Organizational remarks on the subject „Unmanned Aerial Systems „ including design activity, Lecture 1

Warsaw, 22 Feb, 2024

Syllabus

Course name: **Unmanned Aerial Systems**
Course name in other language:
Short name: **UAS**
Course number: **ML.ANK309** version: **A**

Course language: **English**
Responsible for the course: **prof. dr hab. inż. Zdobyslaw Goraj**
ECTS: **5** Number of hours: [Lc, T, Lb, P, S]
Course level: **basic** weekly: [**2,** 0, **0,** **1**, 0]
Form of grading: **Continuous assessment** by semester: [**30,** 0, 0, **15,** 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Aerospace	**Aerospace Engineering**	**graduate studies, full time**	**3**

Prerequisites:
Dynamics of Flight (**ML.ANK312**)

Deadlines for projects submission in 2024

	UAV (module in Polish)	UAS
1.	12.03	14.03
2.	26.03	4.04
3.	16.04	18.04
4.	7.05	9.05
5.	21.05	23.05
6.	4.06	6.06

Contents - short

To familiarize the students
with applications, possibilities,
technologies and latest trends in progress
of unmanned aerial systems

Detailed content

UAV and UAS – overview of systems. Applications and categories. Regulations. Configuration layouts adjusted to the missions. Aerodynamics – peculiarities and ranges of Reynolds numbers and Mach numbers. Wing sections used in UAV design. Flight Performance. Stability & Control. Propulsion systems (based either on fossil fuels, or batteries, or on fuel cells). Structures & Materials. Communication and navigation systems. FLIRs, SARs, SIGINTs and other sensors. Data Fusion. Guidance & Control. Radar & Signatures. Research Remotely Piloted Vehicles – challenges and running projects. International Programmes Overview. Future perspectives. Specific features for rotary UAS. Team project – selection of a mission and design the platform the best suited for the mission: (1) selection of sensors; (2) selection of platform; (3) main aerodynamic characteristics; (4) performances & load envelope; (5) structure – stress & strain analysis; (6) stability & control analysis; (7) project correction – a second loop and refinement of design parameters.

Grading criteria

Students are divided into small groups. Each group (consisting of 3-4 students) selects the type of mission and design the platform to perform the mission. They propose a configuration layout, select necessary sensors and on-board equipment, assess aerodynamic characteristics, adjust proper power unit, propose internal structure, assess performance and finally they perform cost analysis of the whole system. Any student must present a review of a selected scientific paper devoted to various aspects of UAS technology which is delivered to student by lecturer. Final score depends on scores of all 6 successive stages of the project and with extra necessary conditions that student regularly attend lectures and will deliver the presentation mentioned before.

Course results

After completing this course the students will be able to understand philosophy of design of Unmanned Aerial Systems, their main components and how these systems are selected to fulfil any specific mission. Graduates will know the latest trends in designing and using of different sensors, selection the configuration layouts, adjustment of power unit to the mission, performance assessment and endurance optimisation. They also receive information about regulations, risk analysis, safety and security. They are able to propose initial concept of UAS best suited for the mission and task to be performed by UAV. Graduates should know how and where to look for and find the knowledge and latest information about the UAS state-of-the-art.

Practical work

group project,
reading with understanding and
presenting a selected scientific paper

Remark 1 (about Design Process)

Number of design group is equal
to the number of the team and number
of the mission and is defined in the document
entitled: Unmanned Aerial Systems –
projects for choice

Remark 2

Design group consists of 3, 4 or 5 students formed on the basis
„good links and mutual relations”;

Remark 3

Each group has to develop a short document with project schedule and individual responsibility. In this document it should be written how the group is managed, who is a group leader and what are responsibility of each group members. How do you act if any team member will not fulfil his/her responsibility and how the recovery is planned? All team member must reveal their contact „coordinates”, i.e. e_mails, phones etc. All these data must be included in project no 1 and they have influence on the mark the group get for project no 1.

Remark 4

All official documents students are using in design process (including successive projects positively assessed by supervisor) should be kept in a carton folder (please avoid the plastic folder because it create some difficulties for project supervisor when writing some remarks on the plastic cover page). On the carton folder first page the filled-in template (appendix_no_2) should be attached (glued). All individual (successive) projects must start with cover page of the individual project (see page 2 of appendix_no_2). When arriving for project consulting the design team must have all former projects in the carton folder.

Remark 5

Final mark of the project is equal to the mean value of all 6 projects marks. Necessary condition to pass is to get positive marks for all 6 projects. When project is delayed on one week with respect to the schedule the respective mark could be decreased on point 1, after 2 weeks the mark is decreased on 2 points and after 3 weeks on 3 points respectively. When delayed on more than 3 weeks the project could not be positively assessed.

Successive projects are dedicated to:

1. **Selection of sensors, antennas, navigation systems, data links, frequencies and other avionic systems;**
2. **Selection of main geometrical and weight parameters of the aircraft;**
3. **Computing the main aerodynamic characteristics;**
4. **Project of internal loaded structure + weight analysis;**
5. **Assessment of aircraft performance;**
6. **Cost analysis.**

Bibliography

1. R.Lozano, Unmanned Aerial Vehicles. Wiley, London 2010.
2. R.Austin, Unmanned Aerial Systems. Wiley, London 2010.
3. R.Yanushevsky, Guidance of Unmanned Aerial Vehicles. CRC, London 2011.
4. A.Tsourdos et al., Cooperative Path Planning of Unmanned Aerial Vehicles. Wiley, London 2010.
5. P.Angelov, Sense and Avoid in UAS, Wiley, London 2012.
6. Jane's (2011), Jane's Unmanned Aerial Vehicles and Targets, Issue Thirty-six, Editor: Mark Daly.
7. Gundlach Jay, Designing Unmanned Aircraft Systems – A comprehensive Approach, AIAA Education Series, Reston, Virginia 2012