



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

93000805 - Laboratory Course On Radiofrequency Measurements

DEGREE PROGRAMME

09AQ - Master Universitario En Ingenieria De Telecomunicacion

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 2

Index

Learning guide

| | |
|---|----|
| 1. Description..... | 1 |
| 2. Faculty..... | 1 |
| 3. Prior knowledge recommended to take the subject..... | 2 |
| 4. Skills and learning outcomes | 3 |
| 5. Brief description of the subject and syllabus..... | 4 |
| 6. Schedule..... | 5 |
| 7. Activities and assessment criteria..... | 7 |
| 8. Teaching resources..... | 10 |
| 9. Other information..... | 10 |

1. Description

1.1. Subject details

| | |
|---------------------------------------|---|
| Name of the subject | 93000805 - Laboratory Course On Radiofrequency Measurements |
| No of credits | 6 ECTS |
| Type | Optional |
| Academic year of the programme | Second year |
| Semester of tuition | Semester 4 |
| Tuition period | February-June |
| Tuition languages | English |
| Degree programme | 09AQ - Master Universitario en Ingenieria de Telecomunicacion |
| Centre | 09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion |
| Academic year | 2021-22 |

2. Faculty

2.1. Faculty members with subject teaching role

| Name and surname | Office/Room | Email | Tutoring hours * |
|---|--------------------|-----------------------|--|
| 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

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

CG1 - 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.

CG2 - 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.

CG4 - 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.

CG5 - 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.

CT1 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa.

CT3 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas.

CT4 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo.

CT5 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente.

4.2. Learning outcomes

RA328 - 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 | Face-to-face classroom activities | Face-to-face 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 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 4 | | Laboratory session 2 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 2 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 5 | | Laboratory session 3 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 3 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 6 | | Laboratory session 4 Duration: 03:00 Laboratory assignments | | Evaluation Session 4 Written test Continuous assessment Presential Duration: 01:00 |
| 7 | | Laboratory session 5 Duration: 04:00 Laboratory assignments | | |
| 8 | | Laboratory session 5 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 5 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 9 | | Laboratory session 6 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 6 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 10 | | | Presentation of RF companies Duration: 04:00 Additional activities | |

| | | | | |
|----|--|--|--|---|
| 11 | | Laboratory session 7 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 7 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 12 | | Laboratory sessions 8 Duration: 04:00 Laboratory assignments | | Homework/Evaluation Session 8 Individual work Continuous assessment Not Presential Duration: 00:00 |
| 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 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 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
| 4 | Homework/Evaluation Session 2 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
| 5 | Homework/Evaluation Session 3 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
| 6 | Evaluation Session 4 | Written test | Face-to-face | 01:00 | 12.5% | 0 / 10 | CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
| 8 | Homework/Evaluation Session 5 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |

| | | | | | | | |
|----|-------------------------------|-----------------|---------------|-------|-------|--------|--|
| 9 | Homework/Evaluation Session 6 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
| 11 | Homework/Evaluation Session 7 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CG5 CT3 CG4 CG1 CT4 CT5 CT1 CG2 |
| 12 | Homework/Evaluation Session 8 | Individual work | No Presential | 00:00 | 12.5% | 0 / 10 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |

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 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |

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 | CT4 CT5 CG5 CT3 CG4 CG1 CT1 CG2 |
|------------|----------------------|--------------|-------|------|--------|--|

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

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

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"