Course code: ……. **Plan position:** ……

A. INFORMATION ABOUT THE COURSE

B. Basic information

Name of course	Polymer Properties, Processing and Recycling
Field of studies	Mechanical Engineering
Level of studies	First degree
Profile of studies	Academic
Form of studies	Full-time
Specialty	Research and Development Production Maintenance
Unit responsible for the field of studies	Faculty of Mechanical Engineering
Name and academic degree of teacher(s)	Piotr Szewczykowski, PhD Karol Pepliński, PhD Mateusz Rojewski, MSc Eng
Introductory courses	Materials Science and Engineering, Basics of machine construction, Manufacturing techniques
Introductory requirements	Basic knowledge in chemistry, physics, and mathematics, knowledge of MS Office package, ability to use databases of scientific publications, Engineering graphics. Engineering materials

C. Semester/week schedule of classes

Semester	Lectures (W)	Auditorium classes (Ć)	Laboratory classes (L)	Project classes (P)	Seminar (S)	Field classes (T)	Number of ECTS points
Winter/Summer	45		30				5

2. LEARNING OUTCOME

No.	Learning outcomes description	The reference to the learning outcomes of specific field of study	The reference to the learning outcomes for the area
KNOWLEDGE			
K1	has knowledge in the field of manufacturing engineering and polymer processing technology, including techniques, processes and machines	K_W10	P6S_WG
SKILLS			
S1	is able to plan the production process with the use of simple machines and technological devices for plastics processing, control the technological parameters of production and initially estimate its costs	K_U06	P6S_UW
S2	has the ability to self-educate, e.g. in order to improve	K_U12	P6S_UW

	professional competences in the field of machines and technological devices for plastics processing, including the control of technological parameters of production		
SOCIAL COMPETENCES			
SC1	understands the need and knows the possibilities of continuous training (second and third degree studies, postgraduate studies, courses) - improving professional, personal and social competences in the field of polymer processing technology	K_K01	P6S_KK
SC2	is aware of the importance and understands the non-technical aspects and effects of the activity of a mechanical engineer, including its impact on the environment, and the related responsibility for decisions made in the area of polymer plastics processing technology	K_K04	P6S_KK

3. TEACHING METHODS

A. Traditional methods used ***

multimedia lecture, laboratory, and other methods, e.g., CES Edupack software, videos, books, catalogs, diagrams, blackboard, online techniques, exercise workbook classes

B. Distance learning methods used ***

Synchronous method (classes conducted in a way that ensures direct interaction between the student and the teacher in real time, enabling immediate flow of information, the method can be used only if it is provided for in the study plan for a given cycle of education):
e.g. remote lecture in the form of videoconference, remote discussion, etc.

Asynchronous method used as an auxiliary (a method that does not ensure direct interaction between the student and the teacher in real time, used only as an auxiliary / complementary method):

e.g. online educational videos, online multimedia presentations, etc.

4. METHODS OF EXAMINATION

Written test/colloquium, reports from laboratory work

5. SCOPE

Lectures	Introduction to the 'World of Polymers' and historical development of plastics materials. Polymers structure, configuration and molecular weight. Polymerisation reactions and polymer synthesis. Types of polymers. Chosen individual properties of plastics (melt viscosity, density, impact strength etc.). Thermal properties of solid and molten polymers. Copolymers. Crystal structures. Physical states of polymers. Diffusion in polimeric materials. Mechanical behaviour and propeerties of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting, and glass transition phenomena. Factors that influence melting and glass transition temperature. Biomaterials. Examples of polymers and its applications. Composites. Basic additives in plastics and their influence on part properties. Brief description the properties of polymeric materials and plastics behaviour in basics polymer processing. The basic materials processing like injection molding, extrusion, extrusion blow molding, thermoforming, rotational molding, welding, type of plastics recycling, rapid prototyping, etc. The fundamentals of technological

	designing with plastics during project new product. Mechanical recycling technology and other types of polymer recycling: basics, varieties, importance of recycling for the environment conditions for the use of recyclates and regranulates in plastics processing technologies. Impact of polymer plastics processing technology on the natural environment. Microplastic. Sustainable development. Summary.
Laboratories	Identification of different polymeric materials. Physical states of polymers. Hardness measurement of polymers and elastomeric materials. Tensile testing and impact strength of polymeric materials. Moisture and shrinkage measurements. Melt Flow Index and viscosity measurement of polymers. Injection Molding and Thermoforming. Recycling of rubber. Grindig and mechanical recycling.

6. METHODS OF VERIFICATION OF LEARNING OUTCOMES

LEARNING OUTCOME	Form of assessment					
	Oral examination	Written exam	Colloquium	Project	Reports	Class attendance
K1			x		x	x
S1-S2			x		x	x
SC1-SC2			x		x	x

7. LITERATURE

Basic literature	- Callister WD, Rethwisch DG, 2015, Materials Science and Engineering, John Wiley & Sons (Asia) Pte Ltd - Ashby M, Shercliff H, Cebon D, 2014, Materials: Engineering, Science, Processing and Design, Elsevier Ltd, The Boulevard, Langford, Lane, Kidlington, Oxford - Arie R., 1997. Fundamentals of polymer engineering. Technion-Israel Institute of Technology, Plenum Press, New York. - Brydson J.A., 1999. Plastics Material. Seventh edition. A division of Reed Educational and Professional Publishing Ltd, Oxford. - Herman F.M., 2004. Encyclopedia of Polymer Science & Technology, John Wiley & Sons - Manas Ch., Roy S.K., 2007. Plastics Technology Handbook, 4th. Manas Chanda and Salil K. Roy. CRC Press. - Rosato D.R., 2000. Injection molding handbook. Kluwer Academic - Publishers. USA. - Rosato D., 1997. Plastics Processing Data Handbook. 2nd ed. USA
Supplementary literature	- Gebhardt A., 2003. Rapid Prototyping. Carl Hanser Verlag, Munich. - Gunter E., 2006. Designing With Plastics. Carl Hanser Verlag, Munich. - Rao N., O'Brien K., 1998. Design Data for Plastics Engineers. Carl Hanser Verlag, Munich. - Gunter E., 2006. Designing With Plastics. Carl Hanser Verlag, Munich. - Herman F. M.,2004, Encyclopedia of Polymer Science & Technology, John Wiley & Sons.

8. TOTAL STUDENT WORKLOAD REQUIRED TO ACHIEVE EXPECTED LEARNING OUTCOMES EXPRESSED IN TIME AND ECTS CREDITS

Student’s activity		Student workload– number of hours
Classes conducted under a direct supervision of an academic teacher or other persons responsible for classes	Participation in classes indicated in point 1B	75
	Supervision hours	10
Student's own work	Preparation for classes	10
	Reading assignments	30
	Other (preparation for exams, tests, carrying out a project etc)	20
Total student workload		145
	Number of ECTS points	5