**Nazwa przedmiotu:**

Sensors and Measurement Systems

**Koordynator przedmiotu:**

dr inż. Przemysław Bibik

**Status przedmiotu:**

Fakultatywny ograniczonego wyboru

**Poziom kształcenia:**

Studia II stopnia

**Program:**

Robotics

**Grupa przedmiotów:**

Przedmioty obieralne

**Kod przedmiotu:**

ANS511

**Semestr nominalny:**

3 / rok ak. 2020/2021

**Liczba punktów ECTS:**

3

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

1) Number of hours that require the presence of a teacher - 32, including:
a) attendance at the labs - 15 hours;
b) attendance at the lectures - 15 hours;
c) consultancy meetings - 2 hours.
2) The number of hours of independent work of student - 45, including:
• preparation for tests - 10 hours;
• preparation for laboratories and making of reports – 25 hours;
• reading recommended literature by the teacher - 10 hours.
TOTAL: 77 hours.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

1.3 ECTS credits - 32 hours, including:
a) attendance at the labs - 15 hours;
b) attendance at the lectures - 15 hours;
c) consultancy meetings - 2 hours.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

2 ECTS credits - 42 hours, including:
a) attendance at the labs - 15 hours;
b) consultancy meetings - 2 hours.
c) preparation for laboratories and making of reports – 25 hours.

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 15h |
| Ćwiczenia: | 0h |
| Laboratorium: | 15h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

Recommended Aeronautical Systems I and II.

**Limit liczby studentów:**

12 students in one group.

**Cel przedmiotu:**

The course aims to familiarize students with the design of measurement systems, methods of measurement of physical quantities and methods of results analysis.

**Treści kształcenia:**

The lecture covers the basic issues related to the design and operation of measurement systems and analysis of measurement results. It covers the design, operation and characteristics of typical sensors, the structure of the measuring systems, sensors, calibration methods, and methods of measurement systems protection against interference. Presented are the interfaces and buses used in common measuring systems, D/A and A/D converters and the principles of sampling and quantization of signals. It also covers the basic methods of statistical analysis of measurement results like the determination of mean, median, standard deviation and quantiles, histograms and box plots.
In the laboratory, students are acquainted with the principle of operation, characteristics and errors of sensors and measuring systems of fundamental physical quantities.

**Metody oceny:**

Passing the course requires the completion of the lecture and laboratory. Completion of the lecture is based on the evaluation of two tests, the laboratory part completion is based on the average of the reports marks. Final mark is the average of the test and laboratory.

**Egzamin:**

nie

**Literatura:**

1. Nawrocki, W.: „ Measurement Systems and Sensors”, 2005 ARTECH HOUSE, INC., e-book ebrary.
2. Fraden, J.: „ Handbook of Modern Sensors - Physics, Designs and Applications (3rd Edition)”, e-book Knovel .
3. Osiander, R.: „MEMS and microstructures in aerospace applications ”, 2006.
4. Pallet E.H.J.: „Aircraft Instrument Systems”, IAP, 1993.
5. Titterton, D.: „Strapdown Inertial Navigation Technology”, 1997.
Additional:
1. Materials provided by the course leader.

**Witryna www przedmiotu:**

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**Uwagi:**

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka ANS511\_W1:**

Students should aqcuire both foundational knowledge on design, functioning, and characteristics of typical sensors as well as robust measurement methods that protect against interference.

Weryfikacja:

Final test

**Powiązane charakterystyki kierunkowe:** AiR2\_W06

**Powiązane charakterystyki obszarowe:** I.P7S\_WG, III.P7S\_WG.o, P7U\_W

**Charakterystyka ANS511\_W2:**

Students should know the interfaces and buses used in common measuring systems, D/A and A/D converters and the principles of sampling and quantization of signals.

Weryfikacja:

Final test

**Powiązane charakterystyki kierunkowe:** AiR2\_W06

**Powiązane charakterystyki obszarowe:** I.P7S\_WG, III.P7S\_WG.o, P7U\_W

**Charakterystyka ANS511\_W3:**

Students should understand statistical measurement data analysis methods and tools.

Weryfikacja:

Final test

**Powiązane charakterystyki kierunkowe:** AiR2\_W06

**Powiązane charakterystyki obszarowe:** I.P7S\_WG, III.P7S\_WG.o, P7U\_W

### Profil ogólnoakademicki - umiejętności

**Charakterystyka ANS511\_U1:**

Students should be acquainted with the sensors' characteristics and the tools for analyzing measurement errors that appear in systems measuring various physical quantitites.

Weryfikacja:

Laboratory report marks

**Powiązane charakterystyki kierunkowe:** AiR2\_U14, AiR2\_U06

**Powiązane charakterystyki obszarowe:** III.P7S\_UW.2.o, III.P7S\_UW.4.o, I.P7S\_UW