SYLLABUS OF A MODULE

Polish name of a module	**PROJEKTOWANIE WYPRASEK WTRYSKOWYCH I SYMULACJA PROCESU WTRYSKIWANIA**
English name of a module	**DESIGN AND SIMULATION OF INJECTION MOULDED PARTS**
ISCED classification - Code	0715
ISCED classification - Field of study	*Mechanics and metal trades*
Languages of instruction	*English*
Level of qualification:	*1 – BSc (EQF 6)*
Number of ECTS credit points	*6*
Examination:	*A - Assignment*
Available in semester:	*S – Spring only*

Number of hours per semester:

Lecture	Tutorials	Laboratory	Seminar	E-learning	Project
15					**45**

MODULE DESCRIPTION

Module objectives

O1. Provide theory of different polymer processing methods and acquire capabilities to adjust processing parameters.

O2. Provide knowledge of plastic part design basics and tool design basics and acquire basic skills in design using a CAD software.

O3. To acquire capabilities to perform simulation of injection moulding process and provide knowledge about computer aided engineering in polymer processing.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of physics, chemistry, mathematics, mechanics and thermodynamics.
2. Fundamentals of materials science.
3. Safety rules during the use of laboratory equipment and technological machines.
4. Capability of using source literature.
5. Capability of individual work and collaboration in a group.
6. Data analysis and presentation of results.

LEARNING OUTCOMES

LO 1 – Knowledge on polymeric materials and their application.

LO 2 – Knowledge on different polymer processing methods - process, tools, products.

LO 3 – Knowledge on plastic part design and tool design basics.

LO 4 - Knowledge on injection moulding simulation method.

LO 5 - Ability to adjust basic processing parameters in selected polymer processing methods.

LO 6 - Ability to design simple injection moulded part.

LO 7 - Ability to perform simulation of conventional injection moulding process.

MODULE CONTENT

Type of classes – lecture	**Number of hours**
Lec 1 - Basic information about injection moulding process of polymers.	**1**
Lec 2 - Characteristics of injection moulded parts. Part design rules. Parting line.	**1**
Lec 3 - Materials used for injection moulded plastic parts.	**1**
Lec 4 - Shrinkage of plastics.	**1**
Lec 5 - Dimension and shape tolerances of injection moulded parts.	**1**
Lec 6 - Proper design of wall thickness and draft angle in case of injection moulded parts. Design rules: holes, ribs, threads, snap fits, living hinges and bosses.	**1**
Lec 7 - Special tools in CAD software, used to design plastic parts.	**1**
Lec 8 - The rules of technical drawings preparation – injection moulded parts.	**1**
Lec 9 - Computer simulation of injection moulding – basics. Model of cavity, runner and cooling system and mould base.	**1**
Lec 10 - 11 - Material data in computer simulation – characteristics of polymers, tooling materials and cooling liquids.	**2**
Lec 12 - 13 - Preparation of the model in the simulation of conventional injection moulding process – Autodesk Moldflow / Moldex3D software.	**2**
Lec 14 - Processing parameters definition in the simulation software.	**1**
Lec 15 - Analysis of computer simulation results: filling , packing, cooling and warpage simulation.	**1**
Sum	**15**
Type of classes – project (individual) .	**Number of hours**
P 1-5 - Conception of the injection moulded part. Sketch on paper.	**5**
P 6-15 - Design of a part virtual model in a CAD software.	**10**
P 16-30 - Computer simulation of injection moulding, based on the model of the part. Analysis of the possible changes: wall thickness, injection points, used material.	**15**
P 31-37 - Updating of the designed part model – on the basis of the computer simulation results.	**7**
P 38-45 - Technical drawing preparation – 2D documentation of the project in CAD software.	**8**
Sum	**45**

TEACHING TOOLS

1. - Lecture with the use of multimedia presentations.
2. - Multimedia projector.
3. – Examples of real injection moulded parts.
4. - Computer laboratory, software for injection moulding simulation (Autodesk Moldflow and Moldex3D), software for plastic part design and tool design (for example: TopSolid, NX, Autodesk Inventor etc.)

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

F1. - assessment of preparation for the project classes
F2. - assessment of the ability to apply the acquired lecture knowledge while doing the project
F3. - assessment of activity during classes
S1. - assessment of the project report - pass mark *

*) in order to receive a credit for the module, the student is obliged to attain a passing grade

STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
1.	**Contact hours with teacher**	
1.1	Lectures	15
1.2	Tutorials	
1.3	Laboratory	
1.4	Seminar	
1.5	Project	45
1.6	Examination	5
	Total number of contact hours with teacher:	**65**
2.	**Student's individual work**	
2.1	Preparation for tutorials and tests	
2.2	Preparation for laboratory exercises, writing reports on laboratories	
2.3	Preparation of project	30
2.4	Preparation for final lecture assessment	20
2.5	Preparation for examination	10
2.6	Individual study of literature	25
	Total number of hours of student's individual work:	**85**
	Overall student's workload:	**150**
Overall number of ECTS credits for the module6		**6 ECTS**
Number of ECTS points that student receives in classes requiring teacher's supervision:		**2.4 ECTS**
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		**3.0 ECTS**

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1.	Osswald T.A., Baur E., Brinkmann S., Oberbach K., Schmachtenberg E.: International Plastics Handbook, Hanser Publishers, Munich 2006.
2.	Injection Molding Handbook / Ed. Tim A. Osswald, Lih-Sheng (Tom) Turng, Paul J. Gramann, Cincinatti, Hanser Publishers 2001.
3.	Malloy R.A.: Plastic Part Design for Injection Molding. An Introduction, HANSER 2011.
4.	Engineering Plastics. Part and Mold Design. Thermoplastics. A design Guide. Bayer MaterialScience.
5.	Menges G., Michaeli W., Mohren P.: How to Make Injection Moulds, Hanser Publishers, Munich 2001.
6.	Stoeckhert, K. Menning, G.: Mould-Making Handbook, Hanser Publishers, Munich 1998.
7.	Beaumont J.P.: Runner and Gating Design Handbook. Tools for Successful Injection Moulding, Hanser, Munich, Cincinnati, 2004.
8.	Autodesk Moldflow Insight. Design and Concept. Empimeth Consult. Lublin 2010.
9.	Wang M.-L., Chang R.-Y., Hsu C.-H.: Molding Simulation theory and Practice. HANSER 2018.
10.	Johannaber F.: Injection Molding Machines: a User's Guide, Munich, Carl Hanser Verlag 2008.

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

Module coordinator:

dr. Tomasz Jaruga - jaruga@ipp.pcz.pl

Academic teachers:

- dr. Tomasz Jaruga – jaruga@ipp.pcz.pl
- prof. Paweł Palutkiewicz - palutkiewicz@ipp.pcz.pl
- prof. Przemysław Postawa – postawa@ipp.pcz.pl
- dr. Milena Trzaskalska – trzaskalska@ipp.pcz.pl
- dr. Tomasz Stachowiak - stachowiak@ipp.pcz.pl