STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Hybrid materials and fillers		**1010702221010702658**

Field of study	Profile of study (general academic, practical)	Year /Semester
Chemical Technology	**(brak)**	**1 / 2**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Composites and Nanomaterials	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **15**	Classes: **-**	Laboratory: **30**	Project/seminars: **-**		**3**

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

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Hybrid materials and fillers classification and production, nanomaterials, polymer fillers and composites, modifying agents, surface treatment, characterization techniques, inorganic and biopolymer supports, dyes and pigments, additives solid state chemistry, physical chemistry ? properties of surface layer, instrumental chemistry
2	**Skills**	can use basic laboratory techniques in synthesis, modification and application of prepared hybrid materials and fillers as well as dyes and pigments, can use instrument al methods in characterization of materials
3	**Social competencies**	understands the need to supplement her/his education and increasing personal and professional competences

Assumptions and objectives of the course:

The aim of this course is to acquaint students with the hybrid materials and fillers science as the fascinating field of modern technologies and material engineering. This discipline from the boarder of several sciences including chemistry, physics, biology, materials engineering, nanotechnology. Students should gain the skills in the range of production, modification and application of hybrid materials and fillers as well as their characterization.

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

Knowledge:

1. Has the knowledge on techniques and methods of characterization of hybrid materials and fillers - [K_W03 K_W08]
2. Can describe methods, techniques, tools and materials used in the solution of simple problems connected with manufacturing and examination of materials - [K_W06 K_W07]

Skills:

1. Can select methods for the basic ways of characterization of fillers and hybrid materials - [-]
2. Can estimate usefulness and select the tools (methods) for the solution problem in the field of hybrid materials application - [-]
3. Student can discuss biomaterial problems in English - [-]

Social competencies:

1. Student understands the need to supplement her/his education and increasing professional competences - [-]
2. Student has the awareness to obey the engineer ethic rules. - [-]
3. Student can act and cooperate in the group accepting different roles. - [-]

Assessment methods of study outcomes

Final written or oral control following lectures, permanent control during laboratory classes

Course description

1. General aspects regarding fillers and hybrid materials
2. Nanomaterials
3. Modification, modifying agents, surface treatment
4. Exemplary methods in fillers and hybrids materials production
5. Polymer composites based on leyered silicates
6. Pigments and their derivatives
7. Biomaterials
8. Lignin based composites
9. Chitin and chitosan and other polysacharide-based materials
10. Precipitation of hybrid oxide systems of MO-SiO2.
11. Surface modification of hybrid materials utilizing selected alkoxysilanes. Evaluation of the efficiency of modification.
12. Adsorption of selected organic dyes onto synthesized hybrids. Evaluation of the efficiency of adsorption as well as stability of obtained pigments.
13. Physicochemical characterization of obtained materials (laser diffraction method - particle size distribution, elemental composition, parameters of the porous structure, colorimetric measurements, thermal stability, etc.).

Basic bibliography:

1. G. Wypych, Handbook of fillers, 3rd ed., ChemTec Publishing, Toronto 2010
2. M. Xantos, Functional fillers for plastics, Wiley-VCH, New York 2010
3. E.F. Vansant, P. van der Voort and K.C. Vrancken,
4. Characterization and chemical modification of the silica surface, Elsevier, Amsterdam 1995
5. 6. J.A. Rodriguez, M. Fernandez-Garcia, Synthesis, properties and applications of oxide nanomaterials, John Wiley & Sons, New Jersey 2007
6. A.W. Adamson, A.P., Gast, Physical chemistry of surface, John Wiley & Sons, Toronto 1997
7. Ch. Kumar, Nanostructured oxides, Wiley-VCH, Weinheim 2009

Additional bibliography:

1. Scientific papers (e.g. ACS, RSC, Springer, Elsevier, Hindawi), book chapters and patents regarding hybrid materials and fillers

Result of average student's workload

Activity	Time (working hours)
1. Przygotowanie do zaliczenia na prawach egzaminu	15
2. Przygotowanie do ćwiczeń laboratoryjnych	20
3. Udział w wykładach	0
4. Udział w laboratorium	15
5. Kkonsultacje	15

Student's workload

Source of workload	hours	ECTS
Total workload	95	3
Contact hours	60	0
Practical activities	15	0