STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Navigation and motion planning in robotics	**1010532121010550030**

Field of study	Profile of study (general academic, practical)	Year /Semester
Automatic Control and Robotics	**general academic**	**1 / 2**
Elective path/specialty: **Smart Aerospace and Autonomous Systems**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time): **full-time**	

No. of hours	No. of credits
Lecture: **15** Classes: **-** Laboratory: **-** Project/seminars: **30**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
major	**from field**

Education areas and fields of science and art	ECTS distribution (number and %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student starting this module should have basic knowledge regarding sensors
2	**Skills**	He/she should have skills allowing solving basic problems related to sensors. Student should understand the need to extend his/her competences.
3	**Social competencies**	In addition, in respect to the social skills the student should show attitudes as honesty, responsibility, perseverance, curiosity, creativity, manners, and respect for other people.

Assumptions and objectives of the course:

1.Provide students knowledge regarding current and emerging avionics systems.
2.Develop students? skills in solving problems related to navigation and guidance of aircrafts.
3.Acquire such skills by solving practical tests during laboratory classes.
4.Develop students? skills to carry out experiments and to work with navigation and guidance systems.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. acquire knowledge on navigation and guidance systems and their integration - [K_W4]
2. have wide and in-depth knowledge on avionics , navigation equations, aids - [K_W5]
3. be informed about trends and advances in avionics and navigation systems - [K_W6]
4. know methodology of carrying out experiments with avionics - [K_W8]

Skills:

1. is able to acquire, integrate, interpret and evaluate information from literature, databases and www sources on avionics - [K_U1]
2. is able to plan and arrange self-education process in particular covering issues of avionics - [K_U5]
3. is able to apply navigation and guidance methods to solve engineering as well as scientific problems - [K_U9]
4. is able to integrate knowledge coming both from different sub-domains of avionicsm to formulate and solve engineering tasks - [K_U10]
5. can conduct experimental studies and analyse their results with navigation and guidance tools - [K_U12]
6. is able to evaluate strong and weak points of algorithms and their implementation and asses their usefulness to IT tasks - [K_U13]

Social competencies:

1. understands that knowledge and skills related to avionic quickly becomes non relevant - [K_K1]
2. knows examples / case studies of avionics and analysis and understands their limitations - [K_K4]
3. is able to correctly assign priorities to own tasks - [K_K6]

Assessment methods of study outcomes

Formative assessment:

a) lectures:

based on answers to question in the written exam,

b) laboratory classes:

evaluation of doing correctly assigned tasks (following provided lab. instructions),

Total assessment:

a) verification of assumed learning objectives related to lectures:

i. evaluation of acquired knowledge on the basis of the written exam.

ii. discussion of correct answers in the exam

b) verification of assumed learning objectives related to laboratory classes:

i. evaluation of student?s knowledge necessary to prepare, and carry out the lab tasks,

ii. monitoring students? activities during classes,

iii. evaluation of lab reports (partly started during classes, finished after them)

iv. two written tests during the classes,

Additional elements cover:

i. discussing more general and related aspects of the class topic,

ii. showing how to improve the instructions and teaching materials.

Course description

The subject of integrated navigation systems is the combination of an on-board navigation solution providing position, velocity and attitude as derived from accelerometer and gyro inertial sensors, with independent navigation aide data update or correct this on-board navigation solution. In this course, this combination is accomplished with the use of Kalman filter algorithm. Kinematics, equations describing various navigation systems and their error models, navigational aids to navigation and their error models. Applications are presented for various integrated navigation systems in the second part.

Course Outline : Navigation overview : from dead-reckoning to inertial navigation, integrated navigation systems, Navigation equations : position, velocity and attitude data for onboard use, Navigation aids: redundant information to correct navigation data, Optimal combination of navigation and aiding data

Practical work: Exercises will be set, which will involve analysis and design of selected numerical techniques.

When completing this course the students will be able to:

- Understand the fundamentals of navigation and guidance systems and their integration
- Use navigation aids.

The lab-classes will be focused on practical exercises with software implementations and their application to test or real situations. It should cover navigation and guidance of aircrafts

Learning methods:

1. Lectures: multimedia presentation, presentation illustrated with examples presented on black board, solving tasks, multimedia showcase
2. Labs: solving tasks, practical exercises, discussion, teamwork, multimedia showcase, competitions or case studies

Basic bibliography:

1. Moir Aircraft systems, mechanical, electrical and avionics subsystems Halsted press, 2004
2. Applied mathematics in integrated navigation systems, R. Rogers, AIAA press, 2007
3. Strapdown inertial navigation technology, D. Titterton, AIAA press, 2004

Additional bibliography:

Result of average student's workload

Activity	Time (working hours)

1. participating in lectures	15
2. participating in project classes	30
3. preparing to project classes	15
4. finishing reports from project classes (in addition to laboratory classes)	15
5. consulting issues related to the subject of the course; especially related to projects	2
6. studying literature / learning aids	10
7. preparing to assessment tests	12
8. exam results	1

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	48	2
Practical activities	45	2