ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000920 - Optimization Fundamentals

DEGREE PROGRAMME

09AT - Master Universitario en Teoria de la Señal y Comunicaciones

ACADEMIC YEAR & SEMESTER

2020/21 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000920 - Optimization Fundamentals
No of credits	3 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
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	2020-21

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jose Ignacio Ronda Prieto (Subject coordinator)	C-323	joseignacio.ronda@upm.es	Sin horario. Appointment arranged by email

* 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

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- The student should have a fundamental undergraduate level knowledge on linear algebra and mathematical analysis

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

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

RA4 - Formular problemas relacionados con la ingeniería como problemas de optimización en forma estándar

RA5 - Saber resolver problemas de optimización básicos como los de programación lineal o cuadrática

RA6 - Saber resolver problemas de optimización con o sin restricciones mediante métodos analíticos y numéricos

* 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

The course covers the fundamentals of optimization of functions of continuous variables. Both analytical and numerical techniques are considered, with emphasis in the case of convex functions and convex constraints.

5.2. Syllabus

1. Introduction
   1.1. Overview of optimization problems and techniques
   1.2. Revision of linear algebra
   1.3. Quadratic functions and least-squares problems
2. Unconstrained optimization
   2.1. Analytical methods
   2.2. Convex sets and functions
   2.3. Numerical methods
3. Constrained optimization
   3.1. Karush-Kuhn-Tucker conditions
   3.2. Lagrange duality
   3.3. Numerical methods

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 02:00 Lecture			
2	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 02:00 Lecture			
3	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 02:00 Lecture			
4	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 01:00 Lecture			**Continuous evaluation exam 1** Written test Continuous assessment Presential Duration: 01:00
5	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 02:00 Lecture			
6	**Theory class** Duration: 02:00 Lecture **Theory class** Duration: 02:00 Lecture			

7	**Theory class** Duration: 02:00 Lecture			
8				
9				**Continuous evaluation exam 2** Written test Continuous assessment Presential Duration: 01:00 **Final assessment exam** Written test Final examination Presential Duration: 02:00
10				
11				
12				
13				
14				
15				
16				
17				

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
4	Continuous evaluation exam 1	Written test	Face-to-face	01:00	50%	3.5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CT04 CE01 CT06 CE03 CT05 CB10
9	Continuous evaluation exam 2	Written test	Face-to-face	01:00	50%	3.5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CT04 CE01 CT06 CE03 CT05 CB10

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
9	Final assessment exam	Written test	Face-to-face	02:00	100%	5 / 10	CB09 CT01 CB07 CT03 CB06 CT04 CE01 CT06 CE03 CT05 CB10

							CB08

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Extraordinary examination	Written test	Face-to-face	02:00	100%	5 / 10	CT01 CB07 CT03 CB06 CB08 CB09 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 the fourth week of the semester (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.

Continuous evaluation will be performed by means of two partial exams having each a weight of 50% of the final

grade. In each exam a minimum mark of 3.5 / 10 will be required. The second partial exam will be done simultaneously with the final assessment exam. An average of 5 points of 10 is required to pass.

Evaluation through final assessment and extraordinary examination will be carried out in a single exam. The ordinary final exam will consist of two parts, each corresponding to the topics covered in each of the partial exams. It will be necessary to obtain a minimum of 3.5 points in each part. An average of 5 points of 10 is required to pass.

In the extraordinary exam 5 points of 10 is required to pass.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Course slides	Bibliography	Fundamental.
S. Boyd, L. Vandenberghe, Convex Optimization, Cambridge Univ. Press, 2004.	Bibliography	Complementary.
J. Nocedal, S. Wright, Numerical Optimization, Springer, 1999.	Bibliography	Complementary.
Moodle.	Web resource	Links to course resources

9. Other information

9.1. Other information about the subject

The course will be taught in English.

The student is assumed to work between 26 and 27 hours for each course credit or unit.

This guide has been written assuming that the number of students will be similar to that of previous years and therefore it will be possible to accomodate all of them in adequate conditions in a single room, so that full classroom teaching is possible. In case the authorities impose later stronger constraints involving classroom activities, teaching will be made online in a way as will be specified in an addenda to this guide.