Polish course name	**MATERIAŁY DLA PRZEMYSŁU ELEKTRONICZNEGO**
English course name	**MATERIALS FOR THE ELECTRONICS INDUSTRY**
Course code	**WIP-MDL-D1-MFTEI-02**
Field of study	**Materials design and logistics**
Level of qualification	**First degree**
Form of study	**Full-time**
Semester	**2**
Number of ECTS points	**2**
Ways of assessment	**Test**

Number of hours per semester

Lecture	Seminar	Classes	Laboratory	Project
15			15	

TEACHERS:

Dr inż. Marcin Jarosik.

COURSE OBJECTIVES:

› **C1** Providing students with knowledge in the field of materials used in the electronics industry, including their properties and applications.

› **C2** Obtaining by the students the practical skills in testing selected properties of materials used in the electronics industry.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES:

1. Basic knowledge of mathematical analysis and physics, in particular in the "Electricity and Magnetism" section.
2. Ability to work independently and in a group.
3. Ability to use literature sources and internet resources.

COURSE CONTENT

LECTURE

- **L1 - L3** Introduction to electronic materials science: structure of matter, typical processing and manufacturing of electronic components, properties of materials and methods of their testing.
- **L4 - L6** Conductive materials: electric conductivity of metals, wire materials, resistive materials, contact materials, special conductive materials**.**
- **L7** Cryoresistivity, superconductivity and superconducting materials.
- **L8 - L10** Semiconductor materials: properties and application of semiconductors. Manufacture of semiconductor materials.
- **L11 - L13** Dielectric materials: structure and properties of dielectrics, types and applications of dielectrics.
- **L14** Liquid crystal materials: structure, properties and applications.
- **L15** Final test.

LABORATORY

- **Lab1** The Workshop Regulations and OHS Regulations, determination of measurement uncertainties.
- **Lab2 - Lab14** The student performs 6 designated exercises from the list:
  1. Determination of the characteristics and static parameters of the transistor.
  2. Marking of the Fe-Mo thermocouple and determining the point of inversion.
  3. Examination of the LED diode’s and the laser diode’s characteristics.
  4. Measurement of the width of the energy gap in semiconductors.
  5. Characteristics of resistances.
  6. Testing the electrical strength of materials; breakdown voltage measurement.
- **Lab15** Completion of the laboratory.

BASIC REFERENCES

1. Zdzisław Celiński, Materiałoznawstwo elektrotechniczne. Warszawa: Wydaw. Politechniki Warszawskiej, 2011 r.
2. Andrzej Szwedowski, Materiałoznawstwo optyczne i optoelektroniczne: ogólne właściwości materiałów. Warszawa: Wydaw. Nauk.-Techn., 1996 r.
3. Małgorzata Jakubowska, Techniki drukarskie w elektronice: materiały i technologie. Warszawa: Oficyna Wydaw. Politechniki Warszawskiej, 2013 r.

4. Krzysztof Waczyński, Edyta Wróbel, Technologie mikroelektroniczne: metody wytwarzania materiałów i struktur półprzewodnikowych. Gliwice: Wydaw. Politechniki Śląskiej, 2006 r.
5. Ed. R. W. Cahn, P. Haasen, E. J. Kramer, Materials Science and Technology: a Comprehensive Treatment, Vol. 15/16 (Vol. 10), Processing of Metals and Alloys. Processing of Semiconductors. Weinheim: WILEY-VCH Verlag, 2005 r.

SUPPLEMENTARY REFERENCE MATERIALS

LITERATURA UZUPEŁNIAJĄCA

1. I.A. Wrona, M.W. Jarosik, Porównanie wybranych właściwości diod elektroluminescencyjnych. Wybrane zagadnienia inżynierii produkcji w zastosowaniach medycznych, Fundacja na Rzecz Promocji Nauki i Rozwoju TYGIEL, 147 (2015).
2. A.P. Durajski, M.W. Jarosik, K. Kosk-Joniec, I.A. Wrona, M. Kostrzewa, K.A. Szewczyk, R. Szczęśniak, Phonon-Induced Superconducting State: from Metallic Hydrogen to LaH10, Act Physica Polonica A, 138 (2020) 715.

