COURSE DETAILS

DESIGN OF AUTONOMOUS AIRCRAFT

SSD ING-IND/05

DEGREE PROGRAMME: AUTONOMOUS VEHICLE ENGINEERING (MOVE)

ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

YEAR OF THE DEGREE PROGRAMME: II
SEMESTER: II
CFU: 9

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES (IF APPLICABLE)

None

LEARNING GOALS

The course is intended to:

- *complete student knowledge about key technologies for unmanned/autonomous aircraft;*
- *provide insight and hands-on experience on state-of-the-art approaches and technologies;*
- *present practical cases of design and development of autonomous aircraft technologies (exploiting the potential of advanced simulation environments, working with experimental datasets and/or with real hardware, introducing the possibilities offered by mixed approaches).*

EXPECTED LEARNING OUTCOMES

Knowledge and understanding

Students should complete their knowledge regarding design options and state of the art technologies for autonomous aircraft operations and missions

Applying knowledge and understanding

Students should learn how to apply their knowledge in designing autonomous aircraft technologies tailored for specific missions, and should develop a practical understanding of the aspects relevant to simulation-based and flight-based performance assessment.

COURSE CONTENT/SYLLABUS

First Part – Selected topics and tutorials

Selected Topics [4 CFU]
Complements of 3d path planning for unmanned/autonomous aircraft missions
Unmanned Aircraft Systems Communications: architectures, constraints, and budgets
Airborne and Ground-based Target Tracking Systems
Integration of unmanned/autonomous aircraft in the airspace

- *Regulations, airspace principles*
- *UAS Traffic Management and Urban/Advanced Air Mobility*
- *Sense and Avoid*

Complements of A-PNT (Alternative/Assured Positioning Navigation and Timing) for unmanned/autonomous aircraft

Tutorials [1 CFU]

- *Open source mission planning and data processing tools*
- *Matlab/Simulink toolboxes and integrated environments*
- *Robot Operating System (ROS)*

Second Part – Design projects [4 CFU]
The focus is set on one or more key technologies for autonomous/unmanned aircraft. Hands-on and design activities are carried out interactively by students and teacher.

- *Simulation-based project(s)*
- *Experimental project(s)*
- *Flight-oriented final design project*

READINGS/BIBLIOGRAPHY

Slides, lecture notes, technical papers. Main Textbooks :

J. Gundlach, Designing Unmanned Aircraft Systems: A Comprehensive Approach, AIAA Education Series, 2012
R. Austin, Unmanned Aircraft Systems: UAVs Design, Development and Deployment, Wiley, 2010
R.W. Beard, T.W. McLain, Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012
S. Blackman, R. Popoli, Design and analysis of modern tracking systems, Artech House, 1999.
R.C. Nelson, Flight Stability and Automatic Control, McGraw Hill, 1998

TEACHING METHODS

Lectures (approx. 40 % of total hours), exercises (approx. 30 % of total hours), interactive/laboratory activities (approx. 30% of total hours)

EXAMINATION/EVALUATION CRITERIA

*For **integrated courses**, this field should encompass all modules, with indication of the relative weight of each module on the final mark. For integrated courses, this field should be coordinated by the reference teacher for the course.*

a) Exam type:

Exam type	
written and oral	
only written	
only oral	X
project discussion	X
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	
	Numerical exercises	

(*) multiple options are possible

b) Evaluation pattern:

The final grade is formulated by the Examination Committee according to the scores achieved by the student in the discussion of the final project work and of the oral questions.

The final evaluation is discussed and highlighted to each student