



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Air Navigation

### Course

Field of study

Aviation

Area of study (specialization)

Flight Training For Civil Aviation

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/5

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

Tutorials

15

Projects/seminars

Other (e.g. online)

### Number of credit points

3

### Lecturers

Responsible for the course/lecturer:

mgr inż. Kajetan Szymańczyk

Responsible for the course/lecturer:

### Prerequisites

The student starting this subject should have basic knowledge of basic knowledge about the shape of the Earth, coordinate systems and reference as well as the basics of radio navigation. He should also have the ability to apply the scientific method in solving problems and be ready to cooperate within a team.

### Course objective

To acquaint the student with the practical performance of navigation tasks related to the planning, preparation and execution of a flight in selected environmental and operational conditions, change of time, use of typical navigation and radio navigation devices, use of radar devices, interpretation of measurement results, assessment of correctness of functioning and estimation of navigation and radio navigation equipment errors . Ability to use satellite system receivers used in navigation, interpretation of indications and assessment of the possibility of using satellite systems in particular types and phases of navigation, use of navigation methods in professional air operations. The ability to put into practice calculations of grouping parameters.



### Course-related learning outcomes

#### Knowledge

1. has extended and in-depth knowledge of mathematics including algebra, analysis, theory of differential equations, probability, analytical geometry as well as physics covering the basics of classical mechanics, optics, electricity and magnetism, solid state physics, thermodynamics, useful for formulating and solving complex technical tasks related to engineering aeronautical and modeling
2. has ordered and theoretically founded general knowledge in the field of key technical issues and detailed knowledge of selected issues related to air transport, knows the basic techniques, methods and tools used in the process of solving tasks related to air transport, mainly of an engineering nature

#### Skills

1. 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
2. is able to properly use information and communication techniques, applicable at various stages of the implementation of aviation projects
3. is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them
4. can, when formulating and solving tasks related to civil aviation, apply appropriately selected methods, including analytical, simulation or experimental methods
5. can solve tasks using the rules of air traffic and design a runway in accordance with the applicable ICAO requirements
6. student can use theoretical probability distributions. Student is able to analyze and interpret statistical data. Student is able to use the methods and tools of mathematical statistics in engineering practice
7. is able to prepare a short research paper while maintaining the basic editorial rules. He can choose appropriate methods for the conducted research and is able to carry out a basic analysis of the results.
8. is able to organize, cooperate and work in a group, assuming various roles in it, and is able to properly define priorities for the implementation of a task set by himself or others
9. is able to plan and implement the process of own permanent learning and knows the possibilities of further education (2nd and 3rd degree studies, postgraduate studies, courses and exams conducted by universities, companies and professional organizations)

#### Social competences

1. understands that in technology, knowledge and skills very quickly become obsolete
2. correctly identifies and resolves dilemmas related to the profession of an aerospace engineer



### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

- assessment of knowledge and skills demonstrated on the written test - 1.5 hour

Exercises:

The knowledge acquired as part of the exercises is verified by two 45-minute colloquia carried out during 3 and 7 classes

### Programme content

Lecture:

Semester 5:

GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSSs)

Global navigation satellite systems (GNSSs)

General

Operation

Global navigation satellite system (GNSS)

Space segment (example: NAVSTAR GPS)

Control segment

User segment

NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS) integrity

Errors and factors affecting accuracy

Ground-, satellite- and aircraft-based augmentation systems

Ground-based augmentation systems (GBASs)

Satellite-based augmentation systems (SBASs)

Aircraft-based augmentation systems (ABASs)

Navigation specifications

Area navigation (RNAV) and required navigation performance (RNP)

Navigation functional requirements



Designation of RNP and RNAV specifications

Use of performance-based navigation (PBN)

Specific RNAV and RNP system functions

Performance-based navigation (PBN) operations

Performance-based navigation (PBN) principles

On-board performance monitoring and alerting

Abnormal situations

Database management

Requirements of specific RNAV and RNP specifications

RNAV 10

RNAV 5

RNAV 1/RNAV 2/RNP 1/RNP 2

Required navigation performance approach (RNP APCH)

Required navigation performance authorisation required approach (RNP AR APCH)

Advanced required navigation performance (A-RNP)

### Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.
2. Exercises: examples given on the board and performance of tasks given by the teacher - practical exercises.

### Bibliography

Basic

1. Narkiewicz J., Podstawy układów nawigacyjnych, PWN, Warszawa 1999 r.
2. Ortyl A., Autonomiczne systemy nawigacji lotniczej, WAT, Warszawa 2000 r.
3. Janik F., Malinowski C., Podstawowa nawigacja lotnicza, Wydawnictwa komunikacyjne, Warszawa 1957 r.



4. Wyzrozumski W., Podręcznik nawigacji lotniczej, Aeroklub PRL,
6. Wolper James S., Understanding mathematics for aircraft navigation, McGraw-Hill Companies Inc, 2001 r.
7. Narkiewicz J., Globalny system pozycyjny. WKiŁ 2003 r.
8. Advanced Avionics Handbook FAA-H-8083-6, Federal Aviation Administration. Washington 2009 r.

Additional

### Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,0
Classes requiring direct contact with the teacher	50	1,5
Student's own work (literature studies, preparation for exercises, preparation for colloquium / credit; preparation for laboratory classes, preparation of report) <sup>1</sup>	30	1,5

<sup>1</sup> delete or add other activities as appropriate