COURSE DATA

DATA SUBJECT

Code: 34890
Name: Mathematical bases of communications
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	Escola Tècnica Superior d'Enginyeria	2	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	Digital communications	COMPULSORY

COORDINATION

ROGER VAREA SANDRA

SUMMARY

The course "Fundamentos Matemáticos de las Comunicaciones" takes place in the second course,second term of the "Grado en Ingeniería Telemática". This course is part of the common core "Comunicaciones Digitales" and it states the basics of a set of courses that are taught in the third course, such as "Teoría de la Comunicación", "Procesado Digital de la Señal" and "Transmisión de Datos". Thecourse "Fundamentos Matemáticos de las Comunicaciones" can also be seen as a complement of theprevious course "Señales y Sistemas Lineales", where the main assumption is that the signals or inputs to the systems are deterministic. In practical systems, these inputs are mainly stochastic processes. One example are noisy signals, appearing in several communication systems. The course introduces the basic concepts of probability theory, random variables and stochastic processes, which are used in many communication systems when dealing with the mathematical modelling of the different blocks. In a later step, the fundamentals of detection theory are reviewed.

The aim of this course is to provide the students with the knowledge and ability to tackle the remaining courses of the core "Comunicaciones Digitales". Key aspects of the course are the identification and proper use of the probability, statistics and random processes concepts as a tool for the modelling, analysis, transmission and reception of signals over the different communication systems.

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PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Students are expected to have passed:

Matemáticas I, II y III
Señales y Sistemas Lineales

COMPETENCES / LEARNING OUTCOMES

1403 - Degree in Telematics Engineering

E1 - Ability to construct, exploit and manage telecommunication networks, services , processes and applications, understood as systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the perspective of telematics services.

E5 - Ability to follow the technological progress of transmission, commutation and proccess to improve the telemactic networks and services.

G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.

G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.

R1 - Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.

R4 - Ability to analyze and specify the fundamental parameters of communication systems.

DESCRIPTION OF CONTENTS

1. The axioms of probability

Probability models, the axioms of probability, discrete and continuous sample spaces. Independence of events and conditional probability. Bayes rule.

2. One random variable

Discrete and continuous random variables. The cumulative distribution and probability density functions. Functions of a random variable. Transform methods. Parameter estimation: mean and variance of a random variable. Important discrete and continuous random variables. Moments.

3. Vector random variables

Joint cumulative distribution and probability density functions. Conditional probability. Functions of two random variables. The n-dimensional Gaussian distribution. Expectation and moments. Transformation of random vectors. Sums of random variables. Sample mean and variance. Correlation and covariance. Orthogonality, independence and incorrelation.

4. Basics of detection theory

Hypothesis testing, error probability, sufficient statistic.

5. Introduction to random processes

Definition and examples. First and second moments of a random process. Properties: Independence, stationarity and ergodicity. Power spectral density.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Laboratory	20,00
Classroom practices	10,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	10,00
Independent study and work	20,00
Preparation of lessons	25,00
Preparation for assessment activities	20,00
Resolution of case studies	15,00
Total hours	**90,00**

TEACHING METHODOLOGY

1) Work at the course:

a) Theory sessions, including short activities for the students (R-4, R-1, E-5).

b) Problem solving sessions, to practice the concepts from the theory sessions (R-4, G-4, G-6, E-1).

c) Lab sessions, understanding by means of simulations the most important concepts from the theory sessions (R-4, G-4, G-6, E-1, R-1).

2) Student's own work:

a) Homework and exposition in class of the solution (R-4, G-4, E-1, R-1).

b) Exam preparation (R-4, R-1, E-1, E-5).

c) Lab sessions preparation, reading the lab description and the related theoretical concepts (R-4, R-1, E-1, E-5).

3) Consulting sessions:

A certain number of hours are established each week, which the students can attend in order to solve doubts (R-1).

EVALUATION

The evaluation mechanism can be described as a traditional adapted model, which does not amount to a fully continuous assessment. In the first examination session, the following items and weightings will be considered:

- Attendance assessment: 5% of the final grade.
- Attendance, completion, and evaluation through a practical test: 20% of the final grade (R-4, G-4, G-6, E-1, R-1). This 20% consists of 5% for the development and submission of laboratory reports, and the remaining 15% corresponds to an exam related to the topics covered in the practical sessions.
- Individual resolution of proposed exercises: 15% of the final grade (R-4, G-4, E-1, R-1).
- Final exam: 60% of the final grade (R-4, R-1, E-1, E-5).
  For students who are unable to attend classes regularly, an alternative model is offered in which

the assessment of attendance and participation will be replaced by additional assignments, maintaining an equivalent total percentage.

In the second examination session, students may choose between two evaluation options, which must be communicated in advance to the course instructor before the date of the final exam:
Option A) Maintain the same weightings as in the first session, retaking only the final exam and/or lab test.
Option B) Final exam (80% of the final grade) + Practical sessions (20% of the final grade).
To pass the course, it is necessary to obtain at least a 4 out of 10 in the final exam. The remaining assessable items are not subject to any minimum score.
Any clear case of copying or plagiarism in an activity that is part of the evaluation will result in a failure of the course, and the student will be subject to the appropriate disciplinary procedures outlined in the PROTOCOL FOR ACTION AGAINST FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).
In any case, the evaluation system will comply with the provisions of the "Reglament d'Avaluació i Qualificació de la Universitat de València per a Graus i Màsters"
(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)

REFERENCES

- Therrien, Charles W., Tummala, Murali, Probability for Electrical and Computer Engineers, CRC Press, 2nd edition, 2012, ISBN: 978-1-4398-2698-0
- Gubner, John A., Probability and Random Processes for Electrical and Computer Engineers, Cambridge, 2006, ISBN: 0521864704 (recurso electrónico, acceso limitado a la UV).
- Stark, Henry, Woods, John W., Probability and Random Processes with Applications to Signal Processing, Third Edition, Prentice Hall, 2002, ISBN: 0131784579.
- Ross, Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, Third Edition, John Wiley & Sons, 2004, ISBN: 0125980574.
- Leon-Garcia, Alberto, Probability, Statistics, and Random Processes for Electrical Engineering, Third Edition, Pearson Education, 2009, ISBN: 9780137155606.
- Yates, Roy D., Goodman, David J., Probability and stochastic processes: a friendly introduction for electrical and computer engineers, 2nd edition, John Wiley & Sons, 2005, ISBN: 978-0-471-27214-4.