Modelling and Simulation of Logistical Systems for Airports

Code: 101739
ECTS Credits: 6

2025/2026

Degree	Type	Year
Aeronautical Management	OT	4

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is required a background on optimization and systems simulation

Objectives and Contextualisation

The main objective for this subject is to support students to learn fow to formalize the different cause-effect relationships that constitute most operational aeronautic procedures, focussing the modeling efforts on the interaction among the different processes that takes part in the aircraft turnaorund and different phases of flight. Students will analyze the causal models by means of quantitative methods supported by digital simulator, developping scenarios design and state spaces.

This subject is practical oriented, so most supporting material will be practical exercises about real problems in airports, Terminal Manoevring Area and enroute.

Competences

- Allocate and manage aircraft turnaround resources efficiently.
- Apply specific software for solving problems in the aeronautical sector.
- Communication.
- Personal attitude.
- Personal work habits.
- Supervise the management of resources in an airport.
- Thinking skills.
- Use knowledge of the fundamental principles of mathematics, economics, information technologies and psychology of organisations and work to understand, develop and evaluate the management processes of the different systems in the aeronautical sector.
- Work in teams.

Learning Outcomes

1. Accept and respect the role of the various team members and the different levels of dependence within the team.
2. Communicate knowledge and findings efficiently, both orally and in writing, both in professional situations and with a non-expert audience.
3. Develop critical thought and reasoning.
4. Develop curiosity and creativity.
5. Develop independent learning strategies.
6. Develop scientific thinking skills.
7. Develop systemic thinking.
8. Develop the ability to analyse, synthesise and plan ahead.
9. Generate innovative and competitive proposals in professional practice.
10. Identify, manage and resolve conflicts.
11. Identify the fundamental principles of the modelling of airport logistics systems.
12. Improve performance indices in aircraft turnaround operations.
13. Maintain a proactive and dynamic attitude towards career progression, personal growth and continuous professional development. Have the will to succeed.
14. Make efficient use of ICT in communicating ideas and results.
15. Manage information, critically appraising innovations in the field, and analyse future trends.
16. Manage time and available resources. Work in an organised manner.
17. Model delay propagation among the turnaround operations being coordinated.
18. Prioritise operations in accordance with accumulated delays and available resources.
19. Use software for 3D simulation and process flowcharts.
20. Work cooperatively.
21. Work independently.

Content

I.- Formal Specification of Models

Topic 1. Coloured Petri Net formalism

1. Petri Nets
2. Arc Expressions
3. Guards
4. The firing rules applied to Coloured Petri Nets.

Topic 2. Specification of causal models in CPN-Tools

1. Introduction to CPN-Tools
2. Specification of Causal Models
3. Simulation of Causal
4. State Space Analysis.

Topic 3. Arrival and Departure Manager in a Shared Mode Runway

1. Aircraft Classification: Heavy / Medium / Light
2. Arrival process and Holding Trajectories
3. Runway Occupancy and taxiway
4. Take-off process
5. Arrival/Departure schedulling.

Topic 4. Strategic Conflict Free Trajectories

1. Conflict Detection / Conflict Resolution
2. Ground Delay program
3. Downstream induced conflicts
4. Mitigation mechanisms

Topic 5. Gate Assignment Problem

1. Uncertainties affecting the gate assignment
2. Gate Assignment Policies
3. Time constraints
4. Physical constraints

Topic 6. TurnAround

1. Ground Handling tasks
2. Precedence constraints
3. Critical task path
4. Required resources

III.- Air Traffic Simulation in BlueSky

Laboratory Exercices

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Applied Lectures	10	0.4	20, 19
Master Lectures	18	0.72	12
Practical Exercises	12	0.48	10, 12
Type: Supervised			
Supervision practical exercises	8	0.32	10, 20, 19
Type: Autonomous			
Elaborate practical exercises	20	0.8	20
Implementation of Practical Exercises	50	2	10, 20
Own Work	25	1	20

Master lectures

Introduces the basic contents that as a student will need to progress in the topics that make up the program. It also informs about additional documents that the student can use to complement the knowledge taught in the different topics.

