COURSE DESCRIPTION CARD - SYLLABUS

Course name

Construction of multirotor frames

Course

Field of study

Aviation

Year/Semester

3/5

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

15

Laboratory classes

0

Other (e.g. online)

0

Tutorials

15

Projects/seminars

30

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Krzysztof Talaśka, prof. PP

email: krzysztof.talaska@put.poznan.pl

tel. 61 665 2244

Wydział Inżynierii Mechanicznej

ul. Piotrowo 3, pok. 734, 61-138 Poznań

Responsible for the course/lecturer:

dr inż. Dominik Wilczyński

email: dominik.wilczynski@put.poznan.pl

tel. 61 2244512

Wydział Inżynierii Mechanicznej

ul. Piotrowo 3, pok. 423, 61-138 Poznań

Prerequisites

Knowledge: Basic knowledge of mathematics, materials science, mechanics, basics of machine construction, theory of machines and mechanisms, strength of materials.

Skills: Ability to independently formulate a technical problem, develop a construction record in accordance with the principles of technical drawing, calculate the strength of machine elements, shape the structural features of aircraft components.

Social competences: Understanding the need to expand one's competences, readiness to cooperate within a team.

Course objective

Familiarization with the construction, properties and design features of the multirotor frames. The multirotor frame design methodology presented in the course will be practiced during practical classes and during the implementation of individual projects.

Course-related learning outcomes

Knowledge

has ordered, theoretically founded general knowledge in the field of technology and various means of air transport, about the life cycle of means of transport, both hardware and software, and in particular about the key processes taking place in them

has ordered, theoretically founded general knowledge covering key issues in the field of technical thermodynamics, fluid mechanics, in particular aerodynamics

has an ordered, theoretically founded knowledge in the field of engineering graphics and machine construction: technical drawing, object projection, basic principles of engineering graphics, the use of CAD (Computer Aided Design) graphic programs in the construction of machines

Skills

is able to obtain information from various sources, including literature and databases, both in Polish and in English, integrate them properly, interpret them and make a critical evaluation, draw conclusions and exhaustively justify the opinions they formulate

is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them

can, when formulating and solving tasks related to civil aviation, apply appropriately selected methods, including analytical, simulation or experimental methods

Social competences

understands that in technology, knowledge and skills very quickly become obsolete

is aware of the importance of knowledge in solving engineering problems and knows examples and understands the causes of faulty engineering projects that have led to serious financial and social losses, or to a serious loss of health and even life

is able to think and act in an entrepreneurial way, incl. finding commercial applications for the created system, bearing in mind not only the business benefits, but also the social benefits of the activity

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written test from the lecture containing several open theoretical questions. Duration: 90 minutes.

Evaluation criteria: 1 point is provided for each task, points are awarded with an accuracy of 0.25 points, a total of 5 points are available.

Rating scale: less than 50% - 2.0, more than 50% - 3.0, more than 60% - 3.5, more than 70% - 4.0, more than 80% - 4.5, more than 90% - 5.0.

Classes: Written test with 2-3 calculation or design tasks during the last class. Duration: 90 minutes.

Evaluation criteria: 1 point is provided for each task, points are awarded with an accuracy of 0.25 points, a total of 2-3 points are available.

Rating scale: less than 50% - 2.0, more than 50% - 3.0, more than 60% - 3.5, more than 70% - 4.0, more than 80% - 4.5, more than 90% - 5.0.

Projects: Credit in the form of verification of practical skills in designing multirotor frames. Each student performs an individual project on the basis of established output data. The credit consists in defending the completed project.

Evaluation criteria: The correctness of project preparation and technical documentation is assessed. There is 1 point to be won, points are awarded with an accuracy of 0.1 points.

Rating scale: less than 50% - 2.0, more than 50% - 3.0, more than 60% - 3.5, more than 70% - 4.0, more than 80% - 4.5, more than 90% - 5.0.

Programme content

Lectures:

Lecture 1 - Construction, design features of multirotor frames

Presentation of the construction and construction features of multirotor frames, broken down into size classes and the number of arms, material and technological conditions of the frame.

Lecture 2 - Materials used for multirotor frames

Presentation of the advantages and disadvantages of using selected groups of materials for multirotor frames: light alloys, plastics, composites.

Lecture 3 - Tools supporting the work of an engineer designing multirotor frames

Presentation of selected CAD tools with an indication of the advantages in the specificity of designing multirotor frames (modeling + strength analysis: Inventor, Solid Works, Catia, Abaqus, Ansys).

Lecture 4 - Multirotor frame design methodology part. 1

Indication of the steps to be followed when designing multirotor frames: output data, size class, number of motors, number of arms, arrangement of arms.

Lecture 5 - Multirotor frame design methodology part. 2

Indication of the steps to be followed when designing multirotor frames: calculations of dimensions, weight, selection of materials, 3D modelling.

Lecture 6 - Multirotor frame design methodology part. 3

Indication of the stages of proceeding when designing multirotor frames: strength and kinematic analyses, technical documentation.

Lecture 7 - Rapid Prototyping

Preparation of the results of design work for the needs of rapid prototyping - 3D printing.

Lecture 8 - Pass Written test from the lecture containing several open theoretical questions

Exercises:

Exercise 1 - Calculations for the purpose of determining the design features of multirotor frames due to the dimensional class part. 1.

Exercise 2 - Calculations for the purpose of determining the design features of multirotor frames due to the dimensional class part. 2.

Exercise 3 - Calculations for the purpose of determining the design features of multirotor frames due to the number of arms: 2, 3, 4.

Exercise 4 - Calculations for the purpose of determining the design features of multirotor frames due to the number of arms: 6, 8.

Exercise 5 - Calculations for the purpose of determining the design features of multirotor frames due to the arrangement of arms: tricopter, quad +, quad X, quad H.

Exercise 6 - Calculations for the purpose of determining the design features of multirotor frames due to the arrangement of arms: quad V, quad Y, hexa +, hexa X, hexa Y6

Exercise 7 - Calculations for the purpose of determining the design features of the multirotor frames due to the arrangement of the arms: octo +, octo X, octo X8

Exercise 8 - Pass Written test with 2-3 calculation or project tasks.

Projects:

Project 1 - 2 - Definition of guidelines and outputs for individual projects.

Project 3 - 10 - Design calculations, 3D modeling, kinematic and strength analyses.

Project 11 - 14 - Prototyping.

Project 15 - Defense of the project. Passing the project consists in evaluating the correctness of the project preparation and technical documentation.

Teaching methods

Lecture: Lecture with multimedia presentation.

Exercises: Computational exercises.

Project: Workshop methods of practical design and computer classes.

Bibliography

Basic

1. Sarah Kreps, Drony: wprowadzenie, technologie, zastosowania, Wydawnictwo Naukowe PWN, Warszawa, 2019

2. Wiktor Wyszywacz, Drony: budowa, loty, przepisy, Wydawnictwo Poligraf, Brzezia Łąka, 2016

3. Wiktor Wyszywacz, Drony : przepisy, budowa i eksploatacja BSP, loty, meteorologia, nawigacja, pilot, bezpieczeństwo, Wydawnictwo Poligraf, Brzezia Łąka, 2020

4. Lewitowicz J., Podstawy eksploatacji statków powietrznych. Tom I, ITWL, Warszawa 2001

Additional

1. Pilecki S., Lotnictwo i kosmonautyka, WKŁ, Warszawa 1984,

2. Karpowicz J., Współczesne konstrukcje lotnicze, AON, Warszawa 2003.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for classes, preparation for tests,) [1]	40	2,0

[1] delete or add other activities as appropriate