STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Advanced Drying Techniques of Materials and Biomaterials	**1010702121010722587**

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

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

No. of hours	No. of credits
Lecture: **2** Classes: **-** Laboratory: **2** Project/seminars: **-**	**4**

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 %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Students should know the basics of simultaneous heat and mass transfer. Students should know the basics of engineering graphics. Students should know the basic chemical apparatus.
2	**Skills**	Students should speak English. Students should be able to pursue self-directed learning.
3	**Social competencies**	Students should understand the need for further self-learning and the learning of others (students).

Assumptions and objectives of the course:

Aim of the course: Learning advanced techniques of drying a variety of materials. Based on this knowledge, getting the skills to select an appropriate drying technique suitable for both the dried material and matched to the lines. Knowledge of use a renewable energy for drying.

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

Knowledge:

1. knowledge of transport phenomena during the drying process - [K_W02]
2. knowledge of advanced techniques of drying - [K_W04, K_W12]
3. knowledge of new developments in the techniques of drying - [K_W04, K_W12]
4. knowledge of environmental solutions in drying techniques - [K_W09]

Skills:

1. The ability to select suitable drying techniques for different dried materials - [K_U13, K_U14, K_U20]
2. The ability to use renewable sources of energy in drying technology - [K_U12]
3. The ability to use energy and drying medium recycling in drying technology - [K_U12]
4. The ability to design and conduct experimental drying - [K_U18]
5. The ability to use specialist vocabulary in English - [K_U03]

Social competencies:

1. Student understands the need for self-study and improve their professional competence. - [K_K01]
2. Student is aware of the principles of engineering ethics in the wide range. - [K_K02, K_K05]
3. Student is able to interact and work in a group. - [K_K03]

Assessment methods of study outcomes

Laboratory assessment on the basis of the current work in the laboratory and the test checking the knowledge gained during laboratories.

The lectures end with a written exam, for a knowledge and understanding of the material and the ability to draw conclusions from this knowledge.

Course description

The course teaches the advanced techniques for drying a variety of materials. It discusses the impact of the techniques and drying conditions on the kinetics of the process and the quality of the products. Special attention is given to the use of renewable energy and energy recycling and drying agent in drying techniques.

Specifically discussed:

basic definitions, history of drying, energy consumption during the process, moisture contained in the material moist air thermodynamics;

division of drying techniques, drying kinetics, solar drying as technology that uses renewable energy;

different advanced drying techniques indicating their current development (drying of the layers, drum, fluidized bed, fountain, stream, spray, using inert particles, contact, cylindrical, plate, vacuum, radiation, dielectric and microwave drying).

Basic bibliography:

1. Handbook of Industrial Drying, pod. red. Mujumdar A.S, wyd. 3, CRC Press 2006
2. Kudra T., Mujumdar A.S., Advanced Drying Technologies, wyd. 2, CRC Press 2009
3. Strumiłło, Cz., Podstawy teorii i techniki suszenia, wyd. 2, WNT 1983 (in Polish)
4. Van?t Land C.M., 2012, Drying in the Process Industry, John Wiley & Sons Inc., Hoboken, New Jersey

Additional bibliography:

1. Kowalski S.J., Rajewska K., Rybicki A., Fizyczne podstawy suszenia mikrofalowego, Wyd. PP 2005 (in Polish)
2. Oetjen G-W., Haseley P., Freeze-Drying, wyd. 2, WILEY-VCH Verlag 2004
3. Brosnan D.A., Robinson G.C., Introduction to Drying of Ceramics with laboratory Exercises, The American Ceramic Society 2003
4. Biskupski M., Łysiak J., Strutyńska K., Tkaczyk R., 1972, Suszarnie zbożowe i urządzenia do aktywnego wietrzenia. WNT Warszawa (in Polish)
5. Spray Drying Technology, ed. Woo M.W., Mujumdar A.S., Daud W.R.W.

Result of average student's workload

Activity	Time (working hours)
1. lecture	30
2. consultation to the lecture	6
3. consultation to the laboratory	6
4. preparation for laboratory	10
5. laboratory	30
6. exam preparation	20
7. exam	2

Student's workload

Source of workload	hours	ECTS
Total workload	104	4
Contact hours	74	0
Practical activities	0	0