



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros de
Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000928 - Laboratory Course On Rf Measurements

DEGREE PROGRAMME

09AT - Master Universitario En Teoria De La Señal Y Comunicaciones

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	93000928 - Laboratory Course On Rf Measurements
No of credits	6 ECTS
Type	Optional
Academic year of the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	09AT - Master Universitario en Teoria de la Señal y Comunicaciones
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Marta Ferreras Mayo	C-404.1	marta.ferreras@upm.es	Sin horario. Please, contact by e-mail
Gerardo Perez Palomino (Subject coordinator)	B-412	gerardo.perezp@upm.es	Sin horario. Please, contact by e-mail

Manuel Sierra Castañer	C-410	manuel.sierra@upm.es	Sin horario. Please, contact by e-mail
Jesus Grajal De La Fuente	C-407-2	jesus.grajal@upm.es	Sin horario. Please, contact by e-mail
Jaime Esteban Marzo	B-420	jaime.esteban@upm.es	Sin horario. Please, contact by e-mail

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

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Temas Avanzados En Tecnología De Antenas
- Tecnologías De Radiofrecuencia

3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - 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

CB07 - 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

CB08 - 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

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo

CE01 - Analizar y aplicar técnicas para el diseño y desarrollo avanzado de equipos y sistemas, basándose en la teoría de la señal y las comunicaciones, en un entorno internacional

CE02 - Evaluar y sintetizar los resultados de un trabajo en equipo en proyectos relacionados con la teoría de la señal y las comunicaciones, en un entorno internacional.

CE03 - Valorar y contrastar la utilización de las diferentes técnicas disponibles para la resolución de problemas reales dentro del área de teoría de la señal y comunicaciones.

CT01 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa

CT03 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas

CT04 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo

CT05 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de

documentos técnicos y científicos, de una manera adecuada y eficiente

CT06 - Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos

4.2. Learning outcomes

RA9 - To evaluate and to implement RF systems and equipments.

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

This laboratory complements the subjects of Radiofrequency Technologies and Advanced Topics on Antenna Technologies. This laboratory introduces the most important measurement techniques in radio-frequency, including active and passive circuits, time and frequency domain measurements, characterization of electrical properties of materials, antenna characterization and RADAR systems.

5.2. Syllabus

1. Session 1: Vector Network Analyzer: Calibration techniques.
2. Session 2: Vector Network Analyzer. Time domain Techniques.
3. Session 3: Active Components Characterization with complex wave forms.
4. Session 4: Antenna Measurements 1. Antenna test set-up. Anechoic Chambers. Far and Near Field Techniques.
5. Session 5: Antenna Measurements 2. Error diagnosis in antenna measurements.
6. Session 6: Characterization of electrical properties of material through waveguide techniques.
7. Session 7: RADAR System characterization.
8. Session 8: Characterization of dielectric properties of materials using Free-Space Methods

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	Presentation. Introduction to laboratory sessions 1 and 8 Duration: 04:00 Lecture			
2		Laboratory session 1 Duration: 04:00 Laboratory assignments		
3		Laboratory session 1 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 1 Group work Continuous assessment Not Presential Duration: 08:00
4		Laboratory session 2 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 2 Group work Continuous assessment Not Presential Duration: 08:00
5		Laboratory session 3 Duration: 04:00 Laboratory assignments		
6		Laboratory session 3 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 3 Group work Continuous assessment Not Presential Duration: 08:00
7		Laboratory session 4 Duration: 03:00 Laboratory assignments		Evaluation Session 4 Written test Continuous assessment Presential Duration: 01:00
8		Laboratory session 5 Duration: 04:00 Laboratory assignments		
9		Laboratory session 5 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 5 Group work Continuous assessment Not Presential Duration: 08:00
10		Laboratory session 6 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 6 Group work Continuous assessment Not Presential Duration: 08:00

