# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Construction of multirotor frames [S1Lot2-BSP>BRM]

## Course

Field of study
Aviation

Year/Semester
3/5

Area of study (specialization)
Unmanned Aerial Vehicles

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

## Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
30

## Number of credit points

5,00

## Coordinators

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## Lecturers

## Prerequisites

Knowledge: Basic knowledge of mathematics, materials science, mechanics, basics of construction machines, theory of machines and mechanisms, strength of materials. Skills: Ability to independently formulate a technical problem and prepare a record construction in accordance with the principles of technical drawing, calculation of the strength of machine elements, shaping the design features of aircraft components. Social competences: Understanding the need to expand one's competences, readiness to starting cooperation within a team.

## Course objective

Getting to know the structure, properties and design features of multirotor frames. The methodology of designing multirotor frames presented in the course will be practiced practically during classes and during the implementation of individual projects.

## Course-related learning outcomes

Knowledge:
-

Skills:
-

Social competences:
-

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written assessment of the lecture containing several open theoretical questions. Duration: 90 minutes.
Assessment criteria: 1 point is awarded for each task, points are awarded with an accuracy of 0.25 points, a total of 5 points can be obtained.
Rating scale: below 51% - 2.0, from 51% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.
Exercises: Written assessment of exercises containing 2-3 accounting or design tasks last classes. Duration: 90 minutes.
Assessment criteria: 1 point is awarded for each task, points are awarded with an accuracy of 0.25 points, a total of 2-3 points can be obtained.
Rating scale: below 51% - 2.0, from 51% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.
Projects: Assessment in the form of verification of practical skills in designing multirotor frames. Each student completes an individual project based on established output data. Pass consists in defending the completed project.
Assessment criteria: the correctness of the project preparation and preparation of technical documentation is assessed. There is a maximum of 1 point to be gained, points are awarded with an accuracy of 0.1 points.
Rating scale: below 51% - 2.0, from 51% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.

## Programme content

Lectures:
Construction and design features of multirotor frames, materials used for multirotor frames, methodology for designing multirotor frames, CAD tools, prototyping possibilities.
Exercises:
Calculations for determining the design features of multirotor frames.
Projects:
Multirotor frame design.

## Course topics

Lectures:
Lecture 1 - Construction, design features of multirotor frames
Presentation of the structure and design features of multirotor frames divided 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: alloys light, plastics, composites.
Lecture 3 - Tools supporting the work of an engineer designing multirotor frames
Presentation of selected CAD tools with an indication of their advantages in the specificity of frame design multi-rotor aircraft (modeling + strength analyses: Inventor, Solid Works, Catia, Abaqus, Ansys).
Lecture 4 - Methodology for designing multirotor frames, part 1
Indication of the stages of procedure when designing multirotor frames: output data, size class, number of engines, number of arms, arm arrangement.
Lecture 5 - Methodology for designing multirotor frames, part 2
Indication of the stages of procedure when designing multirotor frames: calculations of dimensions, weight, selection of materials, 3D modeling.

Lecture 6 - Methodology for designing multirotor frames, part 3
Indication of the stages of procedure when designing multirotor frames: strength and kinematic analyses, technical documentation.
Lecture 7 - Rapid prototyping
Preparation of design work results for rapid prototyping - 3D printing.
Lecture 8 - Assessment
Written assessment of the lecture containing several open theoretical questions
Exercises:
Exercises 1 - Calculations for the purpose of determining the design features of multirotor frames due to... dimensional class part 1.
Exercises 2 - Calculations for the purpose of determining the design features of multirotor frames due to... dimensional class part 2.
Exercises 3 - Calculations for the purpose of determining the design features of multirotor frames due to... number of arms: 2, 3, 4.
Exercises 4 - Calculations for the purpose of determining the design features of multirotor frames due to... number of arms: 6, 8.
Exercises 5 - Calculations for the purpose of determining the design features of multirotor frames due to... arm system: tricopter, quad +, quad X, quad H.
Exercises 6 - Calculations for the purpose of determining the design features of multirotor frames due to... arm arrangement: quad V, quad Y, hexa +, hexa X, hexa Y6
Exercises 7 - Calculations for the purpose of determining the design features of multirotor frames due to... arm arrangement: octo +, octo X, octo X8
Exercises 8 - Assessment
Written assessment of exercises containing 2-3 accounting or design tasks.
Projects:
Project 1 - 2 - Determination of guidelines and output data for individual projects.
Project 3 - 7 - Design calculations, 3D modeling, kinematic and strength analyses.
Project 8 - 14 - Prototyping.
Project 15 - Project defense.
Completing the project involves assessing the correctness of the project preparation and documentation technical.

## Teaching methods

Lecture: Lecture with multimedia presentation.
Exercises: Computational exercises.
Project: Workshop methods for practical design and computer classes.

## Bibliography

Basic:
-

Additional:
-

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 125 | 5,00 |
| Classes requiring direct contact with the teacher | 60 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 65 | 2,50 |