LEARNING OUTCOMES

› **EU1** The student has knowledge of the materials used in the electronics industry and is able to describe their properties and applications.
› **EU2** The student is able to correctly collect and process of measurement data and is able to correctly interpret the obtained results and present them in the form of a report.

TEACHING TOOLS

› Multimedia presentations.
› Manuals, scripts.
› Sets of laboratory exercises which are the equipment of the Department of Physics.

WAYS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

› **F1**. Assessment of self-preparation for laboratory.
› **F2**. Assessment of the final report’s preparation from respective laboratory exercises.

› **P1.** Assessment of the knowledge acquired during the lectures - final test.

› **P2.** Average grade for preparation to laboratory classes and final reports on individual exercises.

STUDENT WORKLOAD

Form of activity	Number of hours	ECTS
Contact hours with the teacher		
Lectures	15	0,6
Seminar		
Classes		
Laboratory	15	0,6
Project		
Test		
Exam		
Total contact hours	30	1,2
Student's own work		
Getting acquainted with the indicated literature	4	0,16
Preparation for seminar		
Preparation for classes		
Preparation for lab	7	0,28
Project preparation		
Consultation	2	0,08
Preparation for the test	7	0,28
Total student's own work	20	0,8
Total number of hours/ ECTS points for the course	**50**	**2,0**

ADDITIONAL INFORMATION

Timetable of classes	https://wip.pcz.pl/dla-studentow/plan-zajec/studia-stacjonarne
Information about the consultation (time + place)	https://wip.pcz.pl/dla-studentow/konsultacje-dla-studentow

MATRIX OF LEARNING OUTCOMES REALISATION

Learning outcome	Reference of given outcome to outcomes defined for whole program	Course objectives	Course content	Ways of assessment
EU 1	K_W01, K_W04, K_U09, K_K01,	C1	L1 - L15	P1
EU 2	K_W01, K_W03, K_U03, K_U09, K_K02,	C2	Lab1 - Lab15	F1, F2, P2

FORM OF ASSESSMENT - DETAILS

EU1 The student has knowledge of the materials used in the electronics industry and is able to describe their properties and applications.

- 2,0 The student has no knowledge of the materials used in the electronics industry and is also unable to describe their properties and applications.
- 3,0 The student has a cursory knowledge of the materials used in the electronics industry, can describe their properties in general, but cannot describe their application.
- 3,5 The student has a cursory knowledge of the materials used in the electronics industry, can describe their properties in general and can describe their applications in general.
- 4,0 The student has detailed knowledge of the materials used in the electronics industry and can describe their properties and applications in general.
- 4,5 The student has detailed knowledge of the materials used in the electronics industry and can describe their properties in detail and describe their applications in general.
- 5,0 The student has a detailed and systematic knowledge of the materials used in the electronics industry and is able to describe in detail their properties and applications.

EU2 The student is able to correctly collect and process measurement data and is able to correctly interpret the obtained results and present them in the form of a report.

- 2,0 The student is not able to collect and process measurement data and is not able to interpret the obtained results and present them in the form of a report.

- 3,0 The student is skilful at collecting and processing measurement data and, student can interpret the obtained results and present them in the form of a report with slight errors and without meeting the required deadlines.
- 3,5 The student is able to collecting and processing measurement data and, student can interpret the obtained results and present them in the form of a report with slight errors and without meeting the required deadlines.
- 4,0 The student is able to collecting and processing measurement data and, student can interpret the obtained results and present them in the form of a report with slight errors and with required deadlines.
- 4,5 The student is able to collecting and processing measurement data and, student can interpret the obtained results and present them in the form of a report with required deadlines.
- 5,0 The student is very good at collecting and processing measurement data and is able to interpret the obtained results flawlessly and present them in the form of a synthetic report with the required deadlines.