11		Laboratory session 7 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 7 Group work Continuous assessment Not Presential Duration: 08:00
12		Laboratory sessions 8 Duration: 04:00 Laboratory assignments		Homework/Evaluation Session 8 Group work Continuous assessment Not Presential Duration: 08:00
13		Laboratory sessions 1 to 4. Extra time if required Duration: 04:00 Laboratory assignments		
14		Laboratory sessions 5 to 8: Extra time if required Duration: 04:00 Laboratory assignments		
15				
16				
17				Final exam (Global Evaluation) Problem-solving test Final examination Presential Duration: 04:00

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Homework/Evaluation Session 1	Group work	No Presential	08:00	12.5%	0 / 10	CB08 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10
4	Homework/Evaluation Session 2	Group work	No Presential	08:00	12.5%	0 / 10	CB08 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10
6	Homework/Evaluation Session 3	Group work	No Presential	08:00	12.5%	0 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10

7	Evaluation Session 4	Written test	Face-to-face	01:00	12.5%	0 / 10	CB09 CT01 CB07 CT03 CB06 CE02 CT04 CB08 CE01 CT06 CE03 CT05 CB10
9	Homework/Evaluation Session 5	Group work	No Presential	08:00	12.5%	0 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10
10	Homework/Evaluation Session 6	Group work	No Presential	08:00	12.5%	0 / 10	
11	Homework/Evaluation Session 7	Group work	No Presential	08:00	12.5%	0 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10
12	Homework/Evaluation Session 8	Group work	No Presential	08:00	12.5%	0 / 10	

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final exam (Global Evaluation)	Problem-	Face-to-face	04:00	100%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02

		solving test					CT04 CE01 CT06 CE03 CT05 CB10
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7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final exam (Global Evaluation)	Problem-solving test	Face-to-face	04:00	100%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10

7.2. Assessment criteria

In accordance with the "Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid, 26/05/2022", all the students will be evaluated using the same method, which should be progressive by default. Moreover, students who don't pass the subject by means of the progressive evaluation will be additionally evaluated by using the global assessment method. Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through global assessment will be carried out considering all the evaluation techniques used in progressive evaluation.

Evaluation activities that assess learning outcomes that cannot be recovered outside the teaching period are mandatory; these activities will be clearly described and justified in this learning guide.

The evaluation of this subject involves:

PROGRESSIVE EVALUATION (100 %)

The students will be evaluated for each session with his work made during the laboratory session and the homework for each session. The final mark will be the average of the mark of the 8 laboratory sessions. The practical sessions will be performed in groups if the number of students enrolled in the subject is high enough.

GLOBAL EVALUATION (100 %)

For the students who finally need the global assessment, it consists on:

1-Non-recoverable compulsory activities (50%): Practical Sessions 3, 4, 5 and 8, and their related activities.

These sessions cannot be performed outside the teaching period. The practical sessions 4 and 5 (related with antennas measurements) must be carried out in the anechoic chamber, which is a UPM facility involved in research and other activities during the year. Practical sessions 3 (Active Components Characterization with complex wave forms) and 8 (material characterization in free space), involve the use of research instrumentation, which also exhibit a limited time to use for teaching activities,

2- Delivery the reports of the practical sessions 1,2, 6 and 7 and answer questions about them (50%). This activity will take place in the day defined by Junta de Escuela in the exam period. Students who have not completed some of the practical sessions during the teaching period may additionally recover one of them outside this period with the presence of a professor. This additional session (13%) will be selected by the professors in accordance with their availabilities and the available teaching labs.

EXTRAORDINARY ASSESSMENT (100 %)

The extraordinary evaluation will be carried out using the global evaluation described above.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Information of each session	Bibliography	Before the sessions, the students will have the required documentation
Laboratories	Equipment	The sessions will be performed in the different laboratories of the Telecom School
Moodle: "Laboratory Course on Radiofrequency Measurements (LRFM)"	Web resource	All the handouts/guidelines of the practical sessions and the measurements performed during the lab sessions will be provided via Moodle

9. Other information

9.1. Other information about the subject

In a general sense, this subject is related with the SDG number 9: "Industry, innovation and infrastructure" since it analyzes new methodologies applicable for the industry. In particular the point 9.5: "Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending"