



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

2021/22 - Semester 2

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	93000928 - Laboratory Course On Rf Measurements
<b>No of credits</b>	6 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 2
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	09AT - Master Universitario en Teoría de la Señal y Comunicaciones
<b>Centre</b>	09 - Escuela Técnica Superior De Ingenieros De Telecomunicacion
<b>Academic year</b>	2021-22

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
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
Ana Maria Buesa Zubiria	B-415	ana.buesa.zubiria@upm.es	Sin horario. Please, contact by e-mail
Adrian Tamayo Dominguez	C-409	a.tamayo@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

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#### 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 \*

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### 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

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### 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	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	<b>Presentation. Introduction to laboratory sessions 1 and 8</b> Duration: 04:00 Lecture			
2		<b>Laboratory session 1</b> Duration: 04:00 Laboratory assignments		
3		<b>Laboratory session 1</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 1</b> Individual work Continuous assessment Not Presential Duration: 00:00
4		<b>Laboratory session 2</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 2</b> Individual work Continuous assessment Not Presential Duration: 00:00
5		<b>Laboratory session 3</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 3</b> Individual work Continuous assessment Not Presential Duration: 00:00
6		<b>Laboratory session 4</b> Duration: 03:00 Laboratory assignments		<b>Evaluation Session 4</b> Written test Continuous assessment Presential Duration: 01:00
7		<b>Laboratory session 5</b> Duration: 04:00 Laboratory assignments		
8		<b>Laboratory session 5</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 5</b> Individual work Continuous assessment Not Presential Duration: 00:00
9		<b>Laboratory session 6</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 6</b> Individual work Continuous assessment Not Presential Duration: 00:00
10			<b>Presentation of RF companies</b> Duration: 04:00 Additional activities	

11		<b>Laboratory session 7</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 7</b> Individual work Continuous assessment Not Presential Duration: 00:00
12		<b>Laboratory sessions 8</b> Duration: 04:00 Laboratory assignments		<b>Homework/Evaluation Session 8</b> Individual work Continuous assessment Not Presential Duration: 00:00
13		<b>Laboratory sessions 1 to 4. Extra time if required</b> Duration: 04:00 Laboratory assignments		
14		<b>Laboratory sessions 5 to 8: Extra time if required</b> Duration: 04:00 Laboratory assignments		
15				
16				
17				<b>Final exam</b> 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. Continuous assessment

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

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

12	Homework/Evaluation Session 8	Individual work	No Presential	00:00	12.5%	0 / 10	
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### 7.1.2. Final examination

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

### 7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Exam	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

Students will be qualified through continuous evaluation by default. According to the Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid, students willing to renounce to continuous evaluation must complete the Moodle task entitled "Renounce to continuous evaluation" before one month before the beginning of the term (deadline will be announced in Moodle).

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by Junta de Escuela for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester.

Extraordinary examination will be carried out exclusively by the final assessment method.

In the case of continuous evaluation, the students will be evaluated for each session with the work of each student in the laboratory session and the homework or exam for each session. The final mark will be the average of the mark of the 8 laboratory sessions. It is compulsory to complete all the laboratory sessions to pass the subject.

For the students who choose the final exam (and renounce to the continuous evaluation), an exam will be carried out in one of the laboratories. The exam will be practical, and the student will be required to show his capability to do RF measurements.

The extraordinary exam will be done at the end of June. This exam will be practical, and the student will be required to show his capability to do RF measurements.

## 8. Teaching resources

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### 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

## 9. Other information

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### 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"