

FACULTY OF CHEMISTRY

**SUBJECT CARD**

Name of subject in Polish: Mikrofale i inne zaawansowane technologie cieplne w inżynierii chemicznej

Name of subject in English: Microwaves and other advanced thermal technologies in chemical engineering

Main field of study (if applicable): Inżynieria chemiczna i procesowa

Specialization (if applicable): Advanced Chemical Engineering and Nanotechnology

Profile: academic

Level and form of studies: 2nd level, uniform magister studies, full-time

Kind of subject: optional

Subject code: ICC020010

Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	crediting with grade				
For group of courses mark final course with (X)					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1				

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Student knows basic physics
2. Student knows the basic unit processes
3. Student knows the principles of heating processes

**SUBJECT OBJECTIVES**

C1 To provide students with a general knowledge of electromagnetic radiation features, limitation and advantages and volumetric heating

C2 To provide students with a general knowledge of equipment used for generating, transmitting and delivering microwaves into the material.

C3 To provide students with a general knowledge of basic design concepts and assorting the microwave apparatuses according to the microwave proces

C4 To provide students with a general knowledge about safety rules of working with microwaves.

**SUBJECT LEARNING OUTCOMES**

**Relating to knowledge:**

PEU\_W01 Student knows the principles of microwaves characteristics, their limitations and advantages, knows the definition of volumetric heating

PEU\_W02 Student knows the processes that can be conducted with microwaves

PEU\_W03 Student knows the rules of designing and assorting of basic microwave apparatuses

PEU\_W04 Student knows the heat and mass transfer in microwave processes

PEU\_W05 Student knows the rules of safe work with microwaves

**Relating to skills:**

PEU\_U01 Student is able to safely use microwave apparatus.

PEU\_U02 Student is able to explain the principles of operation of microwave equipment.

PROGRAM CONTENT		
Lectures		Number of hours
Lec 1	Introduction	2
Lec 2	Electromagnetic waves, their characteristics and means of transport.	2
Lec 3	Maxwell laws	2
Lec 4	Materials determination according to their dielectric features	2
Lec 5	Volumetric heating	2
Lec 6	Heat and mass transfer in microwave processes	
Lec 7	Specific phenomena that may occur during microwave processes	2
Lec 8	Magnetron - structure, types and functions	2
Lec 9	Waveguide - structure, types and functions	2
Lec 10	Microwave applicator - structure, types and functions	2
Lec 11	Batch processes microwave units. continuous processes microwave units.	2
Lec 12	The chemical engineering processes that microwave technology can be applied into.	2
Lec 13	Measuring methods, control equipment, automation in microwave processes	2
Lec 14	Technical safety in the microwave installation	2
Lec 15	Examples of real microwave installations in chemical engineering.	
	Total hours	<b>30</b>
TEACHING TOOLS USED		
N1. Multimedia presentation		
EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
<b>Evaluation</b> (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEK_W01-05, PEK_U01-02	Final test
PRIMARY AND SECONDARY LITERATURE		
<b>PRIMARY LITERATURE:</b>		
[1] R.J. Meredith, Engineers' Handbook of Industrial Microwave Heating, Institution of Electrical Engineers, London 1998		
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)		
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