN solution for a real case

RA11 - Identify the social and economic impact of mobile communications in a global context

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

This course aims to introduce Wireless Sensor Networs (WSNs) by using the cognitive communications concept. Implementation of WSNs equipped with real-time positioning devices will also be introduced.

4.2. Syllabus

1. Introduction to Wireless Sensor Networks (WSNs)
   1.1. Background
   1.2. Applications
   1.3. Hot Topics
2. Physical Layer and Medium Access Control
   2.1. Modulation and Radio Technologies
   2.2. Medium Access Control (MAC)
3. Routing Strategies and Protocols
   3.1. Basic Theory of Routing Protocols
   3.2. Topology Control Protocols
   3.3. QoS Routing in WSNs

4. Cognitive WSNs

   4.1. Cognitive Radio Networks and Dynamic Spectrum Access

   4.2. Cognitive Diversity Routing

   4.3. Weighted Cognitive Maps to Enable Cognition

5. WSN Development

   5.1. Lab Development Environment

   5.2. Use Case Example (Guided Example)

   5.3. WSN Project Development (Student's Project)

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Introduction to WSNs** Duration: 02:00 **Physical Layer and Medium Access** Duration: 02:00			
2	**Physical Layer and Medium Access** Duration: 02:00 **Physical Layer and Medium Access** Duration: 02:00			**Group Work - Introduction to WSNs** Continuous assessment and final examination Presential Duration: 00:00
3	**Physical Layer and Medium Access** Duration: 01:00 **Physical Layer and Medium Access** Duration: 01:00 **WSN Routing Strategies and Protocols** Duration: 02:00			
4	**WSN Routing Strategies and Protocols** Duration: 02:00 **WSN Routing Strategies and Protocols** Duration: 01:30			**Group Work - Physical and MAC Layer** Continuous assessment and final examination Presential Duration: 00:00 **Test 1 - Introduction + Physical/MAC Layers** Continuous assessment and final examination Presential Duration: 00:30
5	**WSN Routing Strategies and Protocols** Duration: 01:00 **WSN Routing Strategies and Protocols** Duration: 01:00 **Cognitive WSNs** Duration: 02:00			

6	**Cognitive WSNs** Duration: 02:00 **Cognitive WSNs** Duration: 01:30			**Group Work - Routing Strategies and Protocols** Continuous assessment and final examination Presential Duration: 00:00 **Test 2 - Routing Strategies & Protocols** Continuous assessment and final examination Presential Duration: 00:30
7	**Cognitive WSNs** Duration: 02:00 **Cognitive WSNs** Duration: 02:00			
8		**Lab Development Environment** Duration: 01:30		**Group Work - Cognitive WSNs** Continuous assessment and final examination Presential Duration: 00:00 **Test 3 - Cognitive WSNs** Continuous assessment and final examination Presential Duration: 00:30
9		**Use Case Example (Guided Project)** Duration: 02:00		
10		**Use Case Example (Guided Project)** Duration: 02:00		
11		**WSN Project Development (Student's Project)** Duration: 02:00		**Use Case Example (Guided Project)** Continuous assessment and final examination Presential Duration: 00:00
12		**WSN Project Development (Student's Project)** Duration: 02:00		
13		**WSN Project Development (Student's Project)** Duration: 02:00		

14		**WSN Project Development (Student's Project)** Duration: 02:00		
15				**WSN Project Development (Student's Project)** Continuous assessment and final examination Presential Duration: 00:00
16				
17				**Global Test (Only for Students Failing the Progressive Evaluation)** Final examination Not Presential Duration: 01:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Group Work - Introduction to WSNs		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02
4	Group Work - Physical and MAC Layer		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02
4	Test 1 - Introduction + Physical/MAC Layers		Face-to-face	00:30	15%	/ 10	CB7 CB6 UPM1 CB8
6	Group Work - Routing Strategies and Protocols		Face-to-face	00:00	5%	/ 10	CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02 CGI03
6	Test 2 - Routing Strategies & Protocols		Face-to-face	00:30	10%	/ 10	CB7 CB6 UPM1 CB8

8	Group Work - Cognitive WSNs		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02
8	Test 3 - Cognitive WSNs		Face-to-face	00:30	15%	/ 10	CB7 CB6 UPM1 CB8
11	Use Case Example (Guided Project)		Face-to-face	00:00	10%	/ 10	CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02 CB7
15	WSN Project Development (Student's Project)		Face-to-face	00:00	30%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Group Work - Introduction to WSNs		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02
4	Group Work - Physical and MAC Layer		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8

							CGI02
4	Test 1 - Introduction + Physical/MAC Layers		Face-to-face	00:30	15%	/ 10	CB7 CB6 UPM1 CB8
6	Group Work - Routing Strategies and Protocols		Face-to-face	00:00	5%	/ 10	CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02 CGI03
6	Test 2 - Routing Strategies & Protocols		Face-to-face	00:30	10%	/ 10	CB7 CB6 UPM1 CB8
8	Group Work - Cognitive WSNs		Face-to-face	00:00	5%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02
8	Test 3 - Cognitive WSNs		Face-to-face	00:30	15%	/ 10	CB7 CB6 UPM1 CB8
11	Use Case Example (Guided Project)		Face-to-face	00:00	10%	/ 10	CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02 CB7
15	WSN Project Development (Student's Project)		Face-to-face	00:00	30%	/ 10	CB7 CGI03 CB6 UPM1 UPM4 UPM5 CGI04 CB8 CGI02

17	Global Test (Only for Students Failing the Progressive Evaluation)		No Presential	01:00	40%	/ 10	CB7 CB6 UPM1 CB8

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

The progressive evaluation of this course consists of three parts:

1) Written exams at the end of units 1-2 (15%), unit 3 (10%) and unit 4 (15%).

2) Individual/group works (depending on the number of students) to be submitted at the end of the first four units of the course (10% each).

3) Group works to be submitted as part ot the practical (lab) part of the course: guided project (10%) and student's project (30%).

Parts 2 and 3 (individual and group works) must be done during the course and are not recoverable later during the final or extraordinary evaluation. The marks of these two parts will be maintained for the final and extraordinary evaluations if the student fails to pass the course through the progressive evaluation.

Part 1 (written exams) can be recovered during the final and/or extraordinary evaluation in the date set by the School as part of the yearly evaluation calendar.

No minimum mark is set in any of the three parts of the evaluation.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
M. Ibnkahla, "Wireless Sensor Networks: A Cognitive Perspective", CRC Press, 2017	Bibliography	
P. K. Singh, B. K. Bhargava, M. Paprzycki and N. C. Kaushal, "Handbook of Wireless Sensor Networks", Springer, 2020.	Bibliography	
H. M. A. Fahmy, "Concepts, Applications, Experimentation and Analysis of Wireless Sensor Networks", Springer, 2017 (2nd Ed).	Bibliography	
Dargie, W. and Poellabauer, C., "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley, 2010	Bibliography	Available on-line through IEEEXplore (https://ieeexplore.ieee.org/servlet/opac?bknumber=8039611)
Förster, A. "Introduction to Wireless Sensor Networks", Wiley 2016	Bibliography	Available on-line through IEEEXplore (https://ieeexplore.ieee.org/servlet/opac?bknumber=7906176)
Akyildiz, Ian F. and Mehmet Can Vuran. "Wireless sensor networks." John Wiley & Sons, 2010	Bibliography	Available on-line through IEEEXplore (https://ieeexplore.ieee.org/servlet/opac?bknumber=8039664)
On-Line Resources	Web resource	Journal and conference papers and other material available on-line, especially for recent and hot-topics.