Module/Subject Syllabus Summary
[Mechanical Engineering]
Master Degree Studies

Subject:	*Metal forming – numerical modelling II*
Subject type:	
Subject code:	
Year:	
Semester:	
Form of studies:	*Full-time course*
Type of classes and hours per semester:	
Lecture	*15*
Exercise	
Laboratory practice	*15*
Project	
ECTS points:	
Form of credit:	*Examination/assessment*
Lecture language:	*Polish/English*

Subject objective	
C1	Familiarize students with the issues of numerical modelling of metal forming processes
C2	Familiarize students with specialized software
C3	Preparing students for the practical application of knowledge of metal forming

Prerequisites in knowledge, skills and other competencies	
1	Student has knowledge in the field of solid state physics necessary to understand the basic physical phenomena occurring in mechanical engineering
2	Student has knowledge in metal forming technology
3	Student can formulate and solve problems of mechanics and engineering using analytical and experimental methods, including measurements, interpret the results and draw conclusions

Educational effects	
	Knowledge:
EK 1	Student It has expanded and in-depth knowledge of certain branches of mathematics needed to formulate and solve complex tasks in the field of: 1) description, analysis and modelling of mechanical systems, 2) calculations during the design of: processes, technologies, tools, instruments and technological devices
EK 2	Student has an extended knowledge in shaping products with methods of machining, metal forming, polymer plastics processing, and joining materials, taking into account the accuracy of the performance of these products and the state of their surface
EK 3	Student has ordered and in-depth knowledge of designing the optimal machine parts, assemblies and mechanisms, i.a taking into account the fatigue strength and the use of CAD / CAM / FEM

	In terms of skills:
EK 4	Student has the ability to apply relevant general technical issues in the design of production processes
EK 5	Student is able to obtain information from literature, databases and other sources, also in English or another foreign language considered as the language of international communication in the field of production engineering; able to integrate and interpret the information obtained, as well as draw conclusions and formulate opinions along with their detailed justification
EK 6	Student can apply selected methods, tools, techniques, standards and rules regarding change and solving problems arising in various areas of the organization and its environment, as well as in supporting decision-making processes
	In terms of social competence:
EK 7	Student has a non-technical awareness, including the economic impacts, of mechanical engineer job and its impact on the environment, which shapes a great sense of responsibility for decisions
EK 8	Student is aware of the importance of professionalism in mechanical engineer work and the principles of general and professional ethic

Curriculum content of Subject		
Class form: lecture		
	Curriculum content	Number of hours
W1	**General knowledge.** Basic information about forming technology. State of stress and strain. Relationship between the state of stress and strain.	2
W2	**FEM.** Discussion of the Finite Element Method. Presentation of selected examples of applications in engineering practice	2
W3	**Selected technologies of metal forming.** Overview of selected technologies of metal forming – I	2
W4	**Selected technologies of metal forming.** Overview of selected technologies of metal forming – II	2
W5	**Numerical Analysis by FEM.** Presentation of specialized software and boundary conditions and simplifications used in numerical models	2
W6	**Shaping Products with non-developable surface.** Analysis of selected shaping processes	2
W7	**Formation of lumps.** Analysis of selected shaping processes.	3
	Total hours:	15
Class form: laboratory practice		

	Curriculum content	Number of hours
L1	**Introductory classes**. Schedule laboratory. Discussion of the principles of credit for the course. The division into working groups.	2
L2	**Computer software.** Getting to know your computer programs such as CAD and FEM. Principles of numerical modelling of processes.	2
L3	**The construction of a numerical model** of the formation process. Implementation of numerical simulation. Analysis of the results. The preparation of the report.	2
L4	**Analysis of the selected formation process.** Bringing-off models and numerical calculations.	2
L5	**Analysis of the selected formation process.** Bringing-off models and numerical calculations.	2
L6	**Analysis of the selected formation process.** Bringing-off models and numerical calculations**.**	2
L7	End of classes. Make up for the outstanding classes. Verification of acquired practical knowledge. Exposure assessments.	3
	Total hours:	15

Teaching methodology	
1	*Lecture*: Traditional assisted with multimedia tools.
2	*Laboratory*: Classes in laboratory groups. Dividing the simulation tasks taking into account the expected effects of calculations. Individual work with computers. Verification of performance, discussion and presentation.

Student workload	
Form of activity	Average hours to complete activity
Teacher contact hours, including:	
Attendance at lectures	15
Attendance at laboratory practice	15
Total student work time, including:	
1. Preparing for issues in the field of	15

metal forming processes, and FEM	
2. Completion of a project	15
Total student work time	60
Total ECTS for the subject:	
Total of ECTS for practical classes (exercise, laboratory practice, projects)	

Basic and complementary reference literature	
1	SOLID EDGE User Manual - the current version
2	DEFORM User Manual - the current version
3	Zienkiewicz, O.C.; Taylor, R.L. Finite Element Method, 2000 Elsevier
4	Pater Z., Samołyk G. Podstawy teoretyczne obróbki plastycznej metali. Wyd. PWSZ, Chełm 2007
5	Golatowski T. Projectowanie procesów tłoczenia i tłoczników. Wyd. Politechniki Warszawskiej, Warszawa 1991.
6	Pietrzyk M. Metody numeryczne w przeróbce plastycznej metali. Wyd. AGH, Kraków 1991

Educational effect matrix					
Educational effect	Specific educational effect reference to curriculum-wide effects (PEK)	Subject objective	Curriculum content	Teaching methodology	Evaluation methods
EK 1	MBM	*[C1-C3]*	*[W1- W3]*	*[1, 2]*	*[O1]*
EK 2	MBM	*[C1]*	*[W1- W2]*	*[1, 2]*	*[O1]*
EK 3	MBM	*[C3]*	*[W1- W3]*	*[1, 2]*	*[O1]*
EK 4	MBM	*[C1-C3]*	*[W1- W8]*	*[1, 2]*	*[O1]*
EK 5	MBM	*[C2,C3]*	*[W1- W8]*	*[1, 2]*	*[O1, O2]*
EK 6	MBM	*[C3]*	*[W1- W8]*	*[1, 2]*	*[O1, O2]*
EK 7	MBM	*[C1-C3]*	*[W1- W8]*	*[1, 2]*	*[O2]*
EK 8	MBM	*[C1-C3]*	*[W1- W8]*	*[1, 2]*	*[O1, O2]*
EK 9	MBM	*[C1-C3]*	*[W1- W8]*	*[1, 2]*	*[O1, O2]*

Evaluation methods and criteria		
Evaluation method symbol	Evaluation method description	Pass threshold
O1	*Examination*	*50%*
O2	*Completion of a project*	*60%*

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KAPITAŁ LUDZKI
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