COURSE DESCRIPTION CARD - SYLLABUS

Course name
Air navigation [S1Lot2-PSPL>NLs4]

Course

Field of study
Aviation

Year/Semester
2/4

Area of study (specialization)
Aircraft Piloting

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
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

Kajetan Szymańczyk

Lecturers

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 7 and 15 classes

Programme content

RADAR
Pulse techniques
Pulse techniques and associated terms
Ground radar
Principles
Presentation and interpretation
Airborne weather radar
Principles
Presentation and interpretation
Coverage and range
Errors, accuracy, limitations
Factors affecting range and accuracy
Application for navigation
Secondary surveillance radar and transponder
Principles

Modes and codes
Presentation and interpretation

Course topics

Lecture:
Semester 4:
RADIO AIDS
Ground direction finding (DF)
Principles
Presentation and interpretation
Coverage and range
Errors and accuracy
Non-directional radio beacon (NDB)/automatic direction finding (ADF)
Principles
Presentation and interpretation
Coverage and range
Errors and accuracy
Factors affecting range and accuracy
VHF omnidirectional radio range (VOR): conventional VOR (CVOR) and Doppler VOR (DVOR)
Principles
Presentation and interpretation
Errors and accuracy
Distance-measuring equipment (DME)
Principles
Presentation and interpretation
Coverage and range
Factors affecting range and accuracy
Instrument landing system (ILS)
Principles
Presentation and interpretation
Coverage and range
Errors and accuracy
Non-directional radio beacon (NDB)/automatic direction finding (ADF)
Principles
Presentation and interpretation
Coverage and range
Errors and accuracy
Factors affecting range and accuracy
VHF omnidirectional radio range (VOR): conventional VOR (CVOR) and Doppler VOR (DVOR)
Principles
Presentation and interpretation
Errors and accuracy
Distance-measuring equipment (DME)
Principles
Presentation and interpretation
Coverage and range
Factors affecting range and accuracy
Instrument landing system (ILS)
Principles
Presentation and interpretation
Coverage and range
Errors and accuracy
Factors affecting range and accuracy
Microwave landing system (MLS)
Presentation and interpretation
Coverage and range
PERFORMANCE-BASED NAVIGATION (PBN)
Performance-based navigation (PBN) concept (as described in ICAO Doc 9613)
PBN principles

PBN components
PBN scope
Exercises:
Semester 4:
RADIO NAVIGATION
BASIC RADIO PROPAGATION THEORY
Basic principles
Electromagnetic waves
Frequency, wavelength, amplitude, phase angle
Frequency bands, sidebands, single sideband
Pulse characteristics
Carrier, modulation
Kinds of modulation (amplitude, frequency, pulse, phase)
Antennas
Characteristics
Polarisation
Types of antennas
Wave propagation
Structure of the ionosphere and its effect on radio waves
Ground waves
Space waves
Propagation with the frequency bands
Doppler principle
Factors affecting propagation

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.
3. Practical exercises at the didactic and laboratory positions.

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. Wyrozumski 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 2009r.

Additional:
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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