Problem Lectures

Resolution and discussion of problems that will allow to consolidate the formalization of causal relationships in airport operations. Students can use AI supporting tools to develope models.
Practical lectures

Sessions with a smaller group of students than in the master lectures. In these sessions, we work with 2 commercial simulation environments that allow us to validate the theoretical concepts, and analyze possible improvements as a group, as well as the design of the mitigation mechanism to avoid the propagation of perturbations.

BLUESKY sessions

6 sessions are programmed, for the development of an air traffic scenario

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Air Traffic Simulator exercises in BlueSky	0,2	0	0	1, 3, 10, 17, 18, 20, 19
Practical exercises of the different topics	0,6	7	0.28	2, 6, 7, 5, 8, 4, 3, 14, 9, 16, 15, 11, 10, 13, 12, 17, 18, 20, 21
SIMIO exercises	0,2	0	0	1, 12, 20, 19

The single assessment system is not foreseen in this subject.
Evaluation criteria

Both the knowledge acquired in relation to the objectives set in the subject and the degree to which the skills and competences twill be taken into account.

Evaluation activities and instruments

The exercises and practices developed throughout the semester (oral and written report). Optionally a final written test is allowed.

BlueSky 30%
Exercises or final written test 70%

In the case of exam test, if the student fails, he will have the possibility of doing a recovery exam on the dates set by the Coordination of the degree.

The dates for continuous evaluation and submission of exercices will be published on the virtual campus and may be subject to possible programming changes considering potential incidents. Stundents will always be informed in the virtual campus about these changes as it is understood that this is the usual platform for exchange of information between lecturers and students

Indicators and evaluation

The final grade will come from the exercises or final written test (50%) and the practical part (50%), with the condition that in order to pass the subject each one of both parts, practice and theory, must be approved.

Mechanisms of Recovery: For simulation exercises in SIMIO, the student must contact the professor, and a second delivery of the exercises will be allowed. In the case of the practicalworks of follow-up ofthe subject, the the student will be able to take an exam with a practical exercise.

Students in second enrollment: the evaluation of the subject or module may consist, at the decision of the teacher responsible for the subject, in a synthesis test, which allows the evaluation of the learning results provided in the teaching guide of the subject. In this case, the qualification of the subject corresponds to the qualification of the synthesis test.

A student will be considered non-evaluable (NA) if he / she has not submitted any of the 3 tests described.

Honor mark. Granting a grade of honor registration is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that Honor Mark can only be granted to students who have obtained a final grade equal to or greater than 9.00. You can grant up to 5% of Honors of the total number of students enrolled.

Irregularities by the student, copy and plagiarism: Without prejudice to other disciplinary measures deemed appropriate, will be scored with a zero the student's irregularities that may lead to a variation of the rating of an act of evaluation. Therefore, copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending with a zero.

Bibliography

Simulation-based case-studies in Logistics: education and applied research.
Y. Merkurev, G. Merkureva, M.A. Piera, T. Guasch
ISBN: 978-1-84882-186-6, SPRINGER, 2009.
Título: Modelado y Simulación: Aplicación a processos logísticos de fabricación y servicios.
Antoni Guasch, Miquel Àngel Piera, Josep Casanovas, Jaume Figueres
ISBN: 84-8301-704-0, Edicions UPC, 2002.

Coloured Petri Nets: Basic Concepts, Analysis Methods and Practical Use. Volume 1,2,3. Jenssen. Springer

ATM-Seminar papers (http://www.atmseminar.org/)

Software

CPN-Tools (https://cpntools.org/)

SIMIO

BlueSky

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn

(PAUL) Classroom practices	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	11	English	first semester	afternoon
(PLAB) Practical laboratories	12	English	first semester	afternoon
(TE) Theory	1	Catalan	first semester	afternoon