LEARNING GUIDE

YEAR 2017/18

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PLAN 14IB – MASTER COURSE IN AIR TRANSPORT SYSTEMS

Code	**143005001**
Subject	**ESTIMATION THEORY**
Module	CROSS
Languages	SPANISH

Year	FIRST
Semester	FIRST
Type	OB
Credits	5 ECTS

1. COURSE DESCRIPTION

Probability and statistics.

Bayesian inference.

Statistics and analysis of error data. Processing of historical series.

Analysis of uncertainties.

Experts' opinion: Analytical Hierarchy Process (AHP).

Simulations of Montecarlo.

Theory of decision and risk analysis.

IA techniques (neuronal networks, diffused logic, genetic algorithms, ...).

2. PREREQUISITES

a) PREVIOUS KNOWLEDGE REQUIRED for following the COURSE adequately.

Subjects passed:

Other requisites:

b) PREVIOUS KNOWLEDGE RECOMMENDED for following the COURSE adequately.

It is recommended that the student has passed the following subjects:

Other knowledge:

3. COMPETENCES

CG1.- Knowledge and understanding that provide a basis or opportunity for originality in developing and/or applying ideas, often in a research context.

CG2.- Applying acquired knowledge and ability to solve problems in new or unknown environments within broader (or multidisciplinary) contexts related to their field of study.

CT3.- Ability to adopt creative solutions satisfying suitably the different considered needs.

CT5.- Ability to manage information suitably and efficiently, identifying the necessary sources, the main kinds of technical and scientific documents.

CE19.- Comprehension, understanding and ability to apply the mathematical foundations necessary for analysis of security of complex systems.

CE20.- Knowledge of principles, requirements, judgements and methods for operational safety management in air transport system.

4. LEARNING OUTCOMES

CODE.- Learning Outcome description.

5. FACULTY

Department: AEROSPACE ENGINEERING APPLIED MATHEMATICS DEPARTMENT
Course Coordinator: José OLARREA BUSTO

Lecturer / Teacher	e-mail	Office
OLARREA BUSTO, José	jose.olarrea@upm.es	

Tutorial Schedules will be posted on (specify mode and location).

6. COURSE SYLLABUS

Chapter 1. PROBABILITY AND ITS APPLICATIONS IN THE EVALUATION OF RISKS AND RELIABILITY.

1.1. Historical evolution and definition of risk. 1.2. Effect of the analysis of probabilistic risk. 1.3. Processing of uncertainty. 1.4. Meaning of uncertainty. 1.5. Theory of logical decision of Savage: quantitative probability, usefulness, observation, measuring of subjective probabilities.

Chapter 2. REVISION OF THE THEORY OF BASIC PROBABILITY.

2.1. Random variables: Moments, Correlations, Failure rates, correlation. 2.2. Exponential distribution of life: intervals of constant test, exponential failure and repair. 2.3. Statistics distributions: Poisson distribution, Bernouilli distribution and binomial distribution, exponential distribution, gamma distribution, beta distribution, normal and lognormal distribution, Weibull distribution. 2.4. Stochastic process, approximation of distributions.

Chapter 3. BAYESIAN INFERENCE.

3.1. Bayes theorem. 3.2. Example with the exponential distribution. 3.3. Conjugated distributions. 3.4. Calculation of distributions a priori. 3.5. Bayesian punctual estimation. 3.6. Estimation by bayesian confidence regions. 3.7. Bayesian hypothesis contrasting. 3.8. Calculation of distributions afterwards.

Chapter 4. CLASSICAL STATISTICS INFERENCE.

4.1. Estimation of parameters. 4.2. Non parametric estimation of Confidence Intervals. 4.3. Test of hypothesis.

Chapter 5. ESTATISTICS AND ANALYSIS OF ERRORS DATA.

5.1. Weibull analysis. 5.2. Graphic methods. 5.3. Kaplan-Meier method. 5.4. Estimation by maximum authenticity. 5.5. Bayesiana estimation. 5.6 Weibayes method.

Chapter 6. ANALYSIS OF SYSTEMS AND QUANTIFYING.

6.1. Errors trees. 6.2. Events trees. 6.3. Dependent errors. 6.4. Databases of reliability. 6.5. Experts' opinions.

Chapter 7. UNCERTAINTY MODEL AND MEASURING RISK.

7.1. Theory of decision. 7.2. Preferences above actions. 7.3. Decision trees. 7.4. Value of the information. 7.5. Usefulness. 7.6. Multi-attribute processes of decision and models of value. 7.7. Influence diagrams and belief networks.

Chapter 8. MONTECARLO SIMULATIONS.

8.1. One-varied distributions. 8.2. Multi-variations distributions. 8.3. Transformation of set normal distributions. 8.4. Correlation trees.

7. COURSE SCHEDULE

a) Timetable.

Week	Classroom activity	Laboratory activity	Other activities	Evaluation activity
1	Chapter 1 theory and problems			
2	Chapter 2 theory and problems			
3	Chapter 2 theory and problems			
4	Chapter 3 theory and problems			
5	Chapter 3 theory and problems		Proposal of group project	
6	Chapter 4 theory and problems			
7	Chapter 5 theory and problems			
8	Chapter 5 theory and problems			
9	Chapter 6 theory and problems			
10	Chapter 6 theory and problems			
11	Chapter 7 theory and problems			
12	Chapter 7 theory and problems			
13	Chapter 8 theory and problems			
14				Presentation of projects
15				Presentation of projects
16				Final exam

b) Learning activities.

Learning activities	CT	CP	PL	TIE	TP	EP	Others*
ECTS: 5	1,0	0,8		0,4	0,3	2,5	

CT: LECTURES
CP: PROBLEM-SOLVING SESSIONS
PL: LABORATORY PRACTICE
TIE: INDIVIDUAL OR TEAM WORK
TP: PROGRAMMED TUTORIALS
EP: STUDENT'S INDIVIDUAL STUDY AND WORK
***Others** (specify):

c) Teaching methods.

Teaching methods	LM	PBL	MC	EIP	PL	Others*
YES/NO	YES		YES	YES		

LM: MASTERCLASS
PBL: PROJECT-BASED LEARNING
RPA/CM: PROBLEM-SOLVING SESSIONS/CASE STUDIES
EIP: PRESENTATION OF REPORTS AND PROJECTS
PL: LABORATORY PRACTICE
***Others** (specify):

8. EVALUATION SYSTEM

a) Examination board.

Chair:	José OLARREA BUSTO
Board member:	Marta CORDERO GRACIA
Secretary:	Mariola GÓMEZ LÓPEZ
Substitute:	Fco. Javier de VICENTE BUENDÍA

b) Evaluation activities.

Week	Description	Evaluation Type	Evaluation Technique	Duration	Weighting	Minimum Mark	Competences
From 3 - 10	Problems in class	EC+SEF	EAL	1h	25%	5.0	Everyone
15 - 16	Presentation of projects	EC+SEF	EPT; PO	8h	25%	5.0	Everyone
16	Final Exam	EC+SEF	POPF	2h	50%	5.0	Everyone

c) Evaluation criteria.

Knowledge will be assessed by

- An ordinary final exam in which knowledge of the whole subject will be assessed, with a value up to the 50% in the final mark.
- Individual Project: Value up to 25% of the final mark.
- Group Project with oral presentation: Value up to 25% of the final mark.

In case of fail student will have the chance to attend the extraordinary final exam of July, in which knowledge of the whole subject will be assessed, with the same deliberation that for the case of ordinary exam.

For passing the subject it is compulsory to do the proposed projects on time and with enough quality.

Pass is stablished in 5.0, taking into account a scale from 0 up to 10.

9. LEARNING RESOURCES

Description	Type	Observations
Probabilistic Risk Analysis: Foundations and Methods. Tim Bedford and Roger Cooke. Cambridge University Press	Bibliography	
System Reliability Theory. Marvin rausand and Arnljot Hoyland. Wiley Interscience	Bibliography	
Reliability Engineering Handbook. Dimitry Kececioglu. DEStech Publications Inc.	Bibliography	
MIT Open Course Ware. Probability And Its Applications To Reliability, Quality Control, And Risk Assessment	Web resource	Open course from MIT with a similar programme

10. ADDITIONAL INFORMATION