Course description

Department/Unit /	KE / NNUPE			**Academic Year**	2023/2024
Title	Positioning Systems			**Type of completion**	Examination
Accredited/Credits	Yes, 5 Cred.			**Type of completion**	Combined
Number of hours	Lecture 2 [HRS/WEEK] Tutorial 1 [HRS/WEEK] Seminar 1 [HRS/WEEK]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	YES
Summer semester	5 / -	0 / 0	0 / 0	**Counted into average**	YES
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	not determined
Timetable	Yes			**Repeated registration**	NO
Language of instruction	Czech			**Semester taught**	Summer semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	A|B|C|D|E|F			**Ev. sc. – cred.**	S|N
No. of hours of on-premise	0				
Auto acc. of credit	No				
Periodicity	K				
Substituted course	KE/INUPE				
Preclusive courses	N/A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The first part of the course is focused on a thorough acquaintance with the basic elements of navigation systems and their applications in aviation. The following part focuses on the description of methods for determining the positions of targets based on the measurement of time, direction, phase and Doppler shift. Furthermore, the course introduces students to the key positioning systems used in air transport. The last part of the course is focused on a thorough acquaintance with the issues of global navigation systems, especially the description of their activities, sources of positioning errors, positioning accuracy and concepts of global navigation system receivers.

Requirements on student

The student is required to have basic knowledge of electrical engineering, electronic and radio systems, mathematical analysis and probability theory.

Content

1.Introduction to methods of positioning and navigation - systems, geoid, cartographic systems
2. Use of navigation systems in aviation - VFR and IFR
3.Relative and absolute position determination
4.Principles of radio positioning, methods of time measurement, direction measurement, phase measurement and Doppler
5.Methods of measuring time delay of signals and Doppler shift
6.Automatic radio compass, radio sights
7.NDB (radio beacon), VOR / DME (radio beacon), TACAN (airborne radio navigation system)
8.ILS (electronic Instrumented Landing System), LORAN (terrestrial radio navigation system)
9. Overview of global satellite navigation systems (GNSS)
10.GPS (system description, sources of positioning errors, measurement accuracy), DGPS, extension systems (WAAS, EGNOS)
11.Other GNSS systems (GALILEO, GLONASS, BEIDOU)
12. Navigation receiver, functions, modes of capture and monitoring, content and structure of data messages
13. Organization of air transport

Prerequisites - other information about course preconditions

Basic knowledge of electrical engineering, electronic and radio systems, mathematical analysis and probability theory is assumed.

Competences acquired

The student should be able to program in the MatLab environment.

Fields of study

V případě mimořádných opatření bude výuka probíhat vzdáleně s využitím programu MS Teams v době dle rozvrhu. Účast na schůzkách skupiny v MS Teams je ekvivalentní účasti na přednáškách a cvičeních.

In the case of distance learning, lessons will be tought trough MS Teams. Lessons will be at the time shown in the timetable. MS Teams is equivalent to participation and or attendens in lectures and excersises.

Guarantors and lecturers

- **Guarantors:** doc. Ing. Aleš Filip, CSc.
- **Lecturer:** doc. Ing. Aleš Filip, CSc. (100%), Ing. Zdeněk Němec, Ph.D. (100%), Ing. Tomáš Zálabský, Ph.D. (100%)
- **Tutorial lecturer:** doc. Ing. Aleš Filip, CSc. (100%), Ing. Zdeněk Němec, Ph.D. (100%), Ing. Tomáš Zálabský, Ph.D. (100%)
- **Seminar lecturer:** doc. Ing. Aleš Filip, CSc. (100%), Ing. Zdeněk Němec, Ph.D. (100%), Ing. Tomáš Zálabský, Ph.D. (100%)

Literature

- **Basic:** Bezoušek, Pavel. *Radarová technika*. Praha: Vydavatelství ČVUT, 2004. ISBN 80-01-03036-9.
- **Basic:** HRDINA, Zdeněk,Petr ŠEDIVÝ. *Rádiové určování polohy (Družicový systém GPS)*. České vysoké učení technické, 1995. ISBN 80-01-01386-3.
- **Basic:** CAMPOS, Rafael Saraiva a Lisandro LOVISOLO. *RF Positioning: Fundamentals, Applications, and Tools*. London: Artech House Publishers, 2015. ISBN 978-1-60807-816-5.
- **Basic:** KASAL, Miroslav. *Směrové a družicové spoje: přednášky. Vyd. 2.*. Vysoké učení technické, Fakulta elektrotechniky a komunikačních technologií, Ústav radioelektroniky, 2003. ISBN 80-214-2496-6.
- **Recommended:** RICHARDS, M. A., SCHEER, J. A., HOLM, W. A. *Principles of Modern Radar- Basic Principles*. 2010. ISBN 978-1-891121-52-4.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Kontaktní výuka	52
Domácí příprava na výuku	30
Příprava na zkoušku	16
Účast na výuce	52
Total:	**150**

Teaching methods

Monologic (reading, lecture, briefing)
Dialogic (discussion, interview, brainstorming)
Laboratory work

Assessment methods

Oral examination
Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Communication and Radar Systems	Follow-up study	Full-time	Communication and Radar Systems	1	2022	2023	Compulsory courses 1st year	A	1	LS
Communication and Radar Systems	Follow-up study	Full-time	Communication and Radar Systems	1	2023	2023	Compulsory courses 1st year	A	1	LS
Communication and Radar Systems	Follow-up study	Full-time	Communication and Radar Systems	1	2021	2023	Compulsory courses 1st year	A	1